ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE AND CONFLICT MANAGMENT IN WYOMING

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ACRONYMS

ACEC	Areas of Critical Environmental Concern
ADMB	Wyoming Animal Damage Management Board
APHIS	Animal and Plant Health Inspection Service
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	Fiscal Year
HHS	Human Health and Safety
HPAI	Highly Pathogenic Avian Influenza
HSUS	Humane Society of the United States
IWDM	Integrated Wildlife Damage Management
LRMP	Land and Resource Management Plan
MDM	Mammal Damage Management
MIS	Management Information System
MLMU	Mountain Lion Management Unit
MOU	Memorandum of Understanding
NASS	National Agriculture Statistics Service
NEPA	National Environmental Policy Act
NF	National Forest
NHPA	National Historical Preservation Act
NWDP	National Wildlife Disease Surveillance & Emergency Response Program
NWRC	National Wildlife Research Center
ODFW	Oregon Department of Fish and Wildlife
PDM	Predator Damage Management
PMD	Predatory Management District
RMP	Resource Management Plan
SDA	Specially Designated Area
SHPO	Wyoming State Lands and Preservation Office
SMA	Special Management Area
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USC	United States Codes
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WA	Wilderness Area
WDA	Wyoming Department of Agriculture
WDH	Wyoming Department of Health

WDM	Wildlife Damage Management
WGFD	Wyoming Game and Fish Department
WS	Wildlife Services
WSA	Wilderness Study Area
WYSA	Wyoming Statutes Annotated
WOSLI	Wyoming Office of State Lands and Investments

SUMMARY

Wyoming wildlife has many positive values and is an important part of life in the State. However, as human populations expand, and land is used for human needs, there is increasing potential for conflicting human/wildlife interactions. This Environmental Assessment (EA) analyzes the potential environmental impacts of alternatives for United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services program in Wyoming (WS-Wyoming) involvement to resolve conflicts within the State of Wyoming that are caused by predators. This includes animals preying upon or harassing livestock and wildlife; damaging other agricultural resources and property; or threatening human health and safety. The proposed wildlife damage management activities could be conducted on public, private and tribal property in Wyoming when the property owner or manager requests assistance and/or when assistance is requested by an appropriate state, federal, tribal or local government agency.

Wyoming predators addressed in this analysis that are involved in the majority of conflicts are coyotes (*Canis latrans*); black bears (*Ursus americana*); grizzly bears (*U. horribilus*); common ravens (*Corvus corax*) (hereafter referred as to ravens); bald and golden eagles (*Haliaeetus leucocephalus* and *Aquila chrysaetos*, respectively); mountain lions (*Felis concolor*); red foxes (*Vulpes vulpes*); striped skunks (*Mephitis mephitis*); bobcats (*Lynx rufus*); raccoons (*Procyon lotor*); badgers (*Taxidea taxus*); porcupines (*Erethizon dorsatum*) and black-billed magpies (*Pica hudsonia*). Other predators in Wyoming which have historically caused only localized damage on an occasional basis include opossums (*Didelphis marsupialis*), feral and free-ranging cats (*F. domesticus*) (hereafter referred to as feral cats), mink (*Mustela vison*), long-tailed weasels (*M. frenata*), short- tailed weasels (*M. erminea*), American crows (*Corvus brachyrhynchos*), and spotted skunks (*Spilogale putorius*).

The proposed action (Alternative 1) continues the current WS-Wyoming Predator Damage Management (PDM) program using the full range of legally available methods in accordance with applicable federal, State and local laws (unless specifically exempt). WS-Wyoming would continue to provide information and training on the use of nonlethal methods including, but not limited to, herding and other livestock management and cultural practices, livestock guarding animals, exclusion, and frightening devices. WS-Wyoming would also assist resource owners and managers through educational programs on damage identification, prevention, and control, and by providing information on sources of supplies of PDM materials, such as pyrotechnics and propane cannons, or by temporarily loaning supplies, such as live-capture cage traps. The methods which may be used by WS-Wyoming would include a variety of frightening devices, ground shooting, aerial shooting, denning, various trap devices, snares, trained decoy and tracking dogs, M-44s for control of coyotes and red foxes, and DRC-1339 for control of ravens and black-billed magpies.

The EA also considers 4 other alternatives in detail, including:

- Alternative 2 that discontinues all WS-Wyoming involvement in PDM;
- Alternative 3 in which WS-Wyoming is restricted to using only nonlethal PDM methods;
- Alternative 4 that restricts WS-Wyoming to using or recommending only nonlethal methods

- Alternative 5 that requires livestock grazing permittees, landowners or resource managers to: show evidence of sustained and ongoing use of nonlethal techniques aimed at preventing or reducing predation prior to receiving assistance with lethal PDM methods from WS-Wyoming; employees of WS-Wyoming to use or recommend appropriate nonlethal techniques in response to confirmed damage situations prior to using lethal methods; use lethal techniques only when appropriate husbandry or other nonlethal techniques have failed to keep livestock losses below an acceptable level as determined by the cooperator.

This EA provides a detailed analysis of the impacts of each alternative for a range of issues identified as relevant to making decisions among alternatives by the lead, cooperating, and consulting agencies and those identified during a public scoping period for the EA. Issues addressed in detail include: impacts on target predator populations and non-target species, including State and federally-listed Threatened or Endangered (T/E) species; impacts on Special Management Areas; humaneness and ethical perspectives; effects on recreation and aesthetics; impacts on public and pet safety; cost effectiveness; effects of climate change; and indirect and cumulative impacts. Other issues are discussed on a case-by-case basis by alternative, with rationale for not addressing such issues in detail.

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

1.0 INTRODUCTION

Across the United States, wildlife habitat has substantially changed as human populations have expanded and land has been transformed to meet varying human needs. These human uses and needs may compete with the needs of wildlife or attract wildlife and have inherently increased the potential for conflicts between wildlife and people. This EA evaluates the potential environmental impacts of alternatives for the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program involvement in predator damage management (PDM) in Wyoming.

The prevention or control of wildlife damage [the goal of Wildlife Damage Management (WDM)] is an essential and responsible component of wildlife management (The Wildlife Society undated). The WS program is the federal agency authorized to protect American resources from damage associated with wildlife [the Act of March 2, 1931 (46 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). Human/wildlife conflict issues are complicated by the wide range of public responses to wildlife and wildlife damage. Human relationships and values regarding wildlife can range from positive to negative depending on varying human perspectives and circumstances. Wildlife are generally regarded as providing economic, recreational, and aesthetic benefits, including the mere knowledge that wildlife exists as a positive benefit to many people. However, the activities of some wildlife may result in economic losses to agricultural resources and damage to property. Sensitivity to varying perspectives and values is required to manage the balance between human and wildlife needs. In addressing conflicts, wildlife managers must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well.

Activities conducted by WS are designed to prevent or reduce wildlife damage to agricultural, industrial, and natural resources; property; livestock; and threats to public health and safety on private and public lands in cooperation with federal, State and local agencies, tribes, private organizations, and individuals. The WS program uses an Integrated Wildlife Damage Management (IWDM) approach (WS Directive 2.105[1]), in which a combination of methods may be recommended and used sequentially or concurrently to reduce wildlife damage. These methods may include nonlethal techniques such as cultural practices, habitat manipulation, exclusion, or behavioral modification of the offending species. Implementation of IWDM may also require the relocation or lethal control of specific offending animals or the reduction of a local population by lethal means. Program activities are not conducted to punish offending animals, are implemented as part of the WS Decision Model process for resolving conflicts with wildlife (Slate et al. 1992). Use of the WS Decision Model facilitates development of site-specific IWDM strategies for each wildlife/human conflict addressed by WS.

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1 The WS Policy Manual provides guidance for WS personnel to conduct wildlife damage management activities through Program Directives. The WS Program Directives may be obtained from the WS home page at http://www.aphis.usda.gov/wildlifedamage and will not be referenced in Appendix A.

WS-Wyoming currently implements a PDM program as developed in EAs for eastern and western Wyoming (USDA 1997a, b). This EA combines the analyses in the Eastern and Western Wyoming PDM EAs. The new analysis reviews the impacts of the existing program (environmental baseline), develops new and updated alternatives for PDM, and updates the review of potential environmental impacts of the proposed alternatives. Once completed, the final NEPA analysis and associated decision (EA FONSI or Environmental Impact Statement (EIS) Record of Decision) will supersede the current PDM EAs and FONSIs.

WS cooperates with land and wildlife management agencies when appropriate and as requested to effectively and efficiently resolve wildlife damage problems in compliance with all applicable federal, State and local laws and MOUs between WS and other agencies. At the state level, WS-Wyoming has a current MOU with WGFD. National level MOUs were signed between WS and BLM in 2012, and between WS and USFS in 2011. These MOUs transferred the responsibilities for wildlife damage management and related NEPA compliance from BLM and USFS to WS.

1.1 PURPOSE

This EA evaluates the potential impacts on the human environment of alternatives for WS-Wyoming involvement in the protection of agricultural and natural resources, property, and HHS from damage and risks associated with predators in Wyoming. These predators in Wyoming include a range of species that prey on livestock and wildlife, cause property and other resource damage, and threaten HHS (Table 1-1). Damage problems can arise anywhere in the state. Depending on the alternative selected, PDM could be conducted upon request on private, public or tribal lands in Wyoming.

Gray wolves (*Canis lupus*) are associated with similar conflicts as those that may occur with several of the predator species listed above. However, it is our belief that the issues specific to wolf damage management, wolf biology (e.g., impacts on trophic cascades) and the recent history of the Rocky Mountain gray wolf population (e.g., extirpation, subsequent reintroduction, and recovery) warrants detailed review in a separate analysis. Occasional references to gray wolf damage are provided in this EA for contextual or background information.

Table 1-1. Species Addressed in this EA.

Common Name	Scientific Name
American Crow*	*Corvus brachyrhynchos*
Badger	*Taxidea taxus*
Bald Eagle*	*Haliaeetus leucocephalus*
Black-billed magpie*	*Pica hudsonia*
Black bear	*Ursus americanus*
Bobcat	*Lynx rufus*
Common raven*	*Corvus corax*
Coyote	*Canis latrans*
Golden Eagle*	*Aquila chrysaetos*
Grizzly bear*	*Ursus arctos horribilis*
Mink	*Mustela vison*
Mountain lion	*Felis concolor*
Porcupine	*Erethizon dorsatum*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes*
Spotted skunk	*Spilogale putorius*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana*
Weasel, least	*Mustela longicauda*
Weasel, long-tailed	*Mustela frenata*
Weasel, short-tailed	*Mustela erminea*
Feral cat*	*Felis catus*

*Except for eagles, crows, ravens, magpies, feral cats, grizzly bears and state-listed predators, the above species are managed by WGFD.

1.2 NEED FOR ACTION

The need for action is based on requests for assistance with predator damage for the protection of agricultural and natural resources, property, and HHS. The data and information reported herein are based on requests to WS-Wyoming for assistance from the public, tribes and agencies, and as such, represent only a portion of the total damage caused by predators, because not all people who experience damage request assistance from WS-Wyoming. Some individuals, tribes and agencies choose to implement PDM actions on their own, or seek the services of private organizations or contractors (see Chapter 3). PDM assistance may be requested from WS-Wyoming in response to threats of damage and not just documented cases of damage. For example, the general policy of public health programs is to prevent adverse impacts on human health and not necessarily to wait until an illness or injury occurs. WS-Wyoming may also provide technical assistance on nonlethal strategies which can be implemented to protect livestock from predators and prevent depredations from occurring, especially those that may be more effective if implemented prior to predators learning to recognize livestock as a food source.

WS-Wyoming only conducts PDM actions after doing an investigation of the situation and verifying that there is a need for action (see Section 3.3 and WS Decision Model step 2 "assess problem"). WS-Wyoming recognizes that the majority of predators are not involved in conflicts with humans and that the mere presence of a predator does not necessarily indicate a threat of damage. Increasing numbers of people are unfamiliar with wildlife and may experience anxiety when they encounter wildlife in close proximity. In these situations, WS-Wyoming personnel commonly provide technical assistance (advice, training, educational materials) to individuals and communities so the public has the information needed to better understand the role and potential impacts of wildlife in particular situations. These consultations include advice on nonlethal strategies to prevent or reduce the likelihood of any potential future conflicts.

1.2.1 Need for Protection of Livestock

Contribution of Livestock to the Wyoming Economy

Historically, agriculture has been an important part of Wyoming's economy and also an essential part of Wyoming's culture and lifestyle; more than 91% of land in Wyoming is classified as rural. In 2012, 11,736 farms and ranches were operating in Wyoming, with a total land area of 30,363,641 acres. The main agricultural commodities produced in Wyoming include cattle and calves (1.3 million head in 2012), followed by forage crops (hay, grass silage, green chop) at 1,053, 646 acres; sheep and lamb inventory in 2012 was 354,785, ranking 4th in the U. S.; all livestock production was valued at $1.25 billion. About 74% of the state's total agricultural receipts are generated by livestock products, with 88% of total agricultural receipts attributed to beef cattle and calves. In 2012, cattle were the leading commodity in terms of value of production at $1.1 billion (http://www.agcensus.usda.gov, accessed August 14, 2016).

Livestock Predation

Cattle and calves are most vulnerable to predation (killing, harassment, or injury resulting in monetary losses to the owner) at calving and less vulnerable as calves get older and at other times of year. However, sheep (especially lambs) can sustain high predation losses throughout the year (Henne 1975, Nass 1977, 1980, Tigner and Larson 1977, O'Gara et al. 1983). Livestock predation losses can impose economic hardships on livestock owners. Without effective PDM to protect livestock, predation levels would increase (Nass 1977, 1980, Howard and Shaw 1978, Howard and Booth 1981, O'Gara et al. 1983).

Many studies have shown that coyotes are responsible for high predation losses to livestock. Coyotes accounted for 93% of all predator-killed lambs and ewes on nine sheep bands in shed lambing operations in southern Idaho and did not feed on 25% of the kills (Nass 1977). Coyotes were also the predominant predator on sheep during the course of a Wyoming study and essentially the only predator in winter (Tigner and Larson 1977). Other predators that cause measurable predation on cattle, calves, sheep and lambs in Wyoming are black bears, grizzly bears, mountain lions, bobcats, red foxes and feral or free-roaming dogs. Black bear and mountain lion predation on livestock can be severe (National Agricultural Statistical Service (NASS) 2010, 2011). Based on WS-Wyoming Specialist reports, most bear and mountain lion damage management efforts are concentrated in the western part of the State, although the problem seems to be increasing statewide (MIS 2014). Wyoming livestock producers reported losses of 1,700 head of sheep and 5,700 head of lambs to predators in 2014, valued at $3,938,000 (USDA 2015), and 400 head of cattle and 3,500 head of calves to predators, valued at $1,824,000 (NASS 2011). Wolves are also significant predators of livestock in Wyoming (MIS 2014, NASS 2011).

Connolly (1992) determined that only a fraction of the total predation attributable to coyotes is reported to or confirmed by WS. He also stated that based on scientific studies and livestock loss surveys from the NASS, WS only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators. In Wyoming, from FY 2011 through FY 2015, an average of 26.9% of the adult sheep, 34.3% of the lambs and 47.8% of the calves reported killed were verified by WS-Wyoming Specialists (MIS 2015). WS-Wyoming Specialists do not attempt to locate every head of livestock reported by ranchers as killed by predators, but rather verify sufficient losses to determine that a problem exists that requires management action.

Although it is impossible to accurately determine the number of livestock saved from predation by WS-Wyoming, an estimate can be made. Studies reveal that in areas without some level of PDM, losses of adult sheep and lambs can be as high as 8.4% and 29.3%, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983). Similarly, other studies indicate that sheep and lamb losses are much lower where PDM is applied (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Howard and Booth 1981). An Oregon State University study suggests that about 2% of adult sheep, 4.7% of the lambs and 0.9% of the calves produced in Oregon are typically lost to coyote predation each year when standard PDM is conducted (DeCalesta 1987). In Wyoming, in 2010, coyotes accounted for 43.8%% of combined cattle and calf total losses to predators statewide, where PDM is commonly practiced (http://www.nass.usda.gov/, accessed August 24, 2016).

Mountain lions will kill most species of domestic livestock, although sheep and cattle are the predominant prey (Lindzey 1987). In Arizona, Shaw (1981) reported that 93% of mountain lion-killed cattle examined were calves (typically <300 lbs.), and although all age classes of sheep were killed, lambs were preferred. Cattle losses to mountain lions are rare in Wyoming, primarily because calving areas do not typically overlap mountain lion habitat (WGFD 2006). Mountain lion depredations of horses, llamas, goats, poultry, pigs, and other types of livestock have also been documented (Tully 1991). Data from WGFD (2016) indicate approximately 12% of the damage claims submitted for reimbursement in Wyoming were attributed to mountain lions

across the 10 year reporting period (FY 2006 through FY 2016), with lambs and ewes combined representing 89.6% of damage claims paid during the most recent reporting period (FY 2015). Other livestock occasionally killed by mountain lions in Wyoming include cattle, goats, and pigs (WGFD 2016). The loss of domestic pets near residential areas is also on the increase in urban areas of the country, primarily due to human encroachment into occupied mountain lion habitat (Davies 1991, Torres et al. 1996, WGFD 2006).

WYSA (§23-1-901) provides for monetary compensation of damage to livestock caused by mountain lions, and WYSA (§23-3-115) allows property owners or their employees and lessees to kill mountain lions damaging private property, provided they immediately notify the nearest game warden of the incident. As a result of this statute, WGFD obtains annual information on the number of reported conflicts between mountain lions and domestic livestock and provides compensation for those losses. The number of damage claims submitted to WGFD for all mountain lion damage has varied between FY 2006 and FY 2016, ranging from 12 to 23 annually (WGFD 2016).

Livestock producers have an array of non-lethal methods available to prevent or reduce predation on livestock. In Wyoming, in 2014, methods used by sheep producers that reported using at least one nonlethal method included: shed lambing (46.6%), the use of guard animals (guard dogs, llamas and donkeys at 36.1%, 15.6% and 6.9%, respectively), culling (34.0%), night penning (33.9%), frequent checks (29.4%), fencing (24.5%), carrion removal (19.9%), herding (13.5%), changing bedding (12.8%) and the use of fright tactics (7.1%). Wyoming cattle and calf producers similarly used non-lethal techniques, including: frequent checks (47.0%), livestock carcass removal (42.9%), culling (28.3%), fencing (23.5%), herding (22.7%), guard animals (19.8%), night penning (19.4%) and the use of fright tactics (3.1%) (NASS 2011). In 2010, nationwide, cattle and calf producers spent an estimated $188.5 million to implement nonlethal predation management methods (NASS 2011).

Scope of Livestock Losses

NASS (2011) reported that cattle and calf losses from predators totaled nearly 219,900 head nationwide during 2010, representing a loss of $98.5 million to farmers and ranchers. Coyotes and dogs caused the majority of cattle/calf predator losses, accounting for 53.1% and 9.9% of predator losses, respectively. In 2010, the loss of 3,500 calves and 400 head of cattle in Wyoming was attributed to predators, totaling $1,386,000 in losses of calves and $438,000 in losses of cattle. Coyotes were responsible for 46.5% of calf losses to predators and 19.8% of cattle losses to predators, bears were responsible for 15.7% of cattle losses and 7.7% of calf losses, and mountain lions and bobcats collectively were responsible for 11.9% of cattle losses and 11.5% of calf losses (NASS 2011; Table 1-2).

The most current national statistics for sheep and lamb loss to predation is from 2014, where 194,395 sheep/lambs were lost to predation, representing a loss of $32.5 million to ranchers and farmers (USDA 2015). Predator losses accounted for 24.3% of sheep and 63.3% of all lamb losses in Wyoming (Table 1-3), valued at around $313,900 in sheep and $799,000 in lambs. Statewide, total losses to all causes were 3.2% of the total adult sheep and 3.75% of the lamb crop in the state. Losses were not evenly distributed among producers, with 17.9% of operations in the state reporting losses of sheep and 28.3% reporting losses of lambs to predators. Losses to other causes were reported by a higher proportion of operations, with 62.0% of operations reporting

Table 1-2. Cattle and calf losses in Wyoming from predators relative to non-predator losses, including percentage (%), number (#) and value ($) of cattle and calves during 2010 (NASS 2011). NOTE: This table does not include losses to wolves, which are being addressed in a separate EA, or vultures.

Predator	Cattle [1]			Calves[2]		
	%[4]	#	$	%[4]	#	$
Coyotes	19.8	79	NA	46.5	1,628	NA
Mountain lions/bobcats	11.9	48	NA	11.5	402	NA
Dogs	1.0	10	NA	1.7	139	NA
Bears	15.7	4	NA	7.7	60	NA
Other Predators [3]	<0.1	0	NA	3.3	116	NA
Unknown Predators	33	132	NA	14.7	514	NA
Predation Totals [4]	**4.5**	**400**	**438,000**	**8.2**	**3,500**	**1,386, 000**
Non-Predator Totals [4]	**95.5**	**10,600**	**11,596,000**	**91.8**	**26,500**	**10,494, 000**

[1] Cattle value per head is based on a two-year straight average of the value of beef cows reported in the January 1 cattle survey from 2010 and 2011.
[2] Calf value per head is based on the market year average calf price. An average weight of 300 pounds was used in all States.
[3] Does not include vultures and wolves
[4] The % loss value for specific predators/predator groups is the % of all losses to predation. The value for Predator Totals and Non-predator Totals reflect the percent of deaths from the total of all death.

Table 1-3. Sheep and lamb predator and non-predator losses in Wyoming, including percentage (%), number (#) and value ($) of sheep and lambs lost during 2014 (USDA 2015). Reports of the proportion of animals lost to specific predators are reported as % of total predator loss. Table does not include losses to wolves, which are being addressed in a separate EA or vultures.

Predator	Sheep[1]			Lambs[1]		
	%[2]	#	$	%	#	$
Coyotes	64.7	1,100	NA	71.9	4,100	NA
Mountain lions	5.9	100	NA	3.5	200	NA
Dogs	5.9	100	NA	35.2	2005	NA
Bears	5.9	100	NA	1.8	100	NA
Bobcats	<1.2	<20	NA	0.4	24	NA
Foxes	<1.2	<20	NA	3.5	200	NA
Ravens	2.3	39	NA	1.8	100	NA
Eagles	1.9	33	NA	10.5	600	NA
Other Known Predators	0	77	NA	<0.4	<20[3]	NA
Unknown Predators	2.1	36	NA	3.2	185	NA
Predation Totals[2]	**24.3[3]**	**1,700**	**319,000**	**63.3[3]**	**5,700**	**799,000**
Non-Predator Totals[2]	**75.7[3]**	**5,300**	**978,100**	**36.7[3]**	**3,300**	**632,000**

[1] Sheep and lamb value per head is based on values in January 2015 NASS Sheep and Goats Report.
[2] The proportion of deaths relative to the total number of deaths.
[3] Includes take by vultures. Take of <20 animals was not provided by NASS to protect identity of survey participants.

sheep losses to other causes and 36.8% of operations reporting lamb losses to other causes. Other causes of death included age, disease (including parasites), weather conditions, digestive problems and lambing complications. Coyotes were responsible for 64.7% and 71.9% of sheep and lamb losses to all predators, respectively. Dogs were the second leading cause of predator losses (100 sheep and 2005 lambs), followed by mountain lions, bears (black and grizzly) and eagles (Table 1-3). Wyoming producers also reported that 134 sheep and 224 lambs valued at $25000 and $36,000, respectively, were injured but not killed by predators. Indirect livestock losses that can occasionally be attributed to predators include weight loss and stress due to chasing or scattering.

Losses of livestock reported to or verified by WS-Wyoming from coyote predation are higher than the losses caused by mountain lions, black bears and other predators combined (MIS 2014). Bears occasionally kill livestock (*i.e.*, goats, sheep, cattle) and domestic fowl (*i.e.*, chickens, turkeys). Although few black bears kill livestock, once they initiate this behavior, they often become chronic problems (Hygnstrom 1994). Ranked in decreasing frequency of total number of livestock killed from FY2010-FY2014 are coyotes, bears (black/grizzly), mountain lions, wolves and red foxes. Coyote predation accounted for about 69.0% of the total value of all livestock and poultry lost to predators from FY2010-FY2014. Wolves accounted for 11.3%, bears (black and grizzly) 6.8%, mountain lions 4.2%, and red foxes 1.1% (MIS 2014). Table 1-4 summarizes reported and verified livestock losses to predators from FY2010-FY2014 in Wyoming.

Table 1-4. Livestock killed by predators in Wyoming reported to and verified by WS-Wyoming, FY2010-FY2014 (MIS 2014)*.

FISCAL YEAR	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
	COYOTE					BEAR (BLACK/GRIZZLY)				
Cattle	0	1	0	0	0	3	2	0	6	5
Calves	40	96	41	45	24	8	5	11	13	1
Sheep (Adult)	600	541	415	630	429	40	19	18	33	24
Lambs	1,314	1,183	781	768	655	78	47	38	22	119
Goats (adult)	2	2	0	0	1	0	0	0	0	0
Goats (kid)	1	0	4	7	2	0	0	0	0	0
Horses	0	0	0	0	0	0	0	0	0	0
Poultry	26	3	11	1	0	0	0	0	0	0
Pigs	0	0	0	0	0	0	0	0	0	0
Guard Animals	0	0	0	0	1	0	0	0	0	0
Livestock Killed Per Year by Predators	1,983	1,826	1,252	1,451	1,112	129	73	67	74	149
Value ($) of Livestock Lost Per Year to Predators	18,9940	26,9872	23,3429	20,8789	13,6445	22,715	19,875	15,403	23,620	21,132

Table 1-4. Livestock killed by predators in Wyoming reported to and verified by WS-Wyoming, FY2010-FY2014 (MIS 2014)* (cont.)

FISCAL YEAR	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	Aver.
	MOUNTAIN LION					RED FOX					ALL OTHERS**					
Cattle	0	0	0	0	0	0	0	0	0	0	21	7	6	9	2	2.48
Calves	3	2	2	1	5	0	0	0	0	0	31	33	39	21	29	18.00
Sheep	35	24	16	6	11	0	0	0	0	0	23	34	20	23	6	117.88
Lambs	48	57	86	22	42	28	45	7	4	40	139	238	164	84	38	241.88
Goats (adult)	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.32
Goats (kid)	0	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0.76
Horses	3	0	0	1	0	0	0	0	0	0	1	2	0	0	0	0.28
Poultry	0	0	0	0	0	48	60	13	2	18	26	34	84	92	15	17.32
Pigs	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0.16
Guard Animals	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.08
Livestock Killed Per Year by Predators	92	83	105	30	58	76	106	20	6	59	244	352	313	229	90	399.16
Value ($) of Livestock Lost Per Year to Predators	16,530	16,020	13,799	7,469	8,765	3,642	7,780	1,590	350	3,349	79,713	75,373	60,449	38,628	30,826	60,220.12

*Reported losses are determined from cooperator reports, while verified losses are reported by WS-Wyoming Specialists. The coyote is the species responsible for the majority of livestock losses to predators, followed by bears (black/grizzly). Lambs, sheep, and calves were most impacted by these predators, reflecting their availability throughout Wyoming and their vulnerability to predators.
**Others include: badgers, black-billed magpies, bobcats, crows, feral dogs, golden eagles, raccoons, ravens, striped skunks, wolves

In FY2010, WS-Wyoming personnel verified that predators killed 9 cattle, 35 calves, 208 adult sheep, and 465 lambs in Wyoming. The value of these losses was $109,115. In FY2011, WS-Wyoming personnel verified that predators killed 8 cattle, 46 calves, 196 adult sheep, and 433 lambs in Wyoming, valued collectively at $137,262. In FY2012, WS-Wyoming personnel verified that predators killed 2 cattle, 45 calves, 142 adult sheep, and 386 lambs, which were valued at a total of $117,559. Verified livestock losses in Wyoming in FY2013 included 10 cattle, 60 calves, 138 adult sheep, and 259 lambs, with a commercial value of $100,920. Fiscal year 2014 verified livestock losses in Wyoming included 7 cattle, 35 calves, 144 adult sheep, and 427 lambs. These losses were collectively valued at $94,002 (all data from MIS 2014). These losses occurred despite current control efforts by WS-Wyoming personnel and producers, who often entail substantial indirect costs (Jahnke et al. 1987). Table 1-4 shows the types and numbers of livestock killed in Wyoming from FY2010 through FY2014 (MIS 2014).

Livestock Losses on BLM Lands

The primary areas where PDM is conducted in Wyoming is where BLM grazing predominates. Emphasis is on livestock protection on private lands and on grazing allotments administered by the BLM. Because of the large home range size and mobility of predators, it is often necessary to conduct PDM on private lands and adjacent public lands (primarily BLM grazing allotments) in order to provide adequate livestock protection. The most common plant association across much of the BLM-managed lands in Wyoming that supports the highest population densities of coyotes is sagebrush (Table 3 in Gese and Terletzky 2009). The primary livestock grazing use of these lands is cow-calf production and production of range bands of sheep. Most livestock grazing occurs in spring and early summer.

Livestock are most vulnerable to predation during and immediately after calving and lambing. Most calving and lambing is done on private property, after which livestock are commonly turned out to utilize public grazing allotments. Problems with predation typically occur first in areas where sheep and lambs are grazed and secondly in pastures where cattle and calves are grazed. These areas comprise most of the planned management areas which are identified during the BLM work planning process. With the exception of a few bottomland properties, most ranches in Wyoming are contiguous to BLM lands. WS-Wyoming is currently authorized to conduct activities on 11,853,416 acres within the jurisdiction of the three BLM District Offices in Wyoming that oversee 10 Field Offices in the state. From FY2010 through FY2014, on BLM lands, WS-Wyoming Specialists confirmed that coyotes killed 12 calves, 404 adult sheep and 376 lambs valued at $8,548, $61,663 and $39,572, respectively. These losses occurred despite the use of livestock guarding dogs, herders and other nonlethal techniques to discourage predation. Table 1-5 shows the types, numbers and value of livestock killed on BLM lands in Wyoming.

Table 1-5. Livestock/Resources Killed by Predators in Wyoming on BLM Lands, Reported to or Verified by WS-Wyoming during FY2010-FY2014 (MIS 2014).

Fiscal Year		2010	2011	2012	2013	2014
Calves	Black bear	0	0	2	0	0
	Coyote	12	14	2	9	3
	Golden eagle	0	2	0	0	0
	Raven	2	0	3	2	3
	Total	14	16	7	11	6
Sheep	Black bear	1	5	2	0	4
	Bobcat	0	2	0	0	0
	Coyote	476	350	323	531	340
	Feral dog	0	0	0	0	4
	Mountain lion	1	6	8	0	0
	Raven	2	6	0	1	0
	Total	480	369	333	532	348
Lambs	Black bear	0	1	0	5	48
	Coyote	316	258	378	363	269
	Feral dog	0	0	1	0	1
	Golden eagle	15	41	22	1	7

Table 1-5. Livestock/Resources Killed by Predators in Wyoming on BLM Lands, Reported to or Verified by WS-Wyoming during FY2010-FY2014 (MIS 2014).

Fiscal Year		2010	2011	2012	2013	2014
	Magpie	0	0	1	0	0
	Mountain lion	4	1	5	0	0
	Raven	46	50	38	9	5
	Red fox	13	1	0	1	16
	Total	394	352	445	379	346
Goats (kid)	Coyote	0	0	0	2	0
Guard Animals	Coyote	0	0	0	0	1
	Feral dog	1	0	0	0	0
	Total	1	0	0	0	1
Poultry (chickens)	Red fox	0	0	0	0	3
Total Number of Livestock Lost		889	737	785	924	704
Total Value of Livestock Lost		$109,240	$120,301	$140,175	$130,820	$78,940

Livestock Losses on Forest Service Lands

Most livestock grazing on National Forests in Wyoming is represented by sheep range bands and cattle on higher elevation summer grazing allotments in the mountainous regions of the state. For the reporting period FY2010-FY2014, the class of livestock with the highest predation losses on National Forest grazing allotments in Wyoming, both in terms of numbers (663) and valuation ($147,435) (MIS 2014), is lambs (Table 1-6). Bears (both black and grizzly) and coyotes were the most important predators of sheep and lambs. Coyotes were the leading predator of lambs (455 individuals valued at $49,381), while bears took the greatest number of sheep (92 individuals valued at $13,044) (MIS 2014). Mountain lion predation on livestock was insignificant on grazing allotments across the National Forest system in Wyoming during the reporting period (FY2010-FY2014). Table 1-6 summarizes the numbers and value of livestock, by class, protected on National Forest lands in Wyoming.

The potential exists for predation to occur on permitted livestock on all National Forests in Wyoming. PDM activities on NFs are commensurate with the type and number of livestock grazed, time of year and location. On the Medicine Bow, Bridger/Teton and Shoshone NFs, considerable grazing by sheep range bands and cattle is permitted from early summer through fall each year. Because sheep and cattle in these locations are vulnerable to predation, producers frequently report damage and request assistance from WS-Wyoming. The Bridger/Teton NF has historically documented the highest level of livestock losses attributed to predation of any National Forest in Wyoming. This level of predation is mostly the result of large numbers of range bands of sheep, large numbers of cattle, and the inaccessible, rugged terrain characteristics of this National Forest that provide excellent habitat for large predators. Coyote population densities in forested areas of Wyoming are comparable to those of most high desert sagebrush communities in the state (Gese and Terletzky 2009). Bear (black and grizzly) populations are stable to increasing in these same areas, which increases predation potential (Bjornlie et al. 2014, Atkinson et al. 2014).

Table 1-6. Livestock Lost to Predators in Wyoming on National Forest Lands, Reported to or Verified by WS-Wyoming during FY2010-FY2014 (MIS 2014).

Fiscal Year		2010	2011	2012	2013	2014
Cattle	Bear (black/grizzly)	1	0	0	0	0
	Coyote	0	0	0	0	0
	Mountain lion	0	0	0	0	0
	Total	1	0	0	0	0
	Value	$1,300	$0	$0	$0	$0
Calves	Bear (black/grizzly)	2	2	2	0	0
	Coyote	4	0	0	2	0
	Mountain lion	0	0	0	0	0
	Total	6	2	2	2	0
	Value	$3,300	$1,900	$1,570	$1,570	$0
Sheep	Bear (black/grizzly)	28	14	10	28	12
	Coyote	8	5	10	0	11
	Mountain lion	0	0	0	0	0
	Total	36	19	20	28	23
	Value	$4,185	$3,750	$2,777	$3,574	$3,905
Lambs	Bear (black/grizzly)	41	46	23	17	5
	Coyote	48	82	145	92	88
	Mountain lion	0	0	2	0	0
	Total	89	128	170	109	93
	Value	$8,110	$20,276	$17,142	$9,125	$10,759
Total Number Livestock Lost		132	149	192	139	116
Total Value of Livestock Lost		$16,895	$25,926	$21,489	$14,269	$14,664

Livestock Losses on Other Land Classes in Wyoming

A large proportion of the land base in Wyoming on which WS-Wyoming conducts predator control activities is privately owned. This is significant, given that approximately 50% of the land area in Wyoming is public land. Table 1-7 provides a summary of livestock predator losses across the different land classes in Wyoming on which WS-Wyoming conducts PDM. The "All Other Land" category in the table includes county, city, and tribal land, as well as federally-owned land not managed by the BLM or USFS.

Table 1-7. A Comparison of Livestock Losses to Predators on Public and Private Lands Reported to or Verified by WS-Wyoming, FY2010-FY2014 (MIS 2014).

Livestock		BLM Land	USFS Land	State Land	Private Land	All Other Land
Cattle	Total	1	13	20	48	5
	Value	$1,000	$17,172	$24,234	$51,439	$4,900
Calves	Total	59	57	121	424	12
	Value	$35,122	$39,618	$74,902	$240,208	$10,027
Sheep	Total	2,075	135	2,045	2,858	11
	Value	$362,628	$19,392	$361,500	$498,762	$1,406
Lambs	Total	1,934	663	2,309	5,557	38
	Value	$187,051	$71,253	$205,130	$567,992	$3,332
Goats, Kid	Total	2	0	2	23	0
	Value	$346	$0	$346	$3,167	$0
Horses	Total	0	0	0	9	0
	Value	$0	$0	$0	$37,976	$0
Swine	Total	0	0	4	4	0
	Value	$0	$0	$400	$400	$0
Poultry[1]	Total	3	0	31	416	3
	Value	$75	$0	$429	$6,620	$40
Guard Animals[2]	Total	2	0	2	11	0
	Value	$3,100	$0	$3,100	$60,600	$0
Total Number Lost		4,076	868	4,534	9,350	69
Total Loss Value		$589,322	$147,435	$670,041	$1,467,164	$19,705

[1] Includes human-raised game birds (chukars, pheasants)
[2] Includes alpacas

1.2.2 Need for Predator Damage Management for Protection of Natural Resources

Relationships between predator and prey abundance are complex and not easily described. Under certain conditions, predators may influence fluctuations in wildlife populations and affect the goals that managers set for a specific population[2]. Only by understanding the complexity of predator and prey relationships will it be possible to determine if or when management of predators will be effective in helping a specific wildlife population. Ultimately, the effects of predation on wildlife populations, whether perceived or real, influence how wildlife populations are managed.

When wildlife populations are close to carrying capacity, predation tends to have less influence on the population, and reductions in predator numbers are unlikely to result in an increase in the population. When habitat conditions are favorable, wildlife has better nutrition and more cover, which should reduce susceptibility to predation. Likewise, winter habitats with deep snow can limit mobility and increase vulnerability to predation. When alternate prey species occupy the

[2] Habitat restoration and species restoration may be the final goals of management agencies, but most habitat restoration projects take many years, if not decades, to complete. Predation management could insure that depressed prey species populations remain viable in desired habitats or in selected areas.

same habitats, theoretically predator populations have more prey from which to select. In those instances when primary prey species numbers decline, predators may switch to alternate prey, thereby reducing effects of predation on remaining species. Conversely, this ability to switch prey may maintain stable or high predator numbers, which can in turn limit prey population growth when below its carrying capacity. In habitats with multiple predators, those predators may compete with one another, which may influence predator abundance (*e.g.*, increased coyote numbers may result in decreased bobcat numbers). In short, the relationships between predator and prey are complex, difficult to isolate and characterize, and rarely result in simple management solutions.

The health of a predator population is integrally linked to the health of its prey base. Manipulating habitat or predator populations is often posed as a solution to depressed prey populations. However, predator-prey dynamics are complex and the effect on prey populations is often an interaction of predator and prey life history, climate, predator and prey density, disease, and habitat quality (Hayes and Bodenchuk 2010). High predation rates, especially on prey populations with few individuals, can reduce the size and sustainability of prey populations. Likewise, when severe winter conditions or large scale habitat loss severely reduces local prey populations, predators dependent on that prey may further depress or prevent prey population recovery (Neal et al. 1987). Unfortunately, when this situation manifests, predator populations will also decline (Kamler et al. 2002) or be forced to switch to alternate prey, which can be domestic livestock.

WGFD 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 Wyoming. Because predators sometimes compromise population management objectives of pronghorn antelope, mule deer or bighorn sheep in specific hunt areas, or cause unacceptable levels of predation on sensitive wildlife species, WGFD could request assistance from WS-Wyoming to protect such species. WGFD policy requires juvenile (fawn/lamb) recruitment in specific populations or herd management units to be under 65% to trigger a request for PDM activities. In these situations, for WGFD management objectives to be met, monitoring and periodic coyote damage management may be requested, as determined by WGFD. If WGFD requests assistance protecting certain wildlife species, WS-Wyoming would work with specific county predatory management districts (PMD) and WGFD to identify and provide the level of protection requested. Between FY2010 and FY2014, WS-Wyoming conducted 4 PDM projects across the state at the request of WGFD to reduce predation to mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*) populations, especially on Spring/Summer fawning ranges for deer, antelope and bighorn sheep. WGFD may, at some point in the future, request the assistance of WS-Wyoming to protect greater sage grouse (*Centrocercus urophasianus*) from predators.

A relevant example is provided by the black bear. Food habits of this large omnivore vary widely with season and location. In the Rocky Mountain West, black bears emerging from dens consume early season grasses and forbs. As temperatures rise, they follow snowmelt to higher elevations focusing on newly greening vegetation (Beecham and Rohlman 1994). When more nutritious late summer and fall mast crops (berries and nuts) ripen, black bears focus intently on these foods (Beecham and Rohlman 1994, Costello et al. 2001). Ants, bees, and larvae make up the majority of non-vegetation diets of black bears (Beecham and Rohlman 1994). However,

during early summer, newborn ungulates such as elk calves become a key food source for black bears in some areas of the West (Smith and Anderson 1996, Zager et al. 2005, Zager and Beecham 2006). Managers should consider potential effects of black bear predation on depressed ungulate populations and may maintain black bears at lower density in specific hunt areas when it has been documented they are known to depress an ungulate population. Irwin and Hammond (1985) found that, depending upon annual and seasonal variation, 83–94% of the volume of black bear diets in the Grey's River area of western Wyoming consisted of vegetable matter. The bulk of remaining animal matter came from carrion in spring and insects in summer and fall (WGFD 2007).

PDM is most efficient when based on results of sound scientific investigations, and management can be successful when comprehensive research indicates a direction for management actions. Relevant research in the arena of PDM includes:

- Evaluation of population-specific adult and offspring survival and identification of causes of mortality
- Evaluation of the abundance and demography of prey populations to indicate what processes (*e.g*., density-dependent fecundity, food, disease, nest failure) are limiting or regulating the local abundance of the prey species
- Evaluation of water quality, distribution, and potential impacts on population expansion
- Evaluation and improvement of survey methodology and population modeling for management purposes
- Long-term effects of potentially low genetic variability on population performance and management direction
- Effects of unwanted vegetative encroachment/invasion on population viability and land management practices
- Evaluation of techniques to remove unwanted vegetation from prey species range and still retain desired vegetation integrity

While outside of the scope of WS-Wyoming authority and decision making, it is important to note there are other related and ongoing activities designed to enhance game species survival and success (Hagen 2011a). Activities such as habitat restoration and improvements as well as disease management are implemented by agencies such as USFWS, BLM and FS, in coordination with WGFD. Thus, PDM may not be the sole tool used to enhance specific populations of prey species, but is used where management indicates it is appropriate, under the authority of WGFD. WGFD will determine when predation is a limiting factor in the productivity of specific prey species, even while other factors are addressed, and that PDM would be beneficial.

Most importantly, predation must be identified as a major factor limiting prey species and the prey species population must be below habitat carrying capacity. Other factors to consider include: 1) the existence of reliable methods for the removal of the identified predator, 2) an assessment of the total number of predators to be removed in an identified project area, 3) the cost of the proposed project justified on the basis of a realistic increase in prey species numbers and possible subsequent hunter harvest, and 4) public acceptance of the proposed project. While PDM may not always be the appropriate management tool, in the right situation, it is a viable option for reducing predator damage to prey species populations. In addition, PDM undertaken to protect livestock could be coordinated to augment wildlife management objectives/goals of the

WGFD or the USFWS. Conversely, a lack of PDM to protect livestock could conceivably result in adverse impacts to some wildlife species.

Revenue derived from recreation, especially recreation related to wildlife and the outdoors, is increasingly important to the economy of Wyoming. The increased popularity of wildlife watching reveals the importance that people attach to diverse, accessible and robust fish and wildlife populations. The magnitude of its economic impacts proves that wildlife watching is a major force, driving billions of dollars in spending around the country. These economic impacts can be the life-blood of local economies. Rural areas can attract thousands of wildlife watchers each year, generating millions of dollars. In 2011, 658,000 people participated in hunting and wildlife watching in Wyoming (USFWS and USCB 2011). This spending creates thousands of jobs, supports countless local communities, and provides vital funding for conservation. These activities generated economic activity throughout the state related to travel, local recreation, and equipment purchases. USFWS reported that wildlife viewing expenditures in Wyoming totaled more than $350 million in 2011 while hunting related expenditures totaled another $289 million in the same year. The 2011 USFWS Survey found that 775,000 Wyoming residents and nonresidents 16 years old and older fished, hunted, or watched wildlife in Wyoming. Of the total number of participants, 140,000 hunted, and 518,000 participated in wildlife-watching activities, which include observing, feeding, and photographing wildlife. Also, there were 76,000 Wyomingites 16 years old and older and 9,000 Wyomingites 6 to 15 years old who hunted. Finally, there were 182,000 Wyomingites 16 years old and older and 32,000 Wyomingites 6 to 15 years old who wildlife watched.

In addition, in 2011, state residents and nonresidents spent $1.1 billion on wildlife recreation in Wyoming. Of that total, trip-related expenditures were $874 million and equipment expenditures totaled $181 million. The remaining $82 million was spent on licenses, contributions, land ownership and leasing, and other items. All hunting-related expenditures in Wyoming totaled $289 million in 2011. Trip-related expenses, such as food and lodging, transportation, and other trip expenses, totaled $159 million. Expenditures for food and lodging were $40 million and transportation expenditures were $67 million. Other trip expenses, such as equipment rental, totaled $51 million for the year. The average trip-related expenditure per hunter was $1,136. Further, hunters spent $81 million on equipment. Hunting equipment totaled $49 million and made up 60% of all equipment costs. Hunters spent $32 million on auxiliary equipment and special equipment, accounting for 40% of total equipment expenditures for hunting.

Wildlife watchers spent $400 million on wildlife-watching activities in Wyoming in 2006 (USFWS 2008) with a nearly $620 million multiplier effect. Trip-related expenditures, including food and lodging ($157 million), transportation ($155 million), and other trip expenses ($9 million), such as equipment rental, amounted to $321 million (USFWS and USBC 2011). This summation comprised 92% of all wildlife-watching expenditures by participants. The average of the trip-related expenditures for away-from-home participants was $731 per person in 2011. Wildlife-watchers also spent nearly $22 million on equipment—6% of all their expenditures. Specifically, wildlife-watching equipment (binoculars, special clothing, etc.) expenditures totaled $21 million, 96% of the equipment total. Auxiliary equipment expenditures and special equipment expenditures amounted to $905,000—4% of all equipment costs. Wildlife watching also generated almost 8,800 jobs in Wyoming in 2006 (USFWS 2008).

While these spending figures alone are impressive, they are magnified through "ripple" or multiplier effects. Each dollar spent by a hunter or wildlife watcher increases another person's income, enabling that person (or business) to spend more, which in turn increases income for somebody else. The process continues as wide series of ripples through local regional and state economies.

Sage-Grouse

In 2010, the sage-grouse was proposed as a candidate species under the Endangered Species Act (ESA) (USFWS 2010). Managing sage-grouse populations to sustain or increase numbers will be critical to prevent future listing under ESA. Prior to the ESA listing, WGFD developed a management strategy to conserve and enhance greater sage-grouse populations in Wyoming as a result of a larger conservation effort by the Western Association of Fish and Wildlife Agencies to address declines throughout the range of the species (WGFD 2003).

A myriad of factors has been postulated as contributing to declines in sage-grouse populations, including habitat fragmentation, disease, predation, excessive livestock grazing, wildfire and prescribed burns, climate change, development of power lines, fences, and oil and gas exploration/development (roads, well pads, etc.). Research does not conclusively reveal consistent contributing factors (Willis et al. 1993, Connelly and Braun 1997, Schroeder et al. 1999, Beck and Mitchell 2000, Connelly et al. 2000a, b, Schroeder and Baydack 2001, Coates and Delehanty 2010, Holloran et al. 2010, USFWS 2010, Connelly et al. 2011, Miller et al. 2011). These activities have led to a change in the number, distribution and type of predators that prey on sage-grouse. As habitats are altered, and/or where predators dramatically increase in number or in type, impacts of predation may be magnified. “Newcomer” predators in Wyoming, such as red foxes and raccoons, have expanded their range into sage-grouse habitats where they were not previously a concern. These newcomers and traditional sage-grouse predators (primarily common ravens) have increased in numbers largely as a result of readily available food associated with human activities (Coates et al. 2008, Coates and Delehanty 2010). Migratory bird protection has also contributed to increases in avian predator populations and accompanying range expansions.

Management of predators may be necessary in localized situations to maintain sage-grouse populations (WGFD 2003). PDM for North American prairie grouse generally has been addressed by manipulating habitat, because this is believed to be the most economical, efficient, and viable long-term strategy to enhance populations of prairie grouse (Giesen and Connelly 1993, Edelmann et al. 1998); however, short-term management actions (*i.e.,* PDM) may benefit some sage-grouse populations over longer time frames. Predation is probably most frequent on adult males during or shortly after the breeding season and on females during the incubation and brood-rearing periods (Schroeder et al. 1999, Hagen 2011a). Predation rates may depend in part on the availability of alternative prey, such as cottontail rabbits (*Silvlagus* spp.), jackrabbits or other small mammals (Willis et al. 1993). Additionally, habitat quality may influence the rates of predation on sage-grouse (Schroeder and Baydack 2001). PDM is not necessarily limited to lethal removal - it may also include removing key elements in the environment that attract predators (*e.g*., perches, food sources) and/or increasing the quality of habitat for sage-grouse.

More importantly, compromised sagebrush habitat may take many years or decades to recover (if ever) to the point where it can once again provide the necessary elements for sage-grouse to

thrive (Sapsis 1990). PDM is one factor that can be implemented by managers to provide, at least short-term, benefits to depressed or struggling sage-grouse populations (Cotes and Sutherland 1997, Schroeder and Baydack 2001). The WGFD reports that predation is and has always been the major cause of sage-grouse mortality in Wyoming (WGFD 2003). Sage grouse populations in some areas of Wyoming are sufficiently healthy that WGFD allows sport harvest. However, in other areas of the state, WGFD has not achieved management goals for sage-grouse. In addition, Wyoming sage-grouse numbers have declined over the long-term (1957-2003) (Hagen 2011a). Reasons for these population losses likely are the cumulative effects of habitat loss and degradation, changes in PDM methods, and increases in human disturbance. Nest predators identified in Wyoming studies include badgers, red foxes, ravens and ground squirrels. In addition, golden eagles, coyotes, various hawk species, bobcats, and weasels prey on sage-grouse throughout the year. Thus, WGFD may request WS-Wyoming to conduct PDM in an effort to enhance local populations, if appropriate.

Large-scale predator removal is not indicated as a statewide objective in Wyoming (WGFD 2003). Where predation is demonstrated to be of significant concern, planning groups would consider localized PDM. PDM goals include:
1) Minimizing the negative effects of predation to increase sage-grouse recruitment
2) Maintaining habitat quality that discourages predation

Predation-Related Management Practices:
1) Local working groups should consider PDM to maintain or enhance local sage-grouse populations when they determine there is a demonstrated need, such as a population is trending downward over a 10-year period, populations of "newcomer" predators are artificially high in sage-grouse habitat, or specific sage-grouse populations need short-term help.
2) Develop and distribute educational materials regarding modification of human activities/practices that contribute to the establishment or expansion of predator populations through creation of anthropogenic structures and facilities. Examples include landfills and other garbage/waste disposal facilities that may provide artificial food sources for a variety of predators, and buildings/structures that provide nesting/roosting habitat for ravens and raptors.
3) Avoid construction of overhead lines and other perch sites in occupied sage-grouse habitat. Where these structures must be built, or currently exist, bury the lines, locate lines along existing utility corridors or modify the structures in key areas.
4) PDM to enhance sage-grouse survival should be directed only toward predators identified as impacting specific sage-grouse populations.
5) Better quantify and qualify the role of predation on sage-grouse population dynamics in Wyoming.
6) Discourage the establishment of artificially high populations of “newcomer” predators in sage-grouse habitat and bring current robust populations of such predators into balance.
7) Monitor the effectiveness of any PDM efforts that are implemented.
8) Request the USFWS to conduct a species assessment of the common raven and include ravens in the standing depredation order (50 CFR 21.43, “Control of Depredating Birds”).

While sage-grouse still thrive over a large portion of their historical range in Wyoming, conservation measures including PDM as evaluated and determined by WGFD could be helpful in alleviating problems before this species declines to a point from which recovery may be difficult. Nest predation and early brood (chick) mortality by predators has been well

documented in the literature (Schroeder et al, 1999, Connelly et al. 2000b, Schroeder and Baydack 2001, Coates 2007). Research has also shown that in areas of altered habitat, there is potential for increased predation on all life stages of sage-grouse (Scroeder and Baydack 2001, Connelly et al. 2004, Coates 2007). Thus, WS-Wyoming could receive requests from WGFD, as warranted, to provide PDM for the protection of greater sage-grouse.

Big Game

Under certain conditions, predators, primarily coyotes and mountain lions, can have an adverse impact on deer (*Odocoileus* spp.), bighorn sheep, and pronghorn antelope populations; this is not necessarily limited to sick or inferior animals (Pimlott 1970, USFWS 1978, Hamlin et al. 1984, Neff et al. 1985, Shaw 1977). Determining the effects of predation on big game species is challenging due to various factors which can affect big game populations. Studies in some areas of the western United States have concluded that predators have a positive effect on mule deer populations (Hamlin et al. 1984, Ballard et al. 2001, Harrington and Conover 2007), while other studies have found predators have little effect (Ballard et al. 2001, Brown and Conover 2011, Hurley et al. 2011). Differences in deer and predator densities, predator species, weather, disease, human harvest, and whether the prey population is at or near habitat carrying capacity can influence populations. Connolly (1978) reviewed 68 studies of predation on wild ungulate populations and concluded that in 31 cases, predation was a limiting factor. In these cases, coyote predation had a significant influence on white-tailed deer (*O. virginianus*), mule deer, pronghorn antelope, and bighorn sheep populations. Hamlin et al. (1984) observed that a minimum of 90% summer mortality of fawns was a result of coyote predation. Pojar and Bowden (2004) documented that 75% of predation mortality in mule deer fawns in Colorado occurred by July 31. Other authors also observed that coyotes were responsible for the majority of fawn mortality during the first few weeks of life (Knowlton 1964, White 1967). A study in the central Sierra Nevada in California found that predation was the largest cause of fawn loss, resulting in the death of 50.6% of all fawns during the first 12 months of life (Neal 1990). Mountain lions were the main predator in the study area; however, coyotes accounted for 27% of all predation. Teer et al. (1991) concluded from work conducted at the Welder Wildlife Refuge in Texas that coyotes kill 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 was limiting recruitment (the ability of the population to maintain or increase itself). Their study concluded that predation, primarily by coyotes, was the major cause for low fawn crops on Steens Mountain in Oregon. Likewise, predation was the leading cause of pronghorn fawn loss, accounting for 91% of the mortalities that occurred during a 1981-82 study in southeastern Oregon (Trainer et al. 1983). Trainer et al. (1983) also noted that most pronghorn fawns were killed by coyotes, with probable coyote kills comprising 60% of fawn 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 1977, Stout 1982, Knowlton and Stoddart 1992, McCoy et al. 2013, Kilgo et al. 2014) and pronghorn antelope (Smith et al. 1986, Berger and Conner 2008, Brown and Conover 2011).

In some cases, mountain lion predation can have a significant impact on specific prey populations. For example, Sweitzer et al. (1997) determined mountain lion predation caused near extinction of a porcupine population in northwestern Nevada. In another study, Turner et al. (1992) concluded that mountain lion predation limited growth of a feral horse population on the California-Nevada border. Wehausen (1996) reported several instances where mountain lion predation on bighorn sheep populations reduced population growth rates, thereby eliminating the opportunity to remove surplus bighorn sheep for relocation to historic habitat. This effectively halted a bighorn sheep restoration program. Kamler et al. (2002) suggested that mountain lion predation was responsible for the decline of bighorn sheep populations in most areas of Arizona; these declines were most likely linked to overall declines in mule deer populations, which resulted in mountain lions shifting to bighorn sheep as alternate prey. Rominger et al. (2004) similarly reported that mountain lions limited expansion of a transplanted population of bighorn sheep in New Mexico. Hayes et al. (2000) proposed that mountain lion predation on bighorn sheep may have been impeding recovery of a federally listed endangered bighorn sheep population in the Penisular Ranges of California. Also in California, mountain lion predation was found to be the primary cause of a significant decline in mule deer in the Sierra Nevada Mountains, impacting both adult and fawn cohorts (Harrison 1989).

Based on the above information, local short-term PDM under the right situations can be an important tool in maintaining specific wildlife management objectives. Factors such as predator densities, densities of alternate prey, weather conditions, ungulate densities and prey vulnerability can influence survival of various age cohorts in ungulate populations. Research indicates that in some cases, coyote damage management can increase deer and pronghorn antelope fawn survival where predation is impacting juvenile recruitment in these populations.

Mule Deer

Mule deer serve as prey for many large predators of western North America. In the western U.S. and Canada, these predators are primarily mountain lions, coyotes, and bobcats, although black bears, wolves, grizzly bears, and feral dogs will also take mule deer. Predators can have a limiting or regulating effect on mule deer populations. However, many factors interact to influence mule deer abundance, and predation is only one part of the equation. PDM is simply the removal of predators. Predation management is any activity that may influence the relationship between predators and their prey, including habitat enhancement to increase prey security and lethal removal of predators. In most cases, reducing the number of predators to increase mule deer populations is inefficient and cost prohibitive. Therefore, PDM would only be instituted when circumstances indicate a high likelihood of success, and where specific and measurable objectives can be applied and carefully monitored.

Historically, mule deer populations have fluctuated over time. Currently, populations are in decline across the entire range of the species in western North America (WGFD Wyoming Mule Deer Initiative). The Western Association of Fish and Wildlife Agencies Mule Deer Working Group (2002) provided a descriptive summary of the history of mule deer populations in the United States (paraphrased): Since Europeans began settling the West approximately 200 years

ago, the landscape has changed dramatically, as land was initially planted to crops and grazed by livestock. Accounts of mule deer during these early years indicated their numbers were very low. The advent of wildlife conservation policies (institution of hunting seasons, increased law enforcement, protection of land), in conjunction with habitat improvements and large scale predator management, resulted in an explosion of mule deer numbers, with population estimates totaling 2.3 million in 1950. The 1950s and 1960s were considered the "heyday" of mule deer in this country. This period of productivity was followed by sharp declines in mule deer numbers due to the "quiet crisis", a series of subtle, and sometimes insidious factors, including: habitat changes attributed to a variety of land use practices and policies (livestock grazing, fire suppression, proliferation of invasive plants and weeds), habitat fragmentation due to resource (gas, mineral, oil) exploration and human population growth and development, as well as climate change (drought, severe winters). Predation by itself is not necessarily a mule deer population limiting factor, but large numbers of predators can negatively impact deer populations, with effects being most noticeable following winters when deer populations experience high weather-related mortality rates. In combination with the various limiting factors mentioned above, the effects of predation can be amplified when habitat productivity has already been compromised. The long-term decline of mule deer populations in much of Wyoming remains a significant and continuing concern for the public and WGFD. The role predation plays in these declines has not been quantified specific to Wyoming (WGFD 2006).

The most significant predators of mule deer in Wyoming are coyotes and mountain lions. Coyotes are characterized as omnivores, feeding on small animals, carrion and vegetation, but they will also prey on deer, especially fawns (Hamlin et al. 1984, Whittaker and Lindzey 1999). Impacts of coyotes on mule deer recruitment in Wyoming have been documented (Whittaker and Lindzey 1999). Aside from the statewide population estimate provided by Gese and Terletzky (2009), coyote populations or trends are not monitored in Wyoming. Given the resilience of coyotes even to broadscale population control methods (Gese 2005), the statewide coyote population is very likely stable and may be increasing.

Mountain lions are true carnivores, preying primarily on elk and deer. During mountain lion hunt years 2010-2012, WGFD increased quotas in several hunt areas to test whether lion reductions would result in improved mule deer population demographics (i.e., greater doe/fawn ratios, increased population size) (WGFD 2006). To assess how increased mountain lion harvest may impact ungulate populations, WGFD compared selected hunt areas of high density mountain lion harvest with corresponding mule deer hunt areas.

In the Northcentral Mountain Lion Management Unit (MLMU) (consisting of 4 mountain lion hunt areas), increasing harvest of mountain lions the previous four years did not appear to result in a detectable increase in doe/fawn ratios for mule deer. There was, in fact, an inverse relationship between mountain lion harvest and mule deer population size, suggesting that deer populations continue to decline in spite of increased mountain lion harvest. Regression analyses indicated there was a minor positive relationship between mountain lion harvest and mule deer doe-fawn ratios in the Black Hills area and northern Bighorn Mountains, but higher ratios did not result in detectable positive population level impacts to mule deer. The analyses tend to support other mule deer/mountain lion interaction studies where temporary benefits to mule deer recruitment were documented following predator reductions (Hurley et al. 2011). It should be noted that the analyses did not include variables such as habitat quality and weather indices that

also factor into ungulate population dynamics. Since this was a simple correlative analysis, the relative importance of habitat quality and predation in deer population dynamics was not explored (Pierce et al. 2012). In order for mountain lion population reduction to benefit ungulate populations (related to neonate/juvenile survival) there must be adequate habitat in the form of nutritive intake for potentially stressed ungulate populations. If predation is considered a limiting factor, deer populations not suppressed by quality habitat can respond in the short term to predator reductions (Pierce et al. 2012). In summary, to accurately assess how mountain lion harvest relates to ungulate populations quantitatively, managers must take into account variables including weather, habitat, and body condition of ungulates and some assessment of cause-specific mortality (Hurley et al. 2011).

When requesting assistance from WS-Wyoming, WGFD uses research and science to guide management decisions. In reviewing scientific research on PDM, there were similarities in cases where PDM was effective at improving deer populations. In general, PDM has been effective when:

1) Predation was identified as a limiting factor
2) PDM was implemented when deer populations were below habitat carrying capacity
3) PDM efforts reduced predator populations across the landscape to a level that yielded positive results (*e.g.*, about 70% of a local coyote population);
4) PDM efforts were timed to coincide with predator or prey birth periods
5) PDM occurred at a focused scale (generally <250 mi^2)

Many factors are considered prior to implementing a PDM program, including:
1) Development of a management plan that identifies:
    a. Current status of mule deer populations relative to carrying capacity
    b. Factors that may be playing a role in reducing mule deer populations
    c. Deer population objectives desired through predation management
    d. Desired population reduction goals for the predator species
    e. Scale of the predator control effort
    f. Timing, method, and budget for predation management efforts
    g. Public outreach
2) A monitoring procedure to determine when goals have been achieved or how management programs can be adjusted (an adaptive-management strategy)

Pronghorn antelope
Pronghorn are a valuable natural resource to the citizens of Wyoming as well as the national and international publics. Wyoming supports the largest population of pronghorn, approximately 57% of the world population (Hack and Menzel 2002). However, harsh winter conditions, including deep, crusted snow, can cause pronghorn mortality (Martinka 1967, McKenzie 1970, Mitchell 1980, Barrett 1982). Extreme drought conditions may also limit the quality and quantity of forage, leading to poor body condition and greater susceptibility to predation or starvation (Zimmer 2004, Bright and Hervert 2005). Factors influencing pronghorn neonate mortality

include parturition date (Fairbanks 1993, Gregg et al. 2001), habitat quality[3] (Ellis 1970, Autenrieth 1984, Ockenfels et al. 1992), adverse weather (Jacques 2006), disease and parasites (Lee et al. 1998, O'Gara 2004b), and predation (Beale and Smith 1973, Barrett 1982, Jacques 2006). Predation, specifically by coyotes, has been attributed as a major cause of mortality of pronghorn neonates (Barrett 1982, Byers 1997, O'Gara and Shaw 2004, Yoakum and O'Gara 2000, Jacques 2006). O'Gara and Shaw (2004) reviewed the causes of mortality for 995 radio-collared neonates from 18 different studies and showed that > 54% of known fawn mortalities were attributed to predation. Following PDM, fawn recruitment rates have increased between 59% and 349% (Smith et al. 1986, Willis 1988, Menzel 1992, O'Gara and Shaw 2004). A six-year radio telemetry study of pronghorn antelope in western Utah showed that 83% of all fawn mortality was attributed to predators (Beale and Smith 1973). Similar observations of improved pronghorn antelope fawn survival and population increases following damage management have been reported by Smith et al. (1986), Berger and Conner (2008), and Brown and Conover (2011). Major losses of pronghorn antelope fawns to predators have been reported from additional radio telemetry studies (Beale 1978, Barrett 1978, Bodie 1978, Von Gunten 1978, Hailey 1979, Tucker and Garner 1980).

Coyote damage management on Anderson Mesa, Arizona increased the herd from 115 animals to 350 in three years, with a peak of 481 animals documented in 1971 (Neff et al. 1985). After coyote damage management was discontinued, pronghorn fawn survival dropped to only 14 and 7 fawns per 100 does in 1973 and 1979, respectively. Initiation of another coyote management program began with the reduction of an estimated 22% of the coyote population in 1981, 28% in 1982, and 29% in 1983. Pronghorn antelope populations on Anderson Mesa during 1983 showed a population of 1,008 antelope, exceeding 1,000 animals for the first time since 1960. Fawn production increased from a low of 7 fawns per 100 does in 1979 to 69 and 67 fawns per 100 does in 1982 and 1983, respectively. After a five-year study, Neff and Woolsey (1979, 1980) determined that coyote predation on pronghorn antelope fawns was the primary factor causing fawn mortality and low pronghorn densities on Anderson Mesa, Arizona. Smith et al. (1986) noted that reducing coyote predation on pronghorn fawns could result in 100% annual increases in population size, and that coyote removal was a cost-effective pronghorn antelope management strategy.

Bighorn Sheep

Wyoming supports an estimated 6,100 bighorn sheep among 8 core native herds and 5 transplanted herds. Core native herds are those populations that have never been extirpated and repopulated. Native herds occur in the northwest portion of the state, in the Absaroka, Teton, Gros Ventre, and Wind River Ranges. Costly transplant efforts have reestablished bighorn sheep in 7 herds in the Wyoming, Snowy, and Sierra Madre Ranges, near Laramie Peak, along the Lander Front, in the Seminoe/Ferris Mountains, and on the west slope of the northern Bighorn Mountains. The 8 core native herds account for greater than 93% of the bighorn sheep in the state, while the remainder occur in small, isolated transplanted populations. Between 1949 and 1995, 1,489 bighorn sheep were captured from the Whiskey Basin winter range and relocated among 61 separate transplant efforts in Wyoming (Hurley 1996). During that time period, the

[3] Degraded habitats may take 15-30 years to recover and a predation management strategy that effectively increases recruitment may be useful to offset some of the negative effects of poorer habitat. This approach might also allow a more rapid recovery of populations following habitat recovery.

only importation of bighorn sheep into Wyoming were 22 Rocky Mountain bighorns from Idaho released in Shell Canyon in 1992 on the west-slope of the Bighorn Mountains.

Disease transmission, human disturbance, overgrazing, and habitat loss (including loss of traditional movement patterns) are most often cited as factors contributing to declines in bighorn sheep abundance and distribution. These problems tend to be exacerbated in transplanted herds that are often small (<100), isolated, and non-migratory. Transplanted bighorn sheep may fail to expand into adjacent habitats because of inadequate forage and/or unsuitable escape terrain (Risenhoover et al. 1988). Additionally, bighorn sheep have poor dispersal tendencies (Singer and Gudorf 1999) because of social bonding that favors traditional use of home ranges (Geist 1971). Such behavioral aspects of bighorn sheep predispose them to disease epizootics, such as pneumonia complex. Both the state of Wyoming (Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group 2004) and The Wildlife Society (TWS 2015) have formulated position statements on the potential risks of disease transmission between domestic sheep and bighorn sheep. The sedentary nature of bighorn sheep may also increase predation rates because predator densities and/or distribution may be determined by more numerous ungulates such as deer or elk, and because predators may repeatedly search small areas where they are likely to encounter bighorn sheep (Singer and Gudorf 1999). Further, when bighorn sheep are transplanted, they may be predisposed to mountain lion predation because normal escape routes are unknown or unavailable (Krausman et al. 1999).

Transplanted bighorn sheep populations in Wyoming are no different and suffer from problems associated with small, sedentary herds (*i.e.*, poor survival, low recruitment). Wyoming transplant efforts have taken place in low to mid-elevation areas where successional changes from relatively open habitats to dense shrub and conifer stands have reduced the amounts of high quality sheep habitat and blocked migration routes. Further, the mid-elevation mountain shrub communities are more likely to support high densities of mule deer and mountain lions, compared with the high-elevation alpine habitats that dominate the core native herd ranges. Because transplanted bighorn sheep herds in Wyoming occur at low densities (<100) and typically inhabit areas that support healthy deer and elk populations in habitats with reduced visibility, they appear more susceptible to predation than bighorn sheep that occupy native core ranges.

Although mountain sheep have evolved under selective pressure of a variety of predators (Kelly 1980, Nichols and Bunnell 1999), the fact that bighorn sheep are preyed upon is well documented. Recent studies have demonstrated that predation[4] can be an important source of mortality in bighorn sheep herds and, in some cases, may have population-level impacts (Hoban 1990, Wehausen 1996, Ross et al. 1997, Hayes et al. 2000, Rominger and Weisenberger 2000, Logan and Sweanor 2001).

Ross et al. (1997) recommended that managers should expect highly variable predation rates on sheep populations of less than 200 individuals. Most accounts of bighorn sheep predation involve coyotes or mountain lions, with occasional reports of other predators. Although coyotes and mountain lions are the most common predators of bighorn sheep, mountain lions appear to be the

[4] Coyotes and golden eagles are effective predators on bighorn lambs, while mountain lions and wolves prey on adult bighorn sheep; typically, predation loss is not significant enough to hamper population performance, unless lamb recruitment/survival is severely compromised.

only predator capable of causing significant mortality in bighorn sheep populations that occupy suitable habitats. Coyote predation appears to be more incidental, primarily restricted to lambs, and most often reported in areas that lack suitable escape terrain. Gregariousness and the use of steep, rugged terrain are effective adaptations of bighorn sheep for avoiding predation by coursing predators such as coyotes and wolves (Wishart 2000). However, stalking predators like mountain lions may be able to circumvent these escape strategies. Prey species of mountain lions may vary depending on local abundance and vulnerability, but deer are the primary food source for most mountain lion populations (Logan and Sweanor 2000), while bighorn sheep are generally considered alternate prey. Predation on bighorn sheep is largely a function of the behavior of individual mountain lions (Hornocker 1970, Hoban 1990, Ross et al. 1997, Hayes et al. 2000, Rominger and Weisenberger 2000, Logan and Sweanor 2001), rather than the total number of mountain lions in the area. Mountain lions can kill any sex and age class of bighorn sheep. What they kill reflects bighorn sheep behaviors that make individual sex and age classes in particular populations more or less vulnerable. The small size of most bighorn sheep populations and changes in availability of alternative prey for predators like mountain lions likely result in variable predation rates among bighorn populations and among years. The impacts of mountain lion predation on bighorn sheep may be direct (mortality) or indirect (changes in distribution). Recent studies have demonstrated that mountain lion predation can be an important source of mortality in bighorn sheep populations (Wehausen 1996, Ross et al. 1997, Hayes et al. 2000, Logan and Sweanor 2001).

However, Thorne et al. (1979) found coyote predation to be the greatest identified cause of natural mortality during a 3-year study of the Whiskey Mountain bighorn sheep herd in Wyoming. This study was based on the observations and movements of 172 marked (151 neck bands, 21 radio-collars) bighorns. Bighorn sheep remains were found most frequently in coyote scats (40%) collected during spring and early summer. Scat analyses confirmed observations that concluded most successful coyote kills on bighorn sheep occurred in late-May, when lambs were most vulnerable to predation. Hebert and Harrison (1988) believed coyote predation was a major source of lamb mortality in British Columbia and that PDM was responsible for dramatic increases in lamb:ewe ratios recorded during 1987-1988. The authors believed that, "A few instances of predator activity (coyotes chasing sheep or cougar predation on sheep) usually indicate an underlying predator problem" and that, "(coyote) removal programs can confirm the impacts of predators and can produce dramatic improvements in survival and growth (of bighorn sheep)….".

Mountain lion harassment is suspected of causing abnormal behavior in sheep (Wehausen 1996); bighorns in some transplant project areas have been known to split into small groups and scatter widely following lion harassment. Besides direct loss of individuals, scattering may lead to use of sub-optimal habitat characterized by lower quality forage, which compromises physical condition, including lower lamb birth weights (Wehausen 1996).

Other states have experienced similar declines in bighorn sheep under extreme levels of mountain lion predation. In California, direct and indirect effects of mountain lion predation were considered a critical limiting factor to the continued survival of Sierra Nevada bighorn sheep (*O. c. sierrae*) (Wehausen 1996, USFWS 1999), warranting an emergency listing and protection of this bighorn sheep subpopulation under the ESA. Direct effects are defined as predation losses,

whereas indirect effects are more subtle and difficult to measure, as when mountain lions keep bighorn sheep from returning to important winter range. Immediate action was taken with this subpopulation to prevent further declines due to predation.

Wehausen (1996) reported several instances where mountain lion predation on bighorn sheep populations reduced population growth rates and eliminated the opportunity to remove surplus bighorn sheep for relocation to historic habitat, effectively halting restoration programs. Kamler et al. (2002) suggested that mountain lion 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 lions taking bighorn sheep as alternate prey. Rominger et al. (2004) similarly reported that mountain lions limited expansion of a transplanted population of bighorn sheep in New Mexico.

PDM is a valid management option when specific predators can be identified and removed (Sawyer and Lindzey 2002). PDM may be more effective when implemented in small or newly transplanted sheep herds, rather than well-established sheep populations, and strategies should be implemented in ways that allow evaluation of their effects upon bighorn sheep populations. In cases where WGFD determines that predators are a limiting factor on specific bighorn sheep herds, WS-Wyoming may be requested to assist with PDM. WGFD is responsible for all aspects of bighorn sheep management, including disease, population and habitat management. All current herd ranges plus those established in the future could be considered for PDM by WGFD, on a case-by-case basis. These areas and PDM activities would be described during the work plan process with WGFD, and possibly BLM and the USFS.

Birds

In a study of waterfowl (duck) nesting success in Canada, researchers found that eggs in most nests were destroyed by predators. These predators included red fox, coyote, striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), Franklin's ground squirrel (*Citellus franklini*), badger (*Taxidea taxus*), black-billed magpie and American crow (*Corvus brachyrhynchos*) (Johnson et. al. 1988). Cowardin et al. (1985) determined that predation was by far the most important cause of nest failure in mallards (*Anas platyrhynchos*) on their study area. Various studies have shown that skunks and raccoons are major waterfowl nest predators that can contribute to poor nesting success (Keith 1961, Urban 1970, Bandy 1965). On the Sterling Wildlife Management Area in southern Idaho, striped skunks, red foxes and black-billed magpies were documented as common predators of nesting ducks, (Gazda and Connelly 1993). Thomas (1989) and Speake (1985) reported that predators were responsible for more than 40% of nest failures of wild turkeys (*Meleagris gallopavo*) in New Hampshire and Alabama, respectively. Everret et al. (1980) reported that predators destroyed 7 of 8 nests on his study area in northern Alabama. Lewis (1973) and Speake et al. (1985) reported that predation was also the leading cause of mortality in turkey poults, and Kurzejeski et al. (1987) reported in a radiotelemetry study that predation was the leading cause of mortality in hens. Wakeling (1991) reported that the leading natural cause of mortality among older turkeys was coyote predation, with the highest mortality rate for adult females occurring in winter. Other researchers report that hen predation is also high in spring when hens are nesting and caring for poults (Speake et al. 1985, Kurzejeski et al. 1987, Wakeling 1991). Dumke and Pils (1973) reported that ring-necked pheasant (*Phasianus colchicus*) hens were especially prone to predation during the nest incubation period. In Minnesota, pheasant hatching success and brood production was more than doubled with an

intensive reduction of predators (Chessness et al. 1968). Trautman et al. (1974) stated that during a 5-year study in South Dakota, there was a 19% increase in ring-necked pheasant populations on areas with only fox PDM. During a second 5-year study in South Dakota, ring-necked pheasant populations increased 132% on areas with red fox, raccoon, badger, and skunk damage management (Trautman et al. 1974).

In documenting an extensive study of the effects of red fox predation on waterfowl in North Dakota, Sargeant et al. (1984) concluded that reducing high levels of predation was necessary to increase waterfowl production. Williams et al. (1980) reported that a 72% hatching success of wild turkey eggs following a predator poisoning campaign, but only 59% when predators were not poisoned. Balser et al. (1968) determined that PDM resulted in 60% greater production in waterfowl in areas with damage management as compared to areas without damage management. They recommended targeting the entire predator complex when conducting PDM, or compensatory predation may occur by one or more species not being controlled; this compensatory effect was also observed by Greenwood (1986).

Threatened and Endangered (T&E) Species

Predation can have a major impact on T&E species. Predation has been documented during black-footed ferret (*Mustela nigripes*) reintroductions in Wyoming, South Dakota and Montana (USDI 1995). Massey (1971) and Massey and Atwood (1981) found that the presence of predators alone can prevent least terns (*Sterna antillarum*) from nesting and cause them to abandon previously occupied sites. Mammalian predators were found to have significantly impacted the loss of least tern eggs on sandbars and sandpits (Kirsch 1996). Skunks (Massey and Atwood 1979), red foxes (Minsky 1980), coyotes (Grover and Knopf 1982), and raccoons (Gore and Kinnison 1991) are common predators of least terns. During a two-year study, coyote predation accounted for 25% to 38.5% of the mortality of nesting interior least tern (Grover 1979). In Massachusetts, from 1985-1987, predators destroyed 52-81% of all active piping plover (*Charadrius melodus*) nests (MacIvor et al. 1990). Red foxes accounted for 71-100% of the nests destroyed by predators at the site (MacIvor et al. 1990).

WGFD or USFWS may request assistance from WS-Wyoming to protect T&E or other species of concern. If a state or federal management agency finds that a particular species has been impacted by predation, WS-Wyoming could assist in determining whether PDM efforts could help protect the species and if so, implement any necessary management actions.

Summary

Based on research and experience, some state and federal wildlife management agencies have found that PDM can increase some wildlife populations where predation is affecting the ability of such populations to maintain or increase their densities (recruitment). It is also reasonable to assume that wildlife populations in areas where PDM is being conducted for protection of livestock could be receiving a benefit from those actions. It should, however, be emphasized that management of game animals and birds in Wyoming is the responsibility of WGFD. The WGFD has held that while in some situations predators may need to be managed to assist impacted wildlife populations, these cases are the exception and, in most cases, other population-limiting factors are most likely responsible for decreasing or downward-trending populations. The WGFD believes that PDM for protection of free-ranging wildlife populations may not be economical (Facciani 1997). PDM could be requested on a case-by-case basis when WGFD or

the USFWS determines predation is detrimental to management objectives, and WS-Wyoming would only respond after WGFD or the USFWS has made such a determination.

1.2.3 Need for Damage Management to Protect Public Health and Safety

HHS concerns include human attacks from mountain lions, bears, and coyotes that result in injuries or death; disease threats from rabies, tularemia, plague outbreaks where predators act as reservoirs and other zoonotic diseases (i.e., diseases that can be transmitted from wildlife to humans); odor and noise problems associated with nuisance skunks and raccoons under houses; and airstrike hazards from coyotes or other predators crossing runways at airports or military airbases.

1.2.3.1 Direct Threats Posed by Wildlife: Baker and Timm (1998), after several human-coyote interactions in southern California, concluded that the use of foot-hold traps to capture and euthanize a limited number of coyotes would be the best method to resolve the problem and yield long-lasting effects. After a child was killed by a coyote in Glendale, California, city and county officials trapped 55 coyotes in an 80-day period from within ½ mile of the home, an unusually high number for such a small area (Howell 1982). Predator attacks on humans occur very rarely, but could result in requests for assistance from WS-Wyoming under the current program.

Most human-bear conflicts fall into one of two categories: HHS and damage (*e.g.*, agricultural, nuisance). Black bears readily adapt to living in close proximity to humans. Grizzly bears are less adaptable and tolerant of humans, but can present problems in recreational areas (campgrounds, parks). Most non-agricultural conflicts in Wyoming occur in rural and urban residential areas, and recreational areas such as campgrounds. Usually there is one common denominator among human-bear conflicts: food. The diet of bears in urban and suburban environments includes both natural and anthropogenic foods. Conflicts with nuisance bears typically involve food located in garbage cans, bird feeders, storage sheds, or automobiles. If proper precautions are not taken, some of these attractants may concentrate bears and result in localized increases in human-bear conflicts. Access to foods provided by human activities can nearly double the reproductive potential of black bears (Rogers 1987). Wyoming has no specific state statutes or regulations prohibiting feeding of wildlife. However, there are several regulations that prohibit or limit baiting for purposes of hunting or trapping. Some municipalities in Wyoming have enacted ordinances that prohibit the feeding of waterfowl and deer within city limits (Cheyenne prohibits feeding waterfowl in city parks, while Lander, Sheridan and Rawlins prohibit feeding deer inside city limits). The most common resources related to agricultural conflicts involving black bears in Wyoming are commercial timber, vineyards, orchards, apiaries, and livestock. In some localized situations, damage may be extensive. Aside from livestock depredation by black bears, which is a fairly common occurrence in Wyoming, the only other conflict involving black bears that WS-Wyoming has dealt with was a 2008 incident of HHS related to a bear injured in a vehicle collision in a highway construction zone. Conflicts with grizzly bears in Wyoming are most commonly related to HHS (self-defense situations primarily involving the public) and livestock depredations. On average, 2.6

grizzly bears have been taken by the public in self-defense situations per year between 1990 and 2000 (Moody et al. 2005).

Human interactions with black bears can potentially occur wherever habitat or food sources overlap areas of human activity. Bears may become dangerous when they habituate to urban or residential locations, recreation areas such as campgrounds and picnic areas, or garbage dumps or refuse sites where food is easily obtained. These bears may become an attraction for local residents and tourists, posing potential HHS threats. Although black bear-human encounters are frequent, they can often be resolved by managing human behavior. There has been just one fatal black bear attack on humans in Wyoming; however, fatal black bear attacks have occurred more commonly in many U. S. states and in Canada (Herrero et al. 2011). In 2008, WS-Wyoming responded to 1 request for assistance from WGFD regarding HHS threats by black bears.

Although rare, mountain lion attacks on humans in the western United States and British Columbia have increased in the last two decades (Beier 1992, Riley 1998, Cougar Management Guidelines Working Group 2005, ODFW 2006). The increase in human fatalities is primarily due to increased mountain lion populations and human use of mountain lion habitats (Beier 1992, ODFW 2006). Fitzhugh et al. (2003) report there were 16 fatal and 92 non-fatal mountain lion attacks on humans since 1890 in the United States and Canada; of those, seven fatal and 38 non-fatal attacks have occurred since 1991. Since 2003, there have been four incidents in California: a fatal attack and three injuries (CDFG 2013) and three injuries in Colorado (CDOW 2006). An additional non-fatal attack occurred in Aspen, Colorado in 2016, involving a child. One additional fatal and non-fatal attack in Montana should have been included in the Fitzhugh et al. (2003) report (R. Desimone, Montana Fish, Wildlife, and Parks, pers. comm.). More recently, a fatal attack occurred in New Mexico in 2008 (NMGF 2008). No mountain lion-caused human fatalities have been documented in Wyoming. Despite an increasing number of both fatal and non-fatal human incidents in recent years in the western United States and British Columbia, mountain lion attacks on humans and pets in Wyoming are uncommon, and livestock depredations show a stable to slightly decreasing long term trend. WGFD has tracked mountain lion-human conflicts since 1996, and has documented aggressive encounters (lions “too close for comfort”) dating back to 1997. Only a few injuries sustained from mountain lion encounters have been noted in Wyoming in the last century. Mountain lion conflicts related to livestock depredation are sporadic, and are a function of local mountain lion and prey densities. Removal of the offending individual is the most effective technique to resolve mountain lion-human and livestock depredation incidents.

WS-Wyoming conducts limited PDM in Wyoming to address public concerns regarding HHS. Depending on the species and situation, WS-Wyoming generally recommends exclusion methods to reduce HHS concerns, although the immediate conflict animals are often removed. During FY2010-FY2014, WS-Wyoming addressed 172 HHS incidents related to the following species: badgers (1.2%), black bears (0.6%), grizzly bears (4.1%), feral cats (1.2%), coyotes (1.2%), red foxes (2.9%), mountain lions (3.5%), raccoons (6.4%), ravens (8.7%), striped skunks (61.6%), and wolves (1.2%) (MIS 2014).

WGFD is responsible for minimizing depredation to pets and livestock and reducing the potential for human harm in situations where black bears and mountain lions are considered a HHS concern (WGFD 2006) and has entered into a MOU and *Cooperative Agreement* with WS-Wyoming for assistance when and where necessary. Current protocols provide agency personnel with a variety of options to address conflicts ranging from no action to relocation of the offending animal to lethal removal. Agency personnel respond to and resolve incidents based on site-specific conditions. Management actions that target mountain lions and black bears that are a potential threat to HHS or are involved in livestock depredation incidents normally result in the lethal removal of the offending individual(s). In other cases, WGFD responds to nuisance black bear and mountain lion complaints by providing technical assistance and advice to individuals or property owners. When technical assistance does not resolve the problem, WGFD employs live-trapping and relocation or site-specific removal of the offending individual(s), determined on a case-by-case basis. In some situations, WGFD requests assistance from WS-Wyoming in these operations. Relocation of problem animals is the preferred management strategy; however, success is often dependent on the species, age and sex of the relocated animal. Relocated bears may return to their original location or create similar problems in their new location (Rogers 1986). Other WGFD management options include lengthening hunting seasons and increasing the number of hunting permits in areas experiencing black bear and mountain lion problems (WGFD 2006). WGFD will continue to document incident circumstances and outcomes. A "Protocol for Managing Aggressive Wildlife/Human Interactions", which includes mountain lions, was completed in 1999 (Moody et al. 1999). Major components of this protocol include procedures for reporting, documenting, and investigating incidents. This document is designed to aid WGFD in conducting investigations and assuring appropriate coordination with other state and/or federal agencies. Accurate reporting and periodic analysis of this information will improve understanding of the factors that promote conflicts and how to better address them. Reducing non-harvest mortality should allow for increased hunter opportunity through season/quota regulations. Nevertheless, in most instances, agency removal of specific individuals will be necessary to resolve specific depredation incidents. Striving for removal of only the offending individuals should help minimize losses, increase public acceptance, and maintain hunter opportunity (WGFD 2006).

1.2.3.2 Wildlife Disease Surveillance: WS collects animal tissue and environmental samples to assist agencies, tribes and institutions in surveillance for and research on diseases and parasites in wildlife. The majority of tissue samples are collected opportunistically from animals taken during operational PDM activities. The following material provides an indication of the types of requests for assistance addressed by the WS-Wyoming program. WS could conduct surveillance for additional pathogens of concern upon request provided that the methods used and associated impacts were within parameters considered in this EA.

Plague and tularemia surveillance has been ongoing in Wyoming since 2005. Because plague (especially) and tularemia (less importantly) are transmissible to humans (i.e., zoonotic diseases), the HHS implications of knowing the distribution and prevalence of these diseases in wild animals is important. Species like coyotes are considered sentinels

for diseases such as plague, because plague is not usually fatal to coyotes, and coyotes carry antibody titers (an indication of exposure to plague), for long periods of time; hence, even if an animal such as a coyote is not currently infected, its antibody titer will show that it has been exposed to plague at one time, and gives a better idea across time how common such diseases are. Of the 1,848 samples collected since 2005 for plague surveillance, >93% are from coyotes. Nearly 30% of these coyote samples were positive for antibodies to the plague bacteria (n=1,662 tested) and 12.3% showed antibodies to tularemia (n=978 tested).

Canine heartworm surveillance was conducted statewide from December 2007-March 2009. The objective of this project was to determine how common this parasite is in wild canids in Wyoming, and the associated risks to domestic dogs. During this time period, WS-Wyoming personnel examined a total of 549 wild canids (529 coyotes + 20 red fox), with a single positive confirmed. This single finding indicates that Wyoming is a low incidence state for canine heartworm.

Raccoon roundworm is a parasite that occurs in the intestinal tract of its major host, the raccoon. Humans, in general and small children in particular, are susceptible to raccoon roundworm infection via a fecal-oral transmission route. Such human infections are oftentimes fatal. Statewide surveillance for this disease helped define the risks associated with raccoon roundworm across Wyoming. Of 363 raccoons examined from Wyoming's 23 counties, 45% harbored this parasite (Pipas et al. 2014). Understanding the distribution and prevalence of this parasite in Wyoming, especially in and around highly populated areas, is an important step in educating the general public and medical community on the potential risks of raccoon roundworm infection.

Rabies is considered a priority disease for surveillance activities. This disease has occurred in Wyoming for many years. It was first detected in the state in domestic dogs in 1939, in skunks in 1957 and in bats in 1965. Rabies is endemic (established) in Wyoming, although its distribution is patchy. Skunks are the major reservoir of rabies in the state, and hence, the biggest threat of transmission. Historically, skunk rabies was commonly reported in Crook and Campbell counties in northeastern Wyoming. Campbell County still remains a stronghold for skunk rabies. In 2002, the Wyoming Legislature directed the Animal Damage Management Board (ADMB) to develop and implement a wildlife rabies management program. To comply with this directive, the ADMB signed a MOU with WS-Wyoming to provide skunk specimens from across the state to the Wyoming State Veterinary Laboratory (WSVL) in Laramie for rabies testing. WS-Wyoming employees are requested by their supervisors to submit a minimum of five striped skunks annually to comply with the surveillance protocol. In addition, Specialists occasionally submit suspect specimens (samples from strange-acting skunks). Such surveillance activities aid in alerting the public to zoonotic disease incidents, such as the recent rabies outbreak in Goshen County in southeastern Wyoming.

Hydatid disease, or echinococcosis, is caused by a parasitic tapeworm (*Echinococcus granulosus*) of wild and domestic canids and ungulates (deer, elk, moose, domestic sheep/cattle). Adult tapeworms reside in the small intestine of the definitive host, which includes a number of wild canids (coyotes, dogs, foxes). Eggs laid by the adults are

passed into the environment through the feces of the definitive host, where they are ingested by ungulate intermediate hosts. The next generation of tapeworms develops as fluid-filled cysts containing numerous immature forms of the tapeworm called protoscoleces. Hydatid cysts are found primarily in the lungs and liver of wild and domestic ungulates. Echinococcosis is a cosmopolitan, zoonotic disease. Humans are typically infected by ingesting eggs from canid feces, usually those of domestic dogs. Given the lack of information regarding the presence and distribution of this parasite in Wyoming, this survey will provide insight into the prevalence and zoonotic potential of this parasite, as well as potential impacts to wild ungulate (primarily deer/elk) populations. Through August 2016, 156 coyotes and 5 red foxes sampled in Wyoming tested negative for this parasite, whereas 12 of 16 wolves and 1 coyote from Wyoming were positive for *Echinococcus* sp.

Avian influenza is a viral disease that primarily infects wild and domestic birds, but it also can be transmitted to a variety of mammals. In 2006, the United States of America Departments of Agriculture and Interior designed a large-scale, interagency surveillance effort that sought to determine if highly pathogenic avian influenza viruses were present in wild bird populations within the United States of America. Species groups that were targeted included waterfowl, gulls and shorebirds. This early detection system was implemented on a national scale from April 1, 2006 through March 31, 2011 (Bevins et al. 2014). During this sampling period, WS personnel and other entities sampled 1570 birds in Wyoming. No H5N1 highly pathogenic avian influenza viruses were detected in either Wyoming or in the United States during the course of this surveillance effort.

In 2014 and early 2015, a marked increase in mortality of domestic poultry in Canada and the United States was attributed to a variety of highly pathogenic avian influenza viruses detected in wild birds in the United States. Although these viruses are not known to have caused disease in humans, their appearance in North America could increase the likelihood of human infection in the United States, and it is uncertain as to whether these Eurasian origin H5 viruses and their progeny will persist within the North American wild bird population. In response to these detections, United States government officials developed a comprehensive wild bird surveillance plan for avian influenza viruses that may pose a threat to public health or domestic poultry. The resultant surveillance plan, which focuses on sample collection at the watershed level, calls for active surveillance of apparently healthy dabbling ducks on a national scale, along with continued passive surveillance of morbidity and mortality events of any species. During the first year of the surveillance effort, of 180+ birds sampled in Wyoming, just 4 birds (all dabbling ducks) tested positive for avian influenza viruses; none of these viruses were highly pathogenic strains.

1.2.3.3 Airport Hazard Management: Airports provide ideal conditions for many wildlife species due to the characteristic expansive grass-dominated landscapes. Because access to most airport properties is restricted, wildlife living within airport boundaries are protected during hunting and trapping seasons and are insulated from many other human disturbances.

Table 1-8. Number of Work Tasks to Addresses Predator Damage and Conflicts in Wyoming by Resource Protected, FY2010-FY2014 (MIS 2014).*

	Resource											
Fiscal Year / Species	**Agriculture**						**HHS**					
	2010	**2011**	**2012**	**2013**	**2014**	**Total**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
American Crow	0	6	4	5	5	20	1	0	0	0	1	2
Badger	123	48	47	25	9	252	10	4	15	0	0	29
Black bear	87	89	133	60	282	651	3	2	0	1	1	7
Black-billed Magpie	0	1	3	3	3	10	0	0	0	0	0	0
Bobcat	165	90	72	46	15	388	0	1	0	0	0	1
Common raven	167	128	272	402	388	1,357	0	25	19	55	72	171
Coyote	17,166	15,504	16,510	15,406	16,246	80,832	0	12	26	20	4	62
Eagle, Golden and Bald	9	8	7	7	6	37	0	0	0	0	0	0
Feral cat	1	29	87	38	15	170	7	31	9	9	20	76
Mink	0	0	0	0	0	0	0	0	0	0	0	0
Mountain lion	119	119	188	145	182	753	6	15	12	0	0	33
Red fox	893	733	872	620	1,221	4,339	7	0	3	1	34	45
Raccoon	1,870	1,387	1,489	1,678	1,959	8,383	672	379	278	132	225	1,686
Striped skunk	163	227	507	417	310	1,624	1,376	873	426	451	791	3,917
Weasel	0	0	0	0	0	0	0	0	0	0	0	0
Total	**20,824**	**18,398**	**20,263**	**18,907**	**20,651**	**99,043**	**2,093**	**1,343**	**788**	**669**	**1,147**	**6,040**

* A Work Task is defined as a single visit to a property or contact by WS-Idaho personnel to provide technical assistance, to conduct a wildlife damage field evaluation/assessment/investigation, or where a PDM activity/project is in progress. The number of work tasks serves as an index of the intensity of effort needed by WS personnel to address incidents involving the species in question.

Table 1-8 (con't.) Number of Work Tasks to Addresses Predator Damage and Conflicts in Wyoming by Resource Protected, FY2010-FY2014 (MIS 2014). *

	Resource											
Fiscal Year / Species	**Natural Resources**						**Property**					
	10	**11**	**12**	**13**	**14**	**Total**	**10**	**11**	**12**	**13**	**14**	**Total**
American Crow	0	0	1	1	0	2	1	0	0	0	1	2
Badger	0	0	7	152	135	294	19	24	7	10	26	86
Black bear	0	0	0	0	0	0	0	0	0	0	0	0
Black-billed Magpie	0	0	0	0	0	0	0	1	0	0	1	2
Bobcat	2	19	14	204	119	358	0	1	1	0	0	2
Common raven	15	105	55	199	318	692	20	17	2	15	17	71
Coyote	1,250	1,904	2,215	2,082	2,244	9,695	17	6	25	2	15	65
Eagle, Bald and Golden	0	2	3	4	4	13	0	0	0	0	0	0
Feral cat	49	46	21	12	10	138	43	32	48	25	55	203
Mink	0	0	0	0	0	0	0	0	0	0	0	0
Mountain lion	0	2	1	0	0	3	2	1	0	0	0	3
Raccoon	752	574	412	601	491	2,830	644	309	210	208	293	1,664
Red fox	254	176	193	236	520	1,379	38	38	7	7	17	107
Striped skunk	430	395	371	371	389	1,956	243	90	174	149	161	817
Weasel	0	0	0	0	0	0	0	0	0	0	0	0
Total	**2,752**	**3,221**	**3,289**	**3,857**	**4,226**	**17,345**	**1,026**	**520**	**474**	**416**	**586**	**3,022**

* A Work Task is defined as a single visit to a property or contact by WS-Idaho personnel to provide technical assistance, to conduct a wildlife damage field evaluation/assessment/investigation, or where a PDM activity/project is in progress. The number of work tasks serves as an index of the intensity of effort needed by WS personnel to address incidents involving the species in question.

Predator species addressed in this EA, such as coyotes, red foxes and raccoons, can pose a direct threat to planes, both landing and taking off, although overall risks are low. On a national scale, during the time period 1990-2014, there have been 469 strikes involving civil aircraft and coyotes, 142 involving red foxes and 102 with raccoons. For these species, 106 strikes had a negative effect on flight (e.g., aborted takeoff, aircraft delays while planes were checked for damage) and 52 strikes resulted in damage to the aircraft (Dolbeer et al. 2015). It is estimated that only 20 to 25% of all bird strikes are reported (Conover et al. 1995, Dolbeer et al. 2011, Linnell et al. 1996, Linnell et al. 1999), and most likely, mammal strikes are also underreported. Reported damage to aircraft associated with these strikes was over $3.8 million, with the majority of damage resulting from strikes involving coyotes. These are strikes that have occurred despite the fact that most airports are implementing measures to reduce risks of wildlife strikes. The civil and military aviation communities have acknowledged that the threat to HHS from aircraft collisions with wildlife is increasing (Dolbeer et al. 2011). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety, result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995). There have been no strikes in the national database resulting in injuries to people that involve the predator species listed in this EA, although any time a strike results in damage to an aircraft, a HHS risk exists.

WS receives requests for assistance with wildlife damage management at civil airports and military airfields in Wyoming. WS provides assistance at airports in Wyoming with the management of these wildlife problems via technical assistance (hazard assessments and advice and training on hazard management) or direct removal of mammals/birds from the airfields. Examples of wildlife damage management at airports include the removal of birds and mammals from hangars and other buildings as well as lethal removal of mammals and birds crossing runways and taxiways. Airports in the state of Wyoming have reported just one terrestrial mammal strike between 2010 and 2015, involving a badger (FAA National Wildlife Strike Database 2016). WS-Wyoming commonly follows procedures recommended in the publication: "Wildlife Hazard Management at Airports: a Manual for Airport Personnel" (Cleary et al 2005). WS-Wyoming involvement in wildlife hazard management primarily consists of the creation of airport wildlife hazard risks assessments and providing technical assistance on strategies to reduce hazards to aircraft.

1.2.4 Need for Predator Damage Management for Protection of Crops

Field Crops: In Wyoming, field crops such as sunflowers and corn (field and sweet) have been damaged by raccoons, ravens and skunks. From FY2010-FY2014, a total of 39 incidents have been reported or verified, valued at $36 (MIS 2014). Loss values are consistently assigned only to verified cases of damage. Because only one of these 39 cases was verified, the true monetary value is undoubtedly much higher. Fruit (grape, apple) and garden crops have not sustained damage by any predators during the FY2010-FY2014 period.

Livestock Crops/Feed: Predators occasionally cause damage to livestock crops (alfalfa and grass hay) and feed. Burrowing activity in improved or planted pasture attributed to badgers can hamper the use of, or damage, planting and mowing equipment. Predators also cause damage to

livestock crops and feed by direct consumption or contamination, either while the crops are growing, or after harvest. A total of 39 incidents of predator damage to livestock crops and feed in Wyoming were reported or verified during FY2010-FY2014, valued at a total of $540 (MIS 2014). This is a minimum figure, given that loss values were assigned to only 31 of the 39 incidents. These losses have been attributed to badgers (alfalfa fields), raccoons (hay bales, silage, livestock feed) and ravens (hay bales).

1.2.5 Need for Predator Damage Management for Protection of Property

WS-Wyoming responds to requests from permittees, landowners and other individuals to alleviate property damage from black bears breaking into and destroying the interiors of homes or other structures; coyotes and mountain lions killing pets; raccoons causing damage to drip irrigation systems by biting holes in the pipe; raccoons and skunks burrowing into or under homes to den; and badgers, skunks, or raccoons causing damage to landscaping, gardens, or golf courses from feeding activities. From FY2010- FY2014, an average of 604.4 incidents of predator damage to property was reported to or verified by WS-Wyoming, with an average loss per year of $79,331 (MIS 2014). Raccoons accounted for 55.1% of the incidents, striped skunks 27.0%, feral cats 6.7% and red foxes 3.5%. In addition, 18 pets (companion/hobby animals) and guard animals were predated or injured during this time period by coyotes, mountain lions, feral dogs, feral cats and striped skunks, at a combined value of $4,150 (MIS 2014). Table 1-8 summarizes requests for predator damage assistance for confirmed and reported damage in Wyoming by FY for the different resource categories.

1.3 Predators in Wyoming That Cause Damage

To effectively address wildlife damage management issues, it is important to be familiar with the ecology of the species of concern. Full accounts of life histories for these species can be found in mammal reference books and field guides. Some background information is given here for each species in Wyoming discussed in this EA, especially information pertaining to their densities, reproductive capabilities and range. The species are discussed in order of relative importance in reference to economic loss.

Coyote: By state statute, [Wyoming Statutes Annotated (WYSA) §23-1-101(a) (viii) (A)], coyotes are classified as predatory animals and can be taken year round. Coyotes cause the most damage (primarily livestock depredation) of any of the predators WS-Wyoming deals with in Wyoming and, therefore, are the major focus of WS-Wyoming damage management efforts.

Coyotes were once found primarily in western States, but have expanded their range to much of North America. Coyotes are extremely adaptable and generalists in both diet and habitat, equally at home in the Arctic tundra or in urban areas. They are very common in Wyoming and occur statewide. To discuss the impacts of various environmental constraints and external factors on coyote populations, it is essential to understand the basic mechanisms that play a role in the coyote's response to these environmental and other factors, keeping in mind that the coyote has a strong ability to adapt to adverse conditions and persevere.

Determinations of absolute densities for coyote populations are frequently limited to educated guesses (Knowlton 1972). Coyotes are highly mobile animals with home ranges (territories) that vary seasonally and with the sex and age of the animal (Todd and Keith 1976, Althoff 1978, Pyrah 1984). The literature

on coyote spatial organization is complex (Messier and Barrette 1982, Windberg and Knowlton 1988). Coyote population densities vary depending on the time of year, food abundance, and habitat characteristics. Coyote densities have ranged from a low of 0.39/mi^2 during the period of the annual cycle when populations are lowest (just prior to pup birth) to a high of 3.55/mi^2 immediately following whelping (Pyrah 1984, Knowlton 1972). Coyote home ranges may vary from 2.0 mi^2 to 21.3 mi^2 (Andelt and Gipson 1979, Gese et al.1988). Other research by Ozoga and Harger (1966), Edwards (1975), and Danner (1976), documented a wide overlap between coyote home ranges and did not consider them territorial.

Each occupied coyote territory may have several nonbreeding helpers at the den during whelping (Allen et al. 1987, Bekoff and Wells 1982). Therefore, each defended coyote territory may have more than just a pair of coyotes. Messier and Barrett (1982) reported that from November through April, 35% of the coyotes were in groups of three to five animals and Gese et al. (1988) reported that coyote groups of 2, 3, 4, and 5 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 efforts to estimate abundance (Danner and Smith 1980). For example, a positive relationship was established between coyote densities in mid-late winter and the availability of dead livestock (Roy and Dorrance 1985).

Black Bear: The black bear is distributed throughout much of the United States, except the Desert Southwest and Midwest agriculture region and Canada, and south through interior Mexico (Larivière 2001). Black bear populations are stable or increasing across most of their range, with a North American estimate of between 750,000 and 918,000 (estimated by Herrero et al. 2011). The distribution and abundance of black bears is somewhat limited in Wyoming. Black bears primarily utilize habitats on lands administered by USFS, NPS, and BLM, although some habitat does exist on private lands, either directly adjacent to public lands or along riparian habitats (WGFD 2007). Suitable habitat in Wyoming is typically more arid than in other western states. As such, the production and availability of preferred bear foods is lower, resulting in larger home ranges and lower bear densities (Mack 1988, Goodrich 1990, Beck 1991, Beecham and Rohlman 1994, Grogan 1997).

Bears are adaptable, curious, and capable of rapid learning, have excellent long-term memories and exhibit a wide degree of behavioral "plasticity" (*i.e.*, ability to adapt their behavior to changing circumstances). These behavioral characteristics are integral to understanding and managing many problem bear situations. Vocalizations, gestures, and mock charges are typical expressions of frustration, conflict, and stress. Food-seeking bears are conflicted between the desire to approach or to flee ("fight or flight"). Their drive to attain food is strong but frustrated by their close approach to people. They also have the ability to learn from a single experience. In Yosemite, once bears had fed on human foods, the animals were more neutral towards people and demonstrated less fear than would be expected, thus more habituated to people and also conditioned to human foods.

Black bears are usually sexually mature at 3.5 years of age, but some females may not breed until 4.5 years and the average age to first reproduction in Wyoming is 5.2 years (Graber 1981, Kohn 1982, WGFD 2007). Age of first reproduction will be higher in areas with limited food supplies and/or high bear densities relative to available foods. Mating generally occurs in June and July, implantation is delayed until late November to early December, and gestation is generally 60–70 days (Wimsatt 1963, Eiler et al. 1989, Hellgren et al. 1997). Litter size ranges from one to four; in comparison to black bears in the eastern U.S., black bears in the western United States generally have 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 typical of black bears (LeCount 1982). Cubs stay with their mothers 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). At continental scales, there is evidence that differences in survival and reproductive rates exist, with adult bears in western North America having higher survival and lower productivity than adult bears in eastern North America, which tend to have lower survival but are more productive (Beston 2011). 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 10-20% per year (Fraser et al. 1982). Population density varies between 0.3-3.4/mi^2, depending on habitat.

Adult black bears have few natural predators, but young bears may be killed by mountain lions, bobcats, coyotes, or by other black bears (Larivière 2001).

Although black bears are classified in the taxonomic Order Carnivora, they are more properly considered omnivores, eating a wide variety of plants and animals. 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 to bears for storing fat prior to hibernation. When available, bears will catch and consume deer fawns and elk calves, and feed on carrion (Bull et al. 2001, Larivière 2001). Invertebrates also provide a consistent source of protein for bears throughout the year (Bull et al. 2001). In areas near human dwellings, bears may be attracted to anthropogenic food sources, including garbage, bird feeders, gardens, orchards, livestock and livestock feed and beehives.

The black bear is classified as a trophy game animal by Wyoming statute, with management and regulated hunting seasons established by management units (WGFD 2007). Wyoming statutes currently provide monetary compensation for damage to livestock, bees, honey, and hives caused by black bears (WYSA §23-1-901) and allow a property owner, employee, or lessee to kill a bear causing damage to private property. WGFD is mandated to respond to black bear conflicts involving livestock depredation, personal property and HHS. WS-Wyoming receives occasional requests for assistance from WGFD to remove bears that have killed livestock (*i.e.*, sheep and lambs) or threatened HHS. Damage to sheep and beehives accounted for the majority of WGFD reimbursements between FY 2006 and FY 2015; the amount of compensation paid fluctuates annually, as does the total number of claims submitted annually (WGFD 2016).

The WGFD uses a range of harvest criteria to assess harvest impacts on black bears in Wyoming. These include the percent of adult males in the harvest, the percent of females in the harvest and the percent of adults in the female segment of the harvest. The WGFD also uses a female quota system to regulate harvest of black bears in Wyoming. Therefore, all human-caused female mortalities are used for consideration of total desired removal. In addition to harvest criteria, WGFD monitors annual average human-caused black bear mortality per area of suitable habitat (bears harvested/100 km^2/year) for each hunt area. This density provides WGFD an index of more localized impacts of human-caused mortality on black bear populations.

All management actions addressing black bear damage will be conducted according to the protocols outlined in the "Statewide Protocol for Managing Aggressive Wildlife/Human Interactions" (WGFD 1999). The WGFD uses a variety of options to deal with black bear damage. These include no action,

information and education, proper storage of food and/or garbage, repellents, electric fencing, aversive conditioning, translocation and lethal removal. Additionally, all conflicts will be documented in the Department's Trophy Game Incident Database. All management actions involving a human injury due to an encounter with a black bear will be conducted according to the protocols outlined in WGFD (1999).

Grizzly Bear: The grizzly bear's historic range covered much of North America from the Great Plains westward to California and from central Mexico north through Canada and Alaska. Today, the grizzly is found in only about 2% of its original range in the lower 48 states. Currently, south of Canada, there are grizzly bear populations in Wyoming, Washington, Idaho, and Montana. Grizzlies are difficult to survey, yet it is generally agreed there are more than 1,000 in the northwest Montana Rockies, about 750 in and around Yellowstone National Park, about 50 in the Selkirk Mountains of northern Idaho and northeastern Washington, and 30 to 40 in the Cabinet-Yaak area of northern Idaho and western Montana. Probably less than a dozen grizzlies survive in the North Cascades. There are about 22,000 grizzlies in Canada and more than 30,000 in Alaska.

Grizzly bears are normally active at night and during twilight hours. They have poor eyesight but excellent hearing and smell. Except for females with cubs, grizzlies are normally solitary animals. Every other year, females produce one to four young (usually two). A sow is protective of her offspring and will attack if she thinks she or her cubs are threatened. Occasionally, grizzlies will attack without apparent provocation.

Grizzlies are omnivores; plant and animal components of the diet vary in relation to the availability of local food sources, which typically vary on a seasonal basis. They are also opportunistic feeders and will prey or scavenge on almost any available food, including ground squirrels, ungulates, livestock, carrion, and garbage. In areas where animal matter is not as abundant, roots, bulbs, tubers, fungi, and tree cambium play varying roles in meeting protein requirements. High quality foods such as berries, nuts, and fish are important in some geographic areas. During years with poor natural food production, many grizzlies move out of secure habitat to elevations/areas where they are more likely to come into conflict with people, livestock, and property. Most grizzly bear-human conflicts in Wyoming in 2014 were a result of domestic livestock depredations and food rewards from humans in the form of garbage, pet food and livestock feed. Long-term trends in the number of conflicts is likely a result of grizzly bears increasing in numbers and expanding into locations used by humans, including livestock production areas on public and private lands (Moody et al. 2005).

Mountain Lion: The mountain lion is the largest North American feline, with the widest distribution of any New World mammal. It is very common in the western United States, including Wyoming. Other names for this large cat include cougar, panther, catamount, and puma. Mountain lions inhabit an array of habitats from desert to alpine environments, indicating a wide range of adaptability. They are closely associated with deer and elk because of their dependence upon these species as prey.

Mountain lions are managed by WGFD as a trophy game animal and as the management authority for this species, it is the responsibility of WGFD to minimize mountain lion depredation to pets and livestock and reduce the potential for human harm (WGFD 2006); these objectives are generally accomplished through site-specific removal of offending individuals. These types of management actions (*i.e.*, lethal removal, relocation) are taken into account when analyzing mountain lion population demographics and during the development of mortality limits on a hunt area and management unit level (Thompson 2013). WS-Wyoming responds to requests from WGFD for assistance with livestock depredations caused by mountain lions and HHS-related conflicts.

Female mountain lions typically breed for the first time between 22 and 29 months of age (Ashman et al. 1983), but the age of first breeding may be delayed (Hornocker 1970). Mountain lions breed and give birth year-round but most births occur during late spring and summer following a 90-day gestation period (Ashman et al. 1983, Seidensticker et al. 1973, Robinette et al. 1961). Females can produce one to six offspring per litter; the average is between two and three young per litter. Results of reproductive surveys of 435 female mountain lions examined by ODFW personnel between 1995- 2003, 5% of age class 1, 51% of age class 2, 95% of age class 3, 88% of age class 4, 89% of age class 5, 96% of age class 6, and 100% of all females age 7 and older had successfully reproduced (ODFW 2006).

Mountain lion density is related closely to prey availability and intraspecific competition (social tolerance of other mountain lions). Prey availability is directly related to prey habitat quality that directly influences mountain lion nutritional health, reproduction and mortality rates. Studies indicate that as available prey increases, so do mountain lion densities. As mountain lion population density increases, mortality rates from intra-specific fighting and cannibalism also increase, and/or lions disperse into unoccupied or less densely occupied habitat. The relationship of the mountain lion to its prey and to other mountain lions explains why mountain lion densities do not reach levels observed in other wildlife species (ODFW 2006). It is also why mountain lions disperse into nontraditional mountain lion habitat and cause conflicts (Bodenchuk and Hayes 2007). Shaw (1981) presented evidence that livestock (sheep and calves) provided a supplemental prey base that supported mountain lions through seasonal declines in their primary prey (deer). This contributed to the creation of an artificially high lion population density in the study area.

Mountain lions occur statewide in Wyoming. For management purposes, WGFD has established five MLMUs, which encompass the entire state. Each of these is comprised of between 4 and 11 mountain lion hunt areas. WGFD does not estimate mountain lion numbers to manage populations. Rather, population trends are assessed through sex and age composition of mortality data in 3-year management cycles (Thompson 2013). Management objectives for MLMUs and hunt areas are then determined by balancing public demands (*i.e.*, human/lion interactions, livestock depredation, hunting/viewing opportunity) and biological requirements for sustainable lion populations across the landscape. The Wyoming Mountain Lion Management Plan (WGFD 2006) supports an adaptive management process, enabling WGFD personnel the ability to evaluate management changes as they occur by sustaining mountain lion populations in core habitat at varying densities depending on management objectives across the State. This key feature of the plan enables WGFD to address issues related to mountain lion depredation to pets and livestock and the potential for human harm (WGFD 2006); such conflicts are generally addressed through site-specific removal of offending individuals or relocation. Because the WGFD maintains a zero-tolerance policy for confirmed mountain lion livestock depredation, this strategy continues to be an effective and viable management tool for maintaining mountain lion populations at desired objectives.

Red Fox: The red fox is found throughout much of North America, Europe, Asia and North Africa, and was introduced into Australia in the nineteenth century. In areas of abundant food resources, published estimates of red fox densities have been as high as 50/mi^2 (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986). In Ontario, population densities were estimated at 2.6/mi^2 (Voigt 1987). Sargeant (1972) reported red fox territories of 1-3 mi^2, depending on population density.

In Wyoming, the red fox is classified as a predator by state statute (WYSA §23-1-101(a) (viii) (A)), and as such, is not afforded any protection by law. Red fox predate smaller livestock, primarily poultry and lambs, and cause occasional property damage. From FY2010-FY2014, WS-Wyoming received an average of 24.2 complaints regarding red fox, resulting in an average loss of $3,753 per year (MIS 2014).

Bobcat: The bobcat is found in much of the US, southern Canada, and south through most of Mexico, but is most abundant in the western US. This species is typically associated with brushy, rocky and wooded areas, rimrock and chaparral habitat, and can also be found in forested habitats. It is fairly common throughout Wyoming. The bobcat reaches reproductive maturity at 9 to 12 months of age and may have 1-6 kittens following a 2-month gestation period (Crowe 1975, Koehler 1987). Bobcat population densities range from $0.1/mi^2$ to $7/mi^2$ (Rolley 1999) and individuals may live up to 14 years, but annual mortality can be as high as 47% (Rolley 1985).

In Wyoming, the bobcat is classified as a furbearer under state statute, with management responsibility by WGFD (WYSA §23-1-101(a) (iii). Reported and verified damage caused by bobcats in Wyoming from FY2010 through FY2014 occurred to lambs and poultry (chickens, geese, guinea fowl), with total value of these losses $1,062 (MIS 2014). Bobcat depredation problems in Wyoming are localized, and consequently, are a minor component of WS-Wyoming duties.

Striped Skunk: The striped skunk is the most common member of the skunk family (*Mephitidae*). It is found throughout southern Canada, the United States and northern Mexico. This species is generally considered abundant throughout its range and has increased its geographical range in North America following large scale historical forest clearing. The striped skunk is considered a habitat generalist (Rosatte 1987), capable of living in a variety of environments, including woodlands, plains, riparian thickets, agricultural lands and urban areas.

The home range of the striped skunk is not sharply defined over space and time, but is altered to accommodate life history requirements such as raising young, winter denning, feeding activities, and dispersal (Rosatte 1987). Home ranges reported in the literature averaged between 0.85 to 1.9 mi^2 for striped skunks in rural areas (Houseknecht 1971, Storm 1972, Bjorge et al. 1981, Rosatte and Gunson 1984). The range of skunk densities reported in the literature varied from 0.85 to $67/mi^2$ (Ferris and Andrews 1967, Verts 1967, Lynch 1972, Bjorge et al. 1981). Many factors may contribute to these widely divergent population density estimates. Habitat factors, food availability, diseases, season of the year, and geography are but a few of the possible factorss (Storm and Tzilkowski 1982).

The striped skunk is classified under state statute as a predator in Wyoming [WYSA §23-1-101(a) (viii) (A)]. Striped skunks primarily cause odor problems in residential areas; additionally, they can transmit rabies to humans and domestic animals, and sometimes prey on poultry and their eggs. Skunks are primarily targeted reactively to address these types of problems. Striped skunk management actions by WS-Wyoming are directed primarily at nuisance individuals; additionally, WS-Wyoming has conducted rabies surveillance in Wyoming since 2004 and has assisted in numerous research projects related to rabies management strategies.

Spotted Skunk: Spotted skunks are diminutive members of the family Mephitidae. They are strongly nocturnal and eat a wide variety of plant and animal material (fruits, berries, corn, carrion, voles, mice, birds, eggs) (Clark and Stromberg 1987). In Wyoming, two subspecies of the spotted skunks occur: the eastern spotted skunk (*Spilogale putorius interrupta*) and the western spotted skunk (*S. gracilis gracilis*). The eastern subspecies is found in the eastern quarter of Wyoming, generally near streams and rivers, but also in the vicinity of human habitations. The western subspecies occurs in the western three-fourths of the state and prefers dry grass and shrub habitats (Clark and Stromberg 1987). Currently (as of 2016), the WGFD and University of Wyoming are engaged in research to document the distribution, abundance, and genetic similarities between these two subspecies.

Similar to the striped skunk, the spotted skunk is classified under state statute as a predator in Wyoming [WYSA §23-1-101(a) (viii) (A)]. Damage caused by this species is similar to that attributed to striped skunks (odor problems in residential areas; rabies transmission to humans and domestic animals, predation on poultry and their eggs), but is less frequently reported. Skunks are primarily targeted reactively to address these damage issues. Management actions by WS-Wyoming are directed primarily at nuisance individuals.

Raccoon: The raccoon is widely distributed in North America, except in Canada and the Rocky Mountain and Great Basin regions of the US. The raccoon is highly adaptable. Although it is typically associated with forested habitats, it is especially common in urban areas. It is omnivorous, feeding on carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, a wide variety of grains, fruits, and plants, and most foods of anthropogenic origin (Sanderson 1987).

The raccoon is classified by state statute as a predator in Wyoming, and therefore, is afforded no legal protection (WYSA §23-1-101(a) (viii) (A)). Raccoon damage problems involve predation on domestic fowl, damage to crops, and HHS concerns. WS-Wyoming responds to occasional requests from the public for assistance resolving conflicts with nuisance raccoons in residential areas.

Feral Cat: Feral cats are fairly common in Wyoming and across North America. Cats are not native to North America; therefore, native wildlife did not evolve defense strategies against this efficient predator. Domesticated in Egypt around 2,000 BC, cats were introduced to North America with the arrival of European settlers. Today, cats are considered to be the most widespread terrestrial carnivore on earth, with more than 90 million pet cats in the US alone, making cats the most popular pet in the country. The number of outdoor pet cats, strays, and feral cats in the United States alone totals approximately 117 million to 157 million individuals (Dauphiné and Cooper 2011). The sheer number of feral cats on this continent makes predation on wildlife a serious conservation issue.

Cats are prolific breeders, with females capable of having up to three litters per year, with 4-8 kittens/litter. Unlike many native predators, cats are not strictly territorial. As a result, cats can exist at much higher densities and often outcompete native predators. Unvaccinated free-roaming cats can spread deadly diseases such as rabies, feline leukemia and distemper to wild cats and other wildlife and cats are the most common carriers of rabies among domestic animals.

Studies of feral cats show that approximately 60 to 70% of prey items are small mammals, 20 to 30% are birds, and the remainder are amphibians, reptiles, and insects. However, these figures vary by individual cat, time of year, and availability of prey. Birds that nest or feed on the ground are the most susceptible to cat predation.

Complaints involving feral cats are most commonly related to predation on poultry and native wildlife species. Feral cats are classified as a predator under Wyoming statute, and hence, is afforded no legal protection or management direction (WYSA §23-1-101(a) (viii) (A)). Primary responsibility for feral cat control rests with county and local authorities. WS-Wyoming responds only to requests from these entities as well as state and county health departments. WS-Wyoming personnel are authorized to control feral cats to protect livestock, poultry, natural resources and HHS when requested by the appropriate authorities.

Badger: The badger is found throughout most of the western US in plains and deserts, foothills and mountain meadow habitats at moderate densities. Little is known about badger densities other than for a few intensely studied populations. Lindzey (1971) estimated that the Curlew Valley on the Utah-Idaho

border supported 1/mi^2 and Messick and Hornocker (1981) found 13/mi^2 in southwestern Idaho. Although results have varied somewhat among these and other studies, densities have ranged from 0.98-12.95 badgers/mi^2. Home range sizes of adults averaged 1.6 km^2 and 2.4 km^2 for females and males in Idaho (Messick and Hornocker 1981) and from 1.4 km^2 to 6.3 km^2 in Utah (Lindzey 1978). Home ranges of two radio-tracked females in Minnesota were 8.5 km^2 and 17.0 km^2 (Sargeant and Warner 1972, Lampe and Sovada 1981).

Badgers are classified as a furbearer species in Wyoming, managed by the WGFD (WYSA §23-1-101(a)(iii). WS-Wyoming occasionally receives requests for assistance to resolve damage from badgers to rangeland, pasture, and cropland.

Porcupine: The porcupine is the second largest rodent in North America and the only member of the family *Erethizontidae* north of Mexico (Zeveloff 1988). It occurs throughout northern North America to the central Great Plains and south along the Rocky Mountains to northern Mexico, and throughout Wyoming in favorable habitat (Clark and Stromberg 1987). This large, solitary, slow-moving rodent is characterized by an armored coat of up to 30,000 barbed quills (Zeveloff 1988). A long tail and strong, curved claws and tubercles on the soles of the naked feet are all adaptations for climbing.

Porcupines are habitat generalists, occurring in forests, grasslands, sagebrush grasslands, tundra, vegetated riparian areas and even deserts (Clark and Stromberg 1987). Their diet consists of a variety of plants (forbs and woody plants) during the summer, but in winter is restricted to conifer needles and the inner bark of trees (Zeveloff 1988). They can cause extensive damage to trees, earning this species a bad reputation as a forest pest. Economic losses can be considerable where porcupines damage commercial timber, high-value ornamental plantings, fruit trees in orchards and nursery plants by virtue of their girdling, basal gnawing, or branch clipping activities (Schemnitz 1994). Additionally their salt drive, a metabolic requirement for maintaining sodium balance in the body (Roze 1989), results in damage to a variety of anthropomorphic materials, including handles of tools and wood siding on cabins and houses. Porcupines do not hibernate, but, in temperate climates, may den (singly or communally) for periods of time in the winter, using caves, rock formations, logs or trees as denning sites (Zeveloff 1988).

Unlike most rodents, the porcupine mates during the fall and into early winter. After a long gestation period of 205-217 days, the female gives birth to typically one young (Zeveloff 1988). Newborns are precocial, their quills hardening and becoming functional within a few hours of birth; additionally, the young can climb shortly after birth (Clark and Stromberg 1987).

Porcupines are classified as a predator species in Wyoming under WYSA §23-1-101(a) (viii) (A). WS-Wyoming occasionally receives requests for assistance to resolve damage to property by porcupines.

Virginia Opossum: Opossums are cat-sized marsupials, the only marsupial occurring north of Mexico (Seidensticker et al. 1987). They frequent the eastern and central U.S. and are also found in parts of the southwestern U.S., Oregon, and Washington (Jackson 1994, National Audubon Society 2000). Adults range in size from less than 2 lbs. to about 13 lbs., depending on sex and time of year; they grow throughout life (Seidensticker et al. 1987). They have a fairly broad range of pelage colors, but are usually considered as "gray" or "black" phase. Their fur is grizzled white above; long white hairs cover black tipped fur below. They climb well and feed on a variety of foods, including carrion. In addition, these animals eat insects, frogs, birds, snakes, small mammals, earthworms, and berries and other fruits; persimmons, apples, and corn are favorite foods (National Audubon Society 2000). The opossum's home range varies from 10-50 acres (Jackson 1994), but they will concentrate in smaller core areas seasonally when fruits abound (Seidensticker et al. 1987).

Opossums were introduced from the eastern U.S. to areas along the Pacific Coast during the early 1900s, and have expanded their geographic distribution northward into southern Canada in the last 30 years. Current populations in the Great Plains and the Rocky Mountains are the result of transplants (Gardner 1982). In Wyoming, opossums are restricted to a small area of Goshen County and adjacent Platte County in eastern Wyoming. The fossil record clearly suggests that the opossum is a southern species that recently arrived in Wyoming (Clark and Stromberg 1987). The opossum is truly a generalist species in that it thrives in a variety of habitats and, as an omnivore, can utilize most any food item. The reproductive season of the opossum typically occurs from December to February, depending on latitude, and extends into November (Gardner 1982). Gestation is relatively short, averaging 12.8 days, and 1-14 (National Audubon Society 2000) or 1-17 (Gardner 1982) young are born in an embryonic state. The young climb to the marsupium (pouch) on the mother's belly, attach to the teats, and begin to suckle. They remain in the pouch for about 2 months, at which time they begin to explore and may be found traveling on their mother's back with their tails grasping hers (Whitaker and Hamilton 1998). Opossums live for only 1-2 years, with as few as 8% of a population surviving into the second year. The mean density indicated by Seidensticker et al. (1987) was 3.9 per 2.4 mi^2.

Weasel: Weasels are voracious predators, and for their size, will kill and consume about anything they can subdue, although they focus on small rodents. Three weasel species occur in Wyoming: long-tailed, short-tailed (ermine) and least. The long-tailed weasel occurs from southern Canada to northern South America, with the exception of the southwest desert areas of the United States and the Baja California peninsula (Svendsen 1982). It inhabits all life zones from alpine-arctic to tropical, except for deserts, with favored habitats including brushland and open timber, brushy field borders, and grasslands bordering water bodies (Svendsen 1982). The short-tailed weasel is a boreal, circumpolar species having the most widespread distribution of any species in the family Mustelidae (Svendsen 1982). It occupies a variety of habitats from agricultural lowlands, woodlands and meadows, to montane habitats at elevations of 3,000-4,000 m (9,842-13,123 feet) (Svendsen 1982). It can be found in all of Canada and Alaska and in the Rocky Mountain States. In Wyoming, short- and long-tailed weasels appear to avoid dense forest and desert, and the availability of water in summer may limit distribution (Frost and Tessman 2014). The least weasel, which has similar habitat requirements as the other two weasel species, is uncommon in Wyoming. Because least weasel pelts have little commercial value, trappers are asked to avoid trapping them if possible, and to report incidental take so WGFD can accumulate additional data on their distribution (Frost and Tessman 2014).

All weasels are classified as furbearers in Wyoming, and accordingly, are managed by the WGFD (WYSA §23-1-101(a) (iii)). Weasels can be trapped or hunted throughout the state during the open trapping season, and can also be killed by landowners at any time when causing damage to private property. Statistics are not kept on weasels taken for damage control other than the reports provided by WS-Wyoming. WS-Wyoming only infrequently receives requests for assistance with damage problems (typically predation on poultry) attributed to weasels.

Mink: Mink are distributed throughout most of northern North America and, in Wyoming, occupy riparian areas in almost all parts of the state. These areas provide cover, den sites, and access to a wide variety of aquatic and terrestrial prey items (Frost and Tessman 2014). Mink prey on fish, amphibians, crustaceans, birds and their eggs, muskrats and small mammals. Small mammals are the most important food item throughout the year, but other species such as waterfowl and their eggs may be seasonally important (Frost and Tessman 2014).

Mink are classified as a furbearer species in Wyoming, and as such, are managed by the WGFD (WYSA

§23-1-101(a) (iii). Mink can be trapped or hunted throughout the entire state during the trapping season, and may also be killed at any time by landowners if they are causing damage to property. Statistics are not kept on mink taken for damage except for reports provided by WS-Wyoming. Damage complaints for mink are rare and usually related to poultry depredation.

Common Raven: The common raven is geographically one of the most widespread naturally-occurring birds in the world. The current raven population in the western U.S. is considered to be the highest ever recorded; raven numbers are rebounding in parts of the raven's eastern range as well (Boarman and Heinrich 1999, Sauer et al. 2014).

In many areas of the western United States, the raven is considered an indicator of human disturbance because it is often associated with garbage dumps, sewage ponds, highways, agricultural fields, urbanized areas, and other human-altered landscapes (Boarman 1993, Kristen and Boarman 2003). Supplemental food sources such as garbage, crops, road-kills, etc., may provide the raven an advantage over other less opportunistic feeders and appear to have allowed the raven population to increase precipitously in some areas. Mortality factors for ravens are not well known, but probably include predation (including nest predation by other ravens), weather-related factors, disease, and human-induced mortality such as shooting. Illegal shooting is not likely to be a major contributor to the cumulative mortality because ravens quickly learn to avoid humans with firearms after witnessing conspecifics being shot.

WS-Wyoming has been receiving a wide range of complaints relating to raven damage. Agricultural complaints include damage to livestock by pecking the eyes and other soft tissues on newborn livestock, eating livestock feed, and feeding on grains. Non-agricultural property damage complaints include damage to electrical equipment and associated power outages, fouling of satellite dishes, and holes pecked in airplane wings. Health-related complaints include entering garbage containers and strewing trash, accumulation of fecal material on equipment used at landfills, and carrying trash from landfills to nearby residential areas. These damage scenarios would be resolved through technical assistance, non-lethal or lethal approaches or a combination of the latter two, as described under the "Current Program".

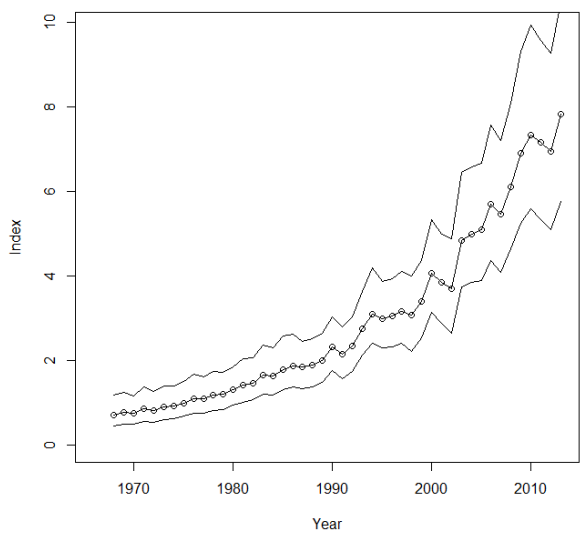


Figure 1-1. Common raven population trend in Wyoming from USGS Breeding Bird Survey (Sauer et al. 2014).

The best information currently available for monitoring trends in raven populations is data from the Breeding Bird Survey (BBS) and population estimates from Partners in Flight (PIF). The BBS is a large-scale inventory of North American birds coordinated by the U.S. Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2004) that is comprised of a set of over 3,500 roadside survey routes primarily covering the continental U.S. and southern Canada. The primary objective of the BBS is to generate an estimate of population change for songbirds. Populations of birds tend to fluctuate, especially locally, as a result of variable

annual local habitat and climatic conditions. Therefore, statistical analyses are used to check for long-term trends in population data. The statistical significance of a trend for a given species is reflected in the calculated P-value (i.e., the probability of obtaining the observed data or more extreme data given that a hypothesis of no change is true, a P value of less than 0.05 being considered statistically significant). Data for Wyoming for 2003-2013 show more than a 2.72% annual increase of ravens and for the western BBS region, a 14% per year increase for the central BBS region and a 4.5% annual increase (average % change/year in number of birds observed per route) in the (Sauer et al. 2014; Figure 1-1).

PIF is an organization launched in 1990 in response to growing concerns about declines in the populations of many land bird species. PIF emphasizes conservation of bird species not covered by existing conservation initiatives. The initial focus was on neotropical migrants, but has since diversified to include most land birds and other avian species requiring terrestrial habitats. The central premise of PIF has been that the resources of public and private organizations in North and South America must be combined, coordinated, and augmented in order to achieve success in conserving bird populations in this hemisphere. PIF is a cooperative effort involving partnerships among federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals. The PIF mission is expressed in three related concepts: 1) helping species at risk, 2) keeping common birds common, and 3) voluntary partnerships for birds, habitats and people.

WS-Wyoming conducts raven damage management at the local population level. In most areas, ravens are considered year-round residents, given that there is no evidence of migration from radio-tagged or marked populations in North America and Iceland (Boarman and Heinrich 1999); however, localized movements into areas just outside its range outside of the breeding season have been documented. Furthermore, there is some question as to whether some birds in flocks of floaters may be true migrants (Boarman and Heinrick 1999).

The BBS data are intended for use in monitoring raven population trends, but it is also possible to use BBS data to develop a general estimate of the size of the raven population. BBS data indicate that raven population trends are steadily increasing in Wyoming, in the Western BBS Region and in the US. Methods adopted by PIF to estimate population size with BBS data (Rich et al. 2003) yield an estimate of 2,100,000 breeding ravens in Canada and the U.S. and 40,000 breeding ravens in Wyoming (http://rmbo.org/pifpopestimates/Database.aspx#continental).

Raven nesting numbers are not precisely known over broad areas, and densities in Wyoming probably vary throughout the state depending on the availability of food and water, and the presence of human disturbance (Boarman and Heinrich 1999). Knight and Call (1981) summarized a number of studies on raven territories and home ranges in the western U.S. Nesting territories ranged in size from 1 pair/3.62 mi2 - 15.7 mi2 in Wyoming and Oregon. In coastal California where an abundant food supply was available, raven nesting pair density was found to be 1 pair/1.7 mi2 and 2.0 mi2 (Linz et al. 1990, 1992). The densities in the Linz et al. (1990, 1992) studies were probably very high as a result of human food "subsidies" and were not representative of all of California. It is likely that Wyoming has similar sites with high nesting densities, although such sites are probably less common than in the more human-populated state of California.

Ravens do not breed until they are 3 years old, though some unsuccessful attempts to nest have been documented for 2-year old birds (Boarman and Heinrich 1999). Non-breeding "floater" ravens tend to roam in loose-knit flocks that can number in the hundreds (Goodwin 1986). It is likely that these "free-floating" flocks are responsible for much of the raven-associated damage because these flocks tend to

congregate at feedlots, landfills, and calving and lambing grounds where food is abundant while the breeding birds tend to remain near their territories. WS-Wyoming take, especially take associated with congregation sites such as calving grounds and landfills, would likely impact the non-breeding floater segment of the raven population more than the less mobile territorial pairs.

Black-billed Magpie: Black-billed magpies are protected as nongame migratory birds under the MBTA and managed by the USFWS; however, USFWS has issued a depredation order for magpies (50 CFR § 21.43) and does not require a federal permit to control magpies when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife or when concentrated in such numbers and manner that they are a health hazard or other nuisance. WS-Wyoming responds to requests from livestock operators and others who experience depredation problems from black-billed magpies. Magpie predation problems are primarily related to calving and lambing periods where they will peck at the eyes, nose, anus and other exposed areas of soft tissue of newly born calves and lambs. However, WS-Wyoming has recorded other types of damage, such as egg predation on ground nesting birds and contamination of livestock feed through droppings.

Black-billed magpies are found in western North America from coastal and central Alaska to Saskatchewan, south to Texas, west to central California and east of the Sierra-Cascade range (Hall 1994). They migrate in winter to lower elevations and in northern parts of their range, south to areas within their breeding range (Hall 1994). They are opportunistic omnivores, eating insects, carrion, seeds, rodents, berries, nuts, eggs and also garbage and food from pets that are fed outside. Black-billed magpies can be found throughout Wyoming, but preferred habitats include sagebrush and other open areas including foothills, agricultural lands and riparian groves below 8,000 feet in elevation. U.S. Geological Survey, Breeding Bird Survey (BBS) population trend data (Sauer et al. 2014) indicate that the black-billed magpie population in the state has been relatively stable over the period of 2003-2013, and the central and Western BBS Regional populations have been stable to slightly declining.

American Crow: Crows are protected as nongame migratory birds under the MBTA and managed by the USFWS; however, USFWS has issued a depredation order on crows (50 CFR § 21.43) which does not require a federal permit to control crows when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife or when concentrated in such numbers and manner that they are a health hazard or other nuisance. Additionally, crows are managed by the WGFD as a small game species, with hunting seasons running from January through February of each year. There are no daily or possession limits. In Wyoming, the most common problem with crows is the financial loss to agricultural crops, primarily in feedlot settings, but occasionally depredation on newborn livestock.

Crows are the most widespread corvid (crows, jays, ravens and magpies) in North America, ranging from the Yukon Territory, Canada, to Baja, California and the Gulf of Mexico and are found from the west coast to the east coast (Johnston 1961). They can be found throughout the year in Wyoming in both rural and urban environments. Crows use a variety of natural and human-altered habitat types including rangelands, riparian woodlands (Knopf and Knopf 1983, Richards 1971), croplands, wetlands, fields, roadsides, pastures (Sullivan and Dinsmore 1992), beaches, shores of streams and lakes (Good 1952, Chamberlain-Auger et al. 1990), urban/suburban areas and golf courses (Chamberlain-Auger et al. 1990, Caffrey 1992). In general, crows thrive in areas of mixed habitat (open areas interspersed with woods) and thus have responded well to human-altered habitats (Marzluff et al. 2001). Johnston (1961) reported that crows reach their peak abundance in agricultural areas near wooded areas and crows have been highly successful at exploiting both agricultural and urban habitats (Marzluff et al. 1994). U.S. Geological Survey, Breeding Bird Survey (BBS) population trend data (Sauer et al. 2014) indicate the

American crow population in the state and Western BBS Region has been relatively stable over the period of 2003-2013, but decreasing in the Western BBS Region.

Crow territories tend to be smaller in urban than in rural areas (Dickinson 1998) and are highly variable in size. Territory sizes range from 0.04 km^2 in suburban New York (Dickinson 1998) to 2.6 km^2 in a waterfowl breeding area of Manitoba (Sullivan and Dinsmore 1992). Caffrey (1992) reported an extremely high breeding density of 0.8 pairs/hectare (ha) on a golf course in Encino, California. This density may be explained by the abundant food and suitable nest sites (trees) available at this site. Emlen (1942) also documented high densities (111 nests in 44 ha) of nesting crows in a walnut orchard in California. In addition, Caffrey (1992) reported territories overlapped extensively and were not defended against conspecifics in southern California. However, in Florida, Kilham (1985) reported aggressive territorial defense during the breeding season. These observations suggest significant flexibility in territory use and defense. This complex territorial behavior is influenced by a number of factors, including food availability, time of year and the relatedness of individuals.

Bald and Golden Eagles: Bald and golden eagles are provided federal protection under the Bald and Golden Eagle Protection Act and the MBTA, which prohibit, except under specified permit conditions, the taking or possession of, and commerce in, such birds. WS works with the USFWS to ensure compliance with laws and protections for eagles and, if necessary, obtains the necessary authorizations when resolving human/eagle conflicts. U.S. Geological Survey, Breeding Bird Survey (BBS) population trend data (Sauer et al. 2014) indicate bald eagles have been increasing in the state and in Western and Central BBS Regions. Golden eagle abundance has been stable to slightly increasing in Wyoming and are stable in the Central and Western BBS Regions. Bald eagle abundance has increased and populations have recovered to the point that the USFWS delisted the bald eagle on August 8, 2007 (Federal Register 72:37346-37372).

Golden eagles are typically found in open mountainous or hilly terrain, where they hunt for small mammals, snakes, and carrion. Golden eagles also prey on lambs, kid goats, and other small livestock. They nest mostly on cliffs, but sometimes in trees and on power lines. To date, WS-Wyoming has resolved all conflicts with golden eagles using technical assistance and/or nonlethal methods and does not anticipate using lethal methods to address conflicts with this species.

Bald eagle damage problems in Wyoming are rare, but may include livestock depredation and bird strike hazards at airports. WS-Wyoming anticipates that requests for assistance may involve both scenarios. WS-Wyoming attempts to resolve conflicts with bald eagles using technical assistance and nonlethal methods.

1.4 RELATIONSHIP OF THIS ENVIRONMENTAL ASSESSMENT TO OTHER ENVIRONMENTAL DOCUMENTS

1.4.1 National Level Memoranda of Understanding (MOU)

MOUs have been signed between WS and the BLM (2012), between WS and USFWS (2012) as well as between WS and the USFS (2011) which recognize the responsibilities of WS for wildlife damage management and related compliance with the NEPA.

The MOU between WS and the USFWS signed in 2012 states: the purpose of this MOU, as required by the Executive Order (EO) 13186,66 Federal Register 3853 (January 17, 2001), is to

strengthen migratory bird conservation and further the purposes of the migratory bird conventions, the Migratory Bird Treaty Act, 16 U.S.C. §§ 703-711(MBTA), the Bald and Golden Eagle Protection Act, 16 U.S.C. §§ 668-668d (BGEPA), the Fish and Wildlife Coordination Act 16 U.S.C. §§ 742a- 754j-2, the Endangered Species Act 16 U.S.C. §§ 1531-1544 (ESA), the National Environmental Policy Act 42 U.S.C. §§ 4321-4347 (NEPA), and other pertinent statutes. This MOU focuses on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between APHIS and USFWS by identifying and enhancing areas of cooperation. This voluntary MOU does not waive legal requirements under the MBTA, BGEPA, ESA, or any other statutes and does not authorize the take of migratory birds.

1.4.2 National Forest Land and Resource Management Plans (LRMP)

The National Forest Management Act requires that each National Forest prepare an LRMP for guiding long-range management and direction. USFS has LRMPs, or "Forest Plans," for their National Forests. WS, under a national MOU, has authority to conduct predator management for the protection of private resources on their lands and is responsible for NEPA compliance. WS, USFS, and WGFD have annual work plan meetings to discuss management actions that are anticipated on each USFS National Forest. During these meetings, USFS identifies anticipated activities that are inconsistent with their LRMP. If an Alternative in this NEPA process were selected that was inconsistent with the LRMP, USFS could amend the LRMP to be consistent with the EA, or elements of that Alternative could be modified when operating on that Forest. The decision would not be implemented on USFS lands until the inconsistency was resolved either through amendment of the LRMP or modification of the Alternative. Any inconsistencies would be identified and resolved before any damage management project was conducted on a National Forest, unless an action were regarded as *emergency management* to resolve an immediate need such as a threat to human health and safety. The Bridger-Teton, Shoshone, Big Horn, Black Hills, Medicine Bow, Sierra Madre and Snowy Range National Forests and Thunder Basin National Grassland have all been contacted for input into this EA to ensure consistency with LRMPs.

1.4.3 BLM Resource Management Plans (RMP)

The BLM currently uses RMPs to guide land use decisions and management actions on lands it administers. Any decisions made as a result of this EA process will be consistent with guidance in these RMPs regarding WS activities. In Wyoming, WS prepares annual Work Plans for each of the three BLM Districts (High Desert District, Wind River/Bighorn Basin (NW) District, and High Plains District). During the preparation of these plans, the BLM districts check the proposed action and provide information needed to ensure that WS actions are consistent with the RMPs for their districts (http://www.blm.gov/wy/st/en/field_offices.html).

1.4.4 WS-Wyoming EAs and Decisions for PDM

Two WS-Wyoming district EAs evaluated PDM in Wyoming, and associated Findings of No Significant Impact (FONSI) were issued as follows:

- Decision and FONSI for Wildlife Damage Management, for the Protection of Livestock, Property and HHS, Wyoming ADC Eastern District. 1997. USDA/APHIS/WS, Western Region, Denver, CO

- Decision and FONSI for Wildlife Damage Management, for the Protection of Livestock, Property and HHS, Wyoming ADC Western District. 1997. USDA/APHIS/WS, Western Region, Denver, CO

This EA will supersede these EAs and encompass statewide actions and facilitate management and communication with cooperating agencies and the public. The current and proposed program is managed in compliance with Wyoming and federal laws and regulations and WS policies. Decisions resulting from this EA will supersede those of the aforementioned documents listed here.

1.4.5 Executive Order (EO) 13186 and MOU between USFWS and APHIS

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

1.4.6 Proposal to Permit Take as provided under the Bald and Golden Eagle Protection Act Final Environmental Assessment

Developed by the USFWS, this EA evaluated the issues and alternatives associated with the promulgation of new regulations to authorize the "*take*" of Bald Eagles and Golden Eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EA evaluated the authorization of disturbance take of eagles, the removal of eagle nests where necessary to reduce threats to human safety, and the issuance of permits authorizing the lethal take of eagles in limited circumstances, including authorizing take that is associated with, but is not the purpose of, an action (USFWS 2010). A Decision and FONSI was made for the preferred alternative in the EA. The selected alternative in the EA established new permit regulations for the "*take*" of eagles (see 50 CFR 22.26) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27). The USFWS published a Final Rule on September 11, 2009 (74 FR 46836-46879).

1.4.7 WGFD Wildlife Management Plans

WGFD does not have formalized management plans for most big game species in Wyoming. Management objectives and strategies are set forth in annual job completion reports, which are updated each year. The agency does prepare management plans as required for post-delisting management of threatened or endangered species, namely grizzly bear (WGFD 2002a) and gray wolf (WGFD 2011, and gray wolf plan addendum, WGFD 2012), and drafted a mountain lion management plan (WGFD 2006) to establish a statewide framework for managing this species and to address potential vulnerabilities of not having such a plan in place. The 2009 Mule Deer Initiative (WGFD 2015) was developed to address public concerns about declining mule deer populations, and to recommend strategies for recovering this species. In summary, WGFD does not have formalized, species-specific management plans for pronghorn antelope, elk, moose, bighorn sheep, mountain goat or black bear; the Mule Deer Initiative is the closest representation of a management plan for big game in Wyoming. All damage management actions by WS-Wyoming would be implemented in accordance with guidelines, restrictions, and objectives set forth in WGFD management plans and the Wyoming Mule Deer Initiative.

1.5 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

1.5.1 Actions Analyzed

This EA evaluates PDM to protect livestock, property, natural resources and HHS in Wyoming. The species causing the most damage to these resources in Wyoming and which are therefore the reason for most calls for assistance to the WS-Wyoming program are: coyote, striped skunk, raccoon, wolf and common raven. To a lesser degree, WS-Wyoming has received requests for assistance to reduce damage caused by other predator species, including bald (*Haliaaetus leucocephalus*) and golden eagles (*Aquila chrysaetos*), red foxes and feral cats. Damage management practices for these and other species are included in the scope of analysis in this EA.

1.5.2 American Indian Lands and Tribes

WS-Wyoming conducts PDM only at a Tribe's request. WS-Wyoming has been requested to provide limited assistance with PDM on Tribal lands in Wyoming. Since Tribal lands are sovereign and the methods employed are the same as for any private land upon which WS-Wyoming provides services, Tribal officials determine if PDM is desired and what PDM activities are allowed. Because the Tribal officials have the ultimate decision on whether PDM is conducted, no conflict with traditional cultural properties or beliefs is anticipated. Therefore, this EA would cover PDM on Tribal lands, where requested and implemented.

1.5.3 Federal Lands

WS-Wyoming is often requested to conduct PDM on federal public lands administered by the BLM and USFS. This EA evaluates the effects of PDM on federal lands, including issues that may affect public land users. All proposals for PDM on federal lands must be reviewed for consistency with LRMPs, policies and regulations of the land management agency. The USFS and BLM are cooperating agencies in the preparation of this EA to facilitate consistency with applicable plans, policies and regulations and to help ensure that issues relevant to federal public lands were adequately addressed in the EA.

1.5.4 Period for Which This EA Is Valid

Unless it is determined that an EIS is warranted, this EA will remain valid until WS-Wyoming determines that new information, environmental conditions, or regulatory changes substantially impact the need for action, issues considered in detail, or environmental consequences of the selected actions. In addition, new information might result in new alternatives that should be considered and may have differing environmental effects than those analyzed herein. These and other changes may warrant a supplemented, revised, or new NEPA analysis and a new decision. This EA will be reviewed each year to ensure that it is complete and still appropriate for the scope of PDM in Wyoming.

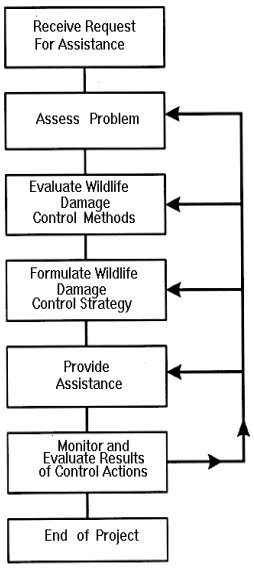
1.5.5 Site Specificity

As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. WS-Wyoming activities that could

involve the take of predators would only occur when authorized by the WGFD, WDA, and/or the Tribes, as appropriate. This EA analyzes potential impacts of PDM and addresses WS-Wyoming PDM activities on all lands under Cooperative Agreement, Work Plan or Agreements for Control within Wyoming. Because the need for action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional PDM efforts could occur. It also addresses the impacts of PDM on areas where additional agreements with WS-Wyoming may be written in the reasonably foreseeable future in Wyoming. Because the proposed action is to continue the current program and because the current program's goal and responsibility is to provide service when requested within the constraints of available funding and manpower, it is conceivable that additional PDM efforts could occur. Thus, this EA anticipates potential expansion and analyzes the impacts of such expanded efforts as part of the current program. This EA emphasizes significant issues as they relate to specific areas whenever possible. However, the issues that pertain to wildlife damage and resulting management are the same, for the most part, wherever they occur, and are treated as such. The standard WS Decision Model (Figure 1-2) and WS Directive 2.201 will be the site-specific guidelines for determining methods and strategies to use or recommend for individual actions conducted by WS-Wyoming in Wyoming (see WS Directive 2.201for a more complete description of the WS Decision Model and examples of its application). Decisions made using the model will be in accordance with all mitigation measures and SOPs described herein and adopted or established as part of the decision.

Many of the predators addressed in this EA can be found statewide and damage or threats of damage can occur wherever those species occur. Planning for the management of predator damage must be viewed as being conceptually similar to other federal or agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Although some of the sites where predator damage could occur can be predicted, all specific locations or times where such damage would occur in any given year cannot be predicted. The threshold triggering an entity to request assistance from WS to reduce damage associated with predators is often unique to the individual; therefore, predicting where and when such a request for assistance would be received by WS is difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever predator damage and the resulting management actions occurs and are treated as such.

Figure 1-2. APHIS-WS Decision Model



Chapter 2 of this EA identifies and discusses issues relating to PDM in Wyoming. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions

conducted by WS-Wyoming. Decisions made using the model would be in accordance with WS directives and SOPs described in this EA as well as relevant laws and regulations. The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Wyoming. In this way, WS believes it meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with the NEPA and still be able to accomplish its mission.

1.5.5.1 WS Decision Making: WS personnel use a thought process for evaluating and responding to damage complaints which is depicted by the WS Decision Model and described by Slate et al. (1992) (Figure 1-2). WS-Wyoming personnel are frequently contacted after requesters have tried or considered non-lethal methods and found them to be impractical, too costly, or inadequate to reduce damage. WS personnel assess the problem then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic and social considerations. Following this evaluation, methods deemed to be practical for the situation are incorporated into a management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the WS Decision Model (Slate et al. 1992), most damage management efforts consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions.

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

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

1.5.5.3 Community Decision-Makers: The decision-maker for the local community would be elected officials or representatives of the community. The elected officials or representatives are popularly elected residents of the local community or appointees who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities is more

complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing entity. WS-Wyoming could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Operational management could be provided by WS only if requested by the local community decision-maker, funding is provided, and if the requested operational management was compatible with the recommendations made by WS.

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

1.5.5.5 Public Property Decision-Makers: The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. WS-Wyoming could provide technical assistance to this person and recommendations to reduce damage. Operational management could be provided by WS if requested, funding is provided, and the requested actions were within the recommendations made by WS. Public involvement would be the responsibility of the agency responsible for managing the site in accordance with agency procedures.

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

1.5.6 Public Involvement/Notification

Issues related to PDM as conducted by WS-Wyoming were initially developed by WS with assistance from the cooperating and consulting agencies and tribes. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS NEPA implementing regulations, this document is being made available for public review and input through a legal notice published in the *Cheyenne Tribune-Eagle*, through direct mailings to parties that have requested to be notified or have been identified to have an interest in the reduction of threats and damage associated with predators in the State, notices sent out via the APHIS Stakeholder Registry, publication of the notice of availability on the WS NEPA website

http://www.aphis.usda.gov/wildlifedamage/nepa and through publication of the EA and notice on regulations.gov at https://www.regulations.gov/docket?D=APHIS-2016-0084.

WS will provide for a minimum of a 30-day comment period for the public and interested parties to review and provide comments on the analysis. New issues or alternatives raised after publication of public notices would be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a final Decision or publication of a notice of intent to prepare an EIS.

1.6 DECISIONS TO BE MADE

WS-Wyoming is the lead agency for this EA, and therefore is responsible for the scope and content of this document as well as the decisions that are made. Authority for addressing the variety of wildlife species causing damage is vested in different agencies. WGFD has primary responsibility for responding to complaints involving mountain lions, black bears and grizzly bears. However, under a MOU between WGFD and WS-Wyoming, WGFD can request assistance from WS-Wyoming for any species under its primary responsibility. For example, WGFD often requests assistance from WS-Wyoming for responding to black bear and mountain lion depredation. The USFWS is the primary management authority for actions involving migratory birds such as eagles, crows, magpies and ravens. The USFWS also has primary management authority for species listed under the ESA including grizzly bears.

Consulting agencies in the development of this EA include the ADMB, BLM, USFS, WGFD, and WDA. Each of the consulting agencies was asked to provide input and direction to WS-Wyoming to ensure that program actions are in compliance with applicable regulations and policies, and in agreement with the desires of the people of the State of Wyoming for managing resident wildlife.

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

- Should WS-Wyoming damage management, as currently implemented, be continued in Wyoming?
- If not, how can WS-Wyoming best respond to requests for assistance with reducing wildlife damage in Wyoming?
- What are the potential impacts of the alternatives for addressing predator damage?
- Might this proposal have significant impacts requiring preparation of an EIS?

1.7 PREVIEW OF THE REMAINDER OF THIS EA

The remainder of this EA is composed of four additional chapters (5 total) and three appendices (A through C). Chapter 2 discusses the issues, issues not analyzed in detail, and affected environment. Chapter 3 describes each alternative, alternatives not considered in detail, mitigation and SOPs. Chapter 4 analyzes the environmental impacts associated with each alternative considered in detail. Chapter 5 is a list of preparers, consultants and reviewers. Appendix A is the literature cited, Appendix B discusses the legal authorities of federal and state agencies in Wyoming, and Appendix C describes PDM methods which could be used or recommended by WS-Wyoming.

CHAPTER 2: ISSUES

Chapter 2 contains a discussion of the issues, including those that receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), those used to develop standard operating procedures and those that will not be considered in detail with rationale. Pertinent portions of the affected environment are included in this chapter in the discussion of issues to be addressed in detail. Additional information on the affected environment is provided in Chapter 1 sections on need for action and background information, and in Chapter 4 analysis of the impacts of the alternatives.

2.1 AFFECTED ENVIRONMENT

Wyoming is comprised primarily of land: of the 97,105 mi^2 in the state, only 714 mi^2 is categorized as inland water. The highest point is Gannet Peak, which rises 13,804 feet and the lowest point is Belle Fourche River. The Great Plains meet the Rocky Mountains in Wyoming. The state is considered as a plateau broken by a number of important mountain ranges. These are the Absaroka, Owl Creek, Wyoming, Gros Ventre, Wind River and the Teton ranges in the northwest; the Big Horns in the northcentral; the Black Hills in the northeast; and the Laramie, Medicine Bow and Sierra Madre ranges in the southern portion of the state.

The Wyoming Basin area is located primarily in Wyoming and consists of broad intermountain basins interrupted by isolated hills and low mountains that merge to the south into a dissected plateau. It is basically a shrub-steppe ecosystem, dominated by sagebrush and shadscale, interspersed with areas of shortgrass prairie. Higher elevations are dominated by mountain shrub vegetation, with coniferous forest commonly found at the highest elevations. The Continental Divide cuts through Wyoming from the northwest to the southcentral border. Rivers east of the Divide drain into the Missouri River Basin and eventually the Atlantic Ocean. These are the North Platte, Wind, Big Horn and Yellowstone Rivers. The Snake River in northwest Wyoming eventually drains into the Columbia River and the Pacific Ocean, as does the Green River through the Colorado River Basin.

Wyoming also contains short-grass prairie, with cottonwoods and shrubs growing along the riverine corridors. About ⅓ of the Black Hills are located in Wyoming. Between Wyoming mountain ranges are the Intermontane Basins, characterized by short grasses and low shrubs. These areas are mostly treeless and are characterized by small amounts of rainfall. The Bighorn and Powder River Basins are major basins in the north. The Wind River Basin in central Wyoming and the Green River, Great Divide, and Washakie Basins are major basins in the south. The Great Divide Basin runs along the Continental Divide. The Red Desert covers a part of the Great Divide Basin and an area to the south of the basin.

WS-Wyoming personnel receive requests to conduct PDM on private, federal, state, tribal, county, and municipal lands in many of the 23 counties of the state. As of February 4, 2015, active cooperative agreements were in place on approximately 40,719,596 acres, about 65% of the State's total acreage [WS-Wyoming Management Information System (MIS) 2014]. WS-Wyoming typically does not conduct management activities on every property under agreement every year nor does the program work continuously throughout the year on most of the properties under agreement. WS-Wyoming Specialists typically spend only a few hours or days on any specific property during the year resolving damage problems. WS-Wyoming usually conducts

PDM on an average of 28,910,409 acres per year for federal fiscal years (FY) 2010-2014 (MIS 2014) (Federal FY = October 1 through September 30 of the following calendar year); this is only about 46 % of the land area in Wyoming. In FY 2014, WS-Wyoming conducted PDM on properties totaling approximately 28,734,663 acres (MIS 2014). This included: 11,853,416 acres of BLM lands, 1,873,623 acres of USFS lands, 1,408,742 acres of state lands, 2,982,000 acres of tribal lands, 10,600,754 acres of private lands, and 16,128 acres of other public lands. Damage management occurs in only a fraction of each land unit under agreement, so calculations using the total area of agreement vastly overestimate the area impacted by the program. For example, one ranch might consist of 20,000 acres, and WS-Wyoming might have the entire ranch listed under agreement for various types of damage management activities. However, the ranch might only calve on 5,000 acres. WS-Wyoming could go in and remove coyotes from the calving range and not the entire ranch, therefore only impacting 25% of the total land under agreement. The amount of land area under agreement is provided to show the proportional breadth of area in which WS-Wyoming works compared to the total range of coyotes in the state. This provides an indicator of the limited impact to state populations of target predator species. Impacts are further mitigated by the fact that in areas where WS conducts damage management, the target animals are not entirely removed. Rather, numbers are reduced to lower the potential for damage. However, in some cases, the influence of management activities can extend beyond the actual work area because coyotes do not recognize property boundaries**.**

2.2 ISSUES ANALYZED IN DETAIL

The following issues or concerns about WS-Wyoming PDM are evaluated in detail in this EA under each alternative. The issues have been identified through interagency planning and coordination and prior NEPA compliance processes in Wyoming. These issues are described in Section 2.3 and are evaluated under each alternative in Chapter 4, Environmental Consequences.

- Effects on Target Predator Species Populations
- Effects on Non-target Species Populations, Including T&E Species
- Impacts on Special Management Areas [*i.e.,* Wilderness Study Areas (WSA)]
- Effects on the Socioeconomic Environment [Humaneness of Damage Management Techniques and Effects on Recreation (*i.e.,* hunting and non-consumptive uses)]
- Impacts on Human Safety
- Impacts on the Environment from the Use of Aircraft
- Effectiveness of WS-Wyoming

2.3 ISSUES ADDRESSED IN DETAIL

2.3.1 Effects on Target Predator Species Populations

Maintaining viable populations of all species is a concern of the public and of biologists within the state and federal land and wildlife management agencies, including WS. A concern of some people is that WS-Wyoming PDM will adversely affect populations of target species, including: coyotes, mountain lions, black bears, bobcats, and other species. To address these concerns, the effects of each alternative on populations of each target species are examined. Take of target species by WS is small in comparison to the overall populations of these species and many

species targeted by WS activities are considered "anthropogenic abundant" (Conover 2002). Quantitative population data for most species is not available; however, population trend data (*i.e.*, qualitative) exists for several target species. Take of predators by WS is reported to and reviewed by the WGFD annually. Additionally, WS would monitor the impact of actions taken under this EA to ensure that take and resulting impacts remain within the parameters analyzed and expected in this EA. A detailed analysis of the effect of WS take on target species populations is presented in Chapter 4.

2.3.2 Effects on Non-target Species Populations, Including T&E Species

This section also addresses concerns that activities of WS-Wyoming could result in the disturbance, injury or death of eagles that may be near or within the vicinity of WS-Wyoming activities. Under 50 CFR 22.3, the term "disturb", as it relates to take under the Bald and Golden Eagle Act, has been defined as "to agitate or bother a Bald and Golden Eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

The ESA states that all federal agencies "...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act" [Sec. 7(a)(1)]. Wildlife Services completed a Section 7 consultation with the USFWS to ensure compliance with the ESA and to ensure that the proposed management actions are not likely to jeopardize the continued existence of any endangered or threatened species (USDA 2013a). Special efforts are made to avoid jeopardizing T/E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. Applicable SOPs and other measures for the protection of State and federally-listed species are presented in Chapter 3 and discussed in Chapter 4 of this EA.

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

2.3.3 Alternative 2: Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans

This section provides information on how the PDM actions that could be conducted under each alternative relate to USFS and BLM Management plans. Special Management Areas are established by land management agencies to set aside lands for a specific purpose (e.g., habitat management for T/E species) or to preserve the characteristics of a site until a formal management decision regarding the site's future management can be made. These areas may have special restrictions on the types of activities which may be conducted in the area. The effect of the alternatives on SMAs and mechanisms for ensuring that PDM actions are consistent with the purpose of SMAs such as WSAs (Wilderness Study Areas) is discussed.

2.3.4 Effects on the Socioeconomic Environment

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

Effects on Recreation (Hunting and Non-Consumptive Uses): Some members of the public may be concerned that WS-Wyoming PDM activities could conflict with recreational activities such as hunting and fishing and non-consumptive uses, such as wildlife viewing or hiking.

Aesthetics is a philosophy dealing with the nature of beauty or the appreciation of beauty. By its very nature, aesthetics is subjective and is dependent on what an observer regards as beautiful. Wildlife generally is regarded as providing economic, recreational and aesthetic benefits (Decker and Goff 1987) and the mere knowledge that wildlife exists is a positive benefit to many people. There may be some concern that the proposed action or alternatives would result in the loss of aesthetic benefits to the public, resource owners or neighboring residents.

Cost Effectiveness of PDM

How cost effective is the program? The relative cost effectiveness of the proposed action is compared with the alternatives. This is not an environmental issue, but is included for management perspective and to communicate the analysis to the public.

2.3.5 Impacts on Human Safety

Some members of the public may be concerned that management methods implemented by WS-Wyoming could threaten public and pet safety. Conversely, some PDM actions are conducted specifically to reduce risks to human health and safety from aggressive, ill or habituated animals.

2.3.6 Impacts on the Environment From the Use of Aircraft

Some members of the public have concerns about the environmental effects of using low flying aircraft. The efficacy and environmental effects of this method are evaluated in Chapter 4.

2.3.7 Summary of Indirect and Cumulative Impacts

Indirect impacts are defined as those impacts which indirectly have an effect on the environment as a result of program implementation. Cumulative impacts, as defined by the CEQ, are impacts on the environment that result from the incremental impact of the action when added to past, present and reasonably foreseeable future actions, regardless of who undertakes such other actions (40 CFR 1508.7). This Section identifies and discusses the possible indirect and cumulative impacts of WS-Idaho's control actions under each alternative considered.

2.4 ISSUES NOT CONSIDERED IN DETAIL WITH RATIONALE

2.4.1 Livestock Losses Are a Tax "Write Off"

Some people believe that livestock producers receive double benefits because producers have a partially tax funded program to resolve predation problems while they also receive deductions for livestock lost as a business expense on tax returns. However, this notion is incorrect because the Internal Revenue Service (IRS) tax code (IRS, Section 1245, 1281) does not allow for livestock losses to be "written off" if the predated livestock was produced on the ranch. Most predation in Wyoming occurs on young livestock (*i.e.*, lambs, kids, and calves). Additionally, many ewes, nannies, and cows added as breeding stock to herds from the lamb, kid, and calf crop, if lost to predation cannot be "written off" since they were not purchased. These factors limit the ability of livestock producers to recover financial losses. This analysis clearly shows that producers do not receive double benefits from having a federal program to reduce predation and additionally collecting federal tax deductions for predation losses.

2.4.2 Livestock Losses Should Be an Accepted Cost of Doing Business

WS is aware of concerns that damage management should not be allowed until economic losses reach an identified threshold of loss or become unacceptable. However, this type of policy would be inappropriate to apply to public health and safety situations. In addition, although some losses of livestock and poultry can be expected and tolerated by livestock producers, WS has the legal responsibility and direction to respond to requests for wildlife damage management, and it is WS policy to aid each requester to minimize losses. WS uses the Decision Model (Slate et al. 1992) discussed in Chapter 3 to determine an appropriate strategy.

Furthermore, in a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie NF, et al., the United States District Court of Utah denied plaintiffs' motion for preliminary injunction. In part the court found that it was only necessary to show that damage from wildlife is threatened to establish a need for wildlife damage management (U.S. District Court of Utah 1993).

2.4.3 No Wildlife Damage Management at Taxpayer Expense, Wildlife Damage Management Should Be Fee-Based

WS is aware of concerns that wildlife damage management should not be provided at the expense of the taxpayer or that it should be fee-based. WS was established by Congress as the agency responsible for providing wildlife damage management to the people of the United States. Funding for WS comes from a variety of sources in addition to federal appropriations. Such nonfederal sources include private, state, county or city government funds and livestock producer head tax funds, which are all applied toward program operations. Federal, state, and local officials have decided that WS damage management needs to be conducted and have allocated funds for these activities. Additionally, damage management is an appropriate sphere of activity for government programs, since wildlife management is a government responsibility. A commonly voiced argument for publicly funded wildlife damage management is that the public should bear the responsibility for damage to private property caused by “publicly-owned” wildlife. Further, the protection of agricultural resources, property, and HHS will always be conducted by some entity. A federal WS program provides a service to agricultural producers,

protects property, natural resources, and HHS, and conducts an environmentally, economically, and biologically sound program in the public interest.

Currently, WS-Wyoming provides free technical assistance on PDM to citizens, private business, and government agencies. Operational damage management may be initiated when the problem cannot effectively be resolved through technical assistance alone, when a work initiation document authorizes WS operational damage management, and when necessary funds are available. Thus, the primary focus of WS-Wyoming operational PDM is fee-based.

2.4.4 Cultural Resource Concerns

The National Historic Preservation Act of 1966, as amended, requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and determine whether there are concerns for cultural properties in areas of these federal undertakings. In most cases, WS activities have little potential to adversely affect sensitive historical and cultural resources.

The Native American Graves and Repatriation Act of 1990 provides protection of American Indian burial sites and establishes procedures for notifying Tribes of any new discoveries. Senate Bill 61, signed in 1992, sets similar requirements for burial protection and Tribal notification with respect to American Indian burial sites discovered on state and private lands. If a burial site is located by a WS-Wyoming employee, the appropriate Tribe will be notified. Damage management activities will only be conducted at the request of a Tribe and, therefore, the Tribe will have ample opportunity to discuss cultural and archeological concerns with WS-Wyoming.

In consideration of American Indian cultural resource interests, the WS-Wyoming program contacted the the Eastern Shoshone Tribe, Fort Washakie, Wyoming and the Northern Arapaho Tribe, Ethete, Wyoming. Each Tribe was requested to identify any cultural concerns relating to the proposed WS-Wyoming program and identify a contact person for the Tribe. Only the Northern Arapahoe Tribe responded. No specific concerns were expressed, but the Tribes did request to be kept informed of the EA process and decision.

2.4.5 Appropriateness of Preparing an EA (Instead of an EIS) For Such a Large Area

Some individuals might question whether preparing an EA for an area as large as the State of Wyoming would meet the NEPA requirements for site specificity. If in fact a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared. In terms of considering cumulative impacts, one EA analyzing impacts for the entire state may provide a better analysis than multiple EA's covering smaller zones. In addition, WS-Wyoming only conducts PDM in a very small area of the State where damage is occurring or likely to occur (see Section 2.1).

2.4.6 PDM Should Be Conducted by Private Nuisance Wildlife Control Agents

Private nuisance wildlife control agents could be contacted to handle predator damage for property owners or property owners could address their own damage problems. Some property owners would prefer to use a private nuisance wildlife control agent because the nuisance wildlife agent is located in closer proximity and thus could provide the service at less expense, they are not required to comply with NEPA, or because they prefer to use a private business rather than a government agency. However, some property owners would prefer to use the services of a

government agency. In particular, large industrial businesses, airport managers, and cities and towns may prefer to use WS because of security and safety issues, legal requirements to be accountable to the public through NEPA compliance and reduced administrative burden. WS employees undergo extensive documented training and certification. This, along with employee and agency experience, can fulfill the needs of these entities. The relationship between WS and private industry is addressed in WS directive 3.101.

2.4.7 Other Environmental Resources

WS damage management has been evaluated for its impacts on several other environmental factors. WS-Wyoming activities likely to result from the proposed or other action alternatives would have a negligible effect on atmospheric conditions, including the global climate. The proposed action by WS-Wyoming would meet requirements of applicable federal environmental laws, regulations, and Executive Orders, including the Clean Air Act and Executive Order 13514; meaningful direct and indirect emissions of greenhouse gases would not occur as a result of the proposed action. The actions discussed in this EA do not involve major ground disturbance or construction. Therefore, the following resource values are not expected to be significantly affected by the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, vegetation, and cultural resources. There are no significant irreversible or irretrievable commitments of resources other than a minor use of fossil fuels to operate vehicles.

Risks Associated with the Use of Lead Ammunition

The cumulative sources of lead in the environment include ammunition used in hunting, and shooting activities as well as airborne emissions from metals industries (such as lead smelters and iron and steel production), manufacturing industries, and waste incineration. The EPA estimates that approximately 72,600 metric tons of lead shot and bullets are deposited in the U.S. environment each year at outdoor shooting ranges (EPA 2001). The reported lead accumulation rates on individual shooting ranges are between 1.4 to greater than 15 metric tons per year (The Wildlife Society 2008). Recent data from USGS (2011) shows that U.S. use of lead from ammunition, shot and bullets was 69,200 metric tons. An additional approximated 3,977 metric tons of lead fishing sinkers are sold in the United States annually (The Wildlife Society 2008). In comparison, average lead use in all APHIS-WS programs is approximately 1.174 metric tons per year. The average yearly total amount of lead used in all states by APHIS-WS (FY08-FY12) was small (0.0017%) compared to the U.S. use of lead from ammunition shot, and bullets based on data from 2011 (USGS 2011). WS-Wyoming adheres to all applicable laws governing the use of lead ammunition, as well as to all lead use restrictions posed by landowners/manager. In Wyoming, the lead ammunition that is used is sparsely and widely disbursed, rather than concentrated in small areas. Lead artifacts and lead from spent ammunition are relatively stable and are not readily released into aquatic or terrestrial systems (The Wildlife Society 2008), especially in alkaline soil environments such as are typically found in Wyoming. Based on this information, WS-Wyoming has determined that the use of lead from shooting is not significant in terms of effects from accumulation in the soil. Given that the majority of lead ammunition is used by non-WS entities, the decisions made by the state, tribes, federal regulatory agencies, and land management agencies regarding use of lead ammunition will be the greatest factor affecting the cumulative contribution of lead in the environment.

2.4.8 Criteria For Determining Which Predator Species Would Be Targeted For Removal Efforts To Benefit Sage-Grouse Nest Success And Chick Survival

PDM for the protection of game species or sensitive species such as sage-grouse would be conducted only if WS-Wyoming receives a request from WGFD. Should WS-Wyoming become involved with PDM activities aimed at benefiting sage-grouse nest success and chick survival, the WGFD would identify which predators are to be targeted. Many species of predators prey on sage-grouse chicks and eggs. A logical criterion for targeting potential sage-grouse predators would therefore be to target those predators that prey on both eggs *and* chicks. To the extent that some of the predators preying on chicks also prey to some degree on sage-grouse eggs, removal of those predators could provide additional benefit to sage-grouse recruitment by increasing nest success as well as chick survival. Wildlife species that have been documented to depredate upon sage-grouse eggs and chicks in Wyoming include common ravens, raptors, coyotes, red foxes, badgers, bobcats and snakes.

2.4.9 Review Of The Scientific Literature To Clarify The Premise That Predators Adversely Affect Bird Populations, Including Sage-Grouse Nesting Success And Recruitment

The following discussion is based on a literature review by Hagen (2011b). Generally, sage-grouse nest success rates and adult survival are high, suggesting that, on average, predation is not limiting. However, in fragmented landscapes or in areas with subsidized predator populations, predation may limit population growth, in essence supporting raven control under certain circumstances. Predator management studies have not provided sufficient evidence to support implementation of PDM to benefit sage-grouse over board geographic or temporal scales, although limited information suggests that predator management may provide short-term relief for population sinks. Evaluating the need for predator management requires linking reduced demographic rates to habitat quality (fragmentation or degradation) or predator populations out of the natural range of variability (exotic species or subsidized populations). In such situations, predator control could be a viable option for wildlife managers. Lethal predator control has been used with some short-term successes with T/E species. Given a 2010 proposal to consider the greater sage-grouse as a candidate species for listing under the ESA by the USFWS and ongoing governmental, tribal and private management efforts, interest still exists for raven control in select situations to provide short-term benefits to sage-grouse (enhancement of nest success and chick survival). Historically, most predator control programs were designed to protect domestic livestock, not wildlife. The question remains as to whether or not predator control programs are effective conservation tools, and if so, under what conditions they may be appropriate.

2.4.10 Dinkins (2013) did not detect a significant increase in sage-grouse nesting success when WS-Wyoming reduced the raven population in Wyoming, so could WGFD believe raven removal for sage-grouse protection is warranted?

The results of a research project in Wyoming reported by Dinkins (2013) has limited biological relevance because the raven removal for which the author made his conclusions was implemented for the protection of livestock and not specifically for the protection of sage-grouse eggs or young. The objectives and application of DRC-1339 treated baits for the purpose of raven predation management on livestock are totally different than the objectives and methods for removing ravens in order to evaluate nest success of sage-grouse. The most striking difference is the location of where ravens are removed. For livestock protection, ravens are targeted at or very

near the location where livestock depredations occur, such as calving grounds or confined feeding operations. In these areas, cattle and calves are concentrated in a very small geographic area – areas not generally used by sage-grouse for nests or leks. In contrast, raven predation management to enhance nest success of sage-grouse is conducted in and around leks and is dispersed over larger geographic areas and far from livestock calving and lambing operations. Sage-grouse leks, nesting locations and raven populations are not concentrated, requiring the application of DRC-1339 treated baits over a much larger geographical area.

Interestingly, Dinkins (2013) did report that sage-grouse nest success was negatively impacted by the presence of ravens within 550 m of a sage-grouse nest. Furthermore, success of sage-grouse nests in areas not occupied by ravens during the last nest check was estimated at 41% using a 28-day incubation period, whereas success of nests in areas occupied by ravens was estimated at only 22% (Dinkins 2013). This suggests that sage-grouse nest success was almost double where ravens were absent compared to areas occupied by ravens, and indicates that raven control to protect sage-grouse may be warranted.

2.4.11 Irreversible and Irretrievable Commitments of Resources

Other than minor uses of fuels for motor vehicles and electrical energy for office maintenance, there are no irreversible or irretrievable commitments of resources. Relative to cumulative uses of these resources, the WS-Wyoming PDM program produces very negligible impacts on the supply of fossil fuels and electrical energy.

2.4.12 Potential Impacts on Minority Populations and Low Income Populations and Protection of Children from Environmental Health and Safety Risks

Environmental Justice has been defined as the pursuit of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. EO12898 requires federal agencies to make Environmental Justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations. Similarly, EO 13045 requires agencies to consider potential environmental health and safety risks to children from proposed federal actions. Children may suffer disproportionately from environmental health and safety risks, including their developmental physical and mental status, for many reasons.

All WS-Wyoming actions would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment. WS-Wyoming activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS-Wyoming personnel use PDM methods as selectively and environmentally conscientiously as possible. Chapter 3 Section 3.4 lists SOPs for PDM actions including those intended to protect human health and safety. All chemicals used by WS-Wyoming are regulated by the EPA through FIFRA, MDA, by MOUs with federal land managing agencies, and by WS Directives. The WS-Wyoming operational program properly disposes of any excess solid or hazardous waste. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. All WS-Wyoming PDM is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected.

2.4.13 Livestock losses are low relative to losses from other sources, the cost of the PDM program and total livestock industry sales. Is WS-Wyoming involvement in PDM really warranted given these statistics?

WS-Wyoming has had an effective PDM program in place for decades. Therefore, livestock losses in Wyoming are the losses that occur with this PDM program in place and are expected to be low. Furthermore, livestock producers generally do not wait for losses to accumulate to a high level before taking PDM action on their own or requesting assistance from WS-Wyoming or other entities. Instead, for the protection of the livestock under their care, attempt to act before such losses become unacceptable. The reports of livestock losses in the EA do not reflect the losses that might have occurred had actions not been taken to limit losses (EA Section 1.1.1). The important question here is how many livestock are saved from predation by PDM activities? We present data available from studies on the amount of losses that are prevented by PDM in Sections 1.1.1. Available reports indicate that, in the absence of PDM, losses for some producers can be much higher (O'Gara et al. 1983, Nass, 1977, Baker et al. 2008). See also analysis of effectiveness for each alternative in Chapter 4. Moreover, although statewide, regional, or national losses may be low, losses are not evenly distributed throughout the industry. Impacts on individual producers may be substantial.

The decision-maker will weigh the costs and benefits when (s)he analyzes the alternatives identified in this EA, and will make a policy determination based, in part, on that cost/benefit analysis.

CHAPTER 3: ALTERNATIVES

This Chapter consists of five parts: 1) introduction, 2) description of alternatives considered and analyzed in detail, including the No Action/Proposed Action (Alternative 1), 3) PDM strategies and methods which may be used or recommended by WS-Wyoming, 4) alternatives considered but not analyzed in detail with the rationale, and 5) minimization measures and SOPs for PDM. Table 3-1 compares the varied methods that could be used under each alternative.

Five alternatives were recognized, developed, analyzed in detail by WS-Wyoming, the ADMB, BLM, USFS, USFWS, WDA, WGFD and WLB. Six additional alternatives were considered but not analyzed in detail. To be eligible for detailed consideration, alternatives must enable WS-Wyoming to address the diversity of resources to be protected and wildlife species involved in conflicts. Alternatives must be adaptable to varied situations that can occur, be responsive to the issues addressed in Chapter 2, and enable timely resolution of conflicts.

3.1 DESCRIPTION OF THE ALTERNATIVES

3.1.1 Alternative 1 – Continue Current Federal Predator Damage Management Activities in Wyoming (Proposed Action)

Continuation of WS-Wyoming PDM activities is defined as the "No Action" alternative because this alternative proposes no changes from the current practices. This is consistent with CEQ's definition for ongoing projects. The "No Action" alternative is also a procedural NEPA requirement [40 CFR 1502.14(d)] and will serve as a baseline for comparison with the other alternatives.

Overview: The No Action alternative would continue current WS-Wyoming integrated PDM activities in Wyoming. Currently, WS-Wyoming PDM activities are conducted under two EAs (USDA 1997a, b) which will be superseded by this EA once finalized. Combining the EA into one analysis does not change the overriding legal and administrative oversight and may provide for better analysis by looking at statewide WS effects.

All WS PDM is based on interagency relationships, which require close coordination and cooperation because of overlapping authorities and legal mandates (e.g., WGFD, WDA, USFWS, BLM, USFS). WS-Wyoming PDM activities are conducted in compliance with applicable state, federal, tribal and local laws, regulations, policies, and procedures. Under this alternative, WS-Wyoming provides technical assistance (education, information and advice) in response to damage complaints. If appropriate, when permitted by the landowner/manager and WGFD, and when cooperative funding is available, WS-Wyoming may also implement nonlethal or lethal PDM methods for preventive (to prevent loss, or in response to historical loss) and corrective (in response to current loss or hazard) control on USFS, BLM, state, county and private lands under MOUs, cooperative service agreements and work initiation documents. Work initiation documents are signed with the landowner or administrator and describe the methods to be used and the species to be managed. Most requests for PDM assistance come from private individuals experiencing predator damage or threats of damage, but requests may also come from public entities such as a county sheriff or other local or state government office or resource manager. Occasionally, a federal land or wildlife management agency (BLM, USFS, USFWS) may request

WS-Wyoming assistance. Management is directed toward problem predators in localized areas and/or individual offending animals, depending on the circumstances.

WGFD has management authority over most species of resident wildlife on BLM and USFS lands, as long as the species is not listed under the federal ESA (e.g., T&E species). WS-Wyoming signed a cooperative service agreement with WGFD in 2015 to conduct a program for the protection of livestock, property and HHS from trophy game animal damage utilizing an integrated wildlife damage management methodology. USFWS has management authority for migratory birds and T&E species. All actions involving these species must be conducted in accordance with USFWS regulations and other regulatory provisions (e.g., migratory bird depredation permits) established for their management. Authorizations may be granted directly to WS-Wyoming or they may be granted to WGFD or the entity experiencing damage, which may, in turn designate WS-Wyoming as their agent for purposes of addressing the damage. Furthermore, WGFD and the USFWS could request WS-Wyoming to conduct PDM for the appropriate wildlife species managed by these respective agencies.

Under the current program, PDM could be conducted on federal, state, county, municipal, tribal and private properties in Wyoming according to upon execution of relevant work initiation documents or work plans (discussed below) and by following a professional Decision Model (Slate et al. 1992, WS Directive 2.201) to determine the most appropriate course of action on a case-by-case basis. When appropriate, non-lethal methods, such as physical exclusion, habitat modification, relocation (for T & E species such as grizzly bears), or harassment would be recommended or utilized to reduce damage (Appendix C). In other situations, predators could be removed as humanely as practicable using shooting, trapping, registered pesticides and other methods. In developing site-specific damage management strategies, preference would be given to practical and effective non-lethal methods before lethal methods are applied. However, non-lethal methods may not always be applied as a first response to each damage problem depending on the nature of the problem and level of risk. The most appropriate response could be a combination of non-lethal and lethal methods or could include instances where lethal methods alone would be the most appropriate strategy (*i.e.*, HHS).

Most of the requests for PDM come from livestock operators who utilize private and public lands. The majority of livestock owners operate on private property, but may graze their livestock on public lands for part of the year. In addition, many livestock owners also graze livestock on lands which adjoin public lands and experience predation caused by animals that originate on public lands. Requests for PDM on BLM and USFS lands can originate with livestock permittees, the land managing agency, or adjoining property owners. Livestock owners are provided PDM assistance from WS-Wyoming within the regulatory and fiscal constraints of the current program. Table 3-2 summarizes PDM methods which are authorized for WS-Wyoming use by land class.

The current PDM program on private lands is governed by WS policy and a specific private property agreement for that particular property which specifies the methods to be used and the species targeted. All anticipated WS-Wyoming activities on public (USFS, BLM, and WGFD) lands are outlined in WS-Wyoming work plans[5]. WS-Wyoming produces a work plan for each specific BLM Field Office, USFS NF, and WGFD wildlife habitat management area for review.

[5] WS has MOUs with BLM (2012) and USFS (2011), giving WS the authority and responsibility to be the lead agency under NEPA, with BLM and USFS serving as cooperating agencies where PDM activities occur on lands managed by them.

Coordination meetings are held at least annually between WS-Wyoming and personnel from the respective land management agencies to discuss accomplishments of the previous year, issues of concern, and any anticipated changes in proposed work plans. Site-specific information for proposed work is detailed in the work plans and on associated maps developed by WS, BLM, USFS or WGFD. Maps are used to delineate areas where PDM restrictions or limitations are necessary to avoid conflicts with other land uses. During work planning meetings, WS-Wyoming provides information on proposed actions to the cooperating agencies (BLM, USFS, and WGFD). BLM and USFS are responsible for reviewing the proposed actions to assess their compatibility with established RMPs or LRMPs. It is the land management agency's responsibility to show where a proposed action would conflict with land use plans. In cases where the land management agency demonstrates that a conflict exists, further discussions are initiated to establish what measures would be necessary to alleviate the conflict. These meetings, along with the WS Decision Model (Slate et al. 1992, WS Directive 2.201), provide further site-specific mechanisms to evaluate and monitor the program. Work plans are consistent with LRMPs and RMPs and associated NEPA analyses for that specific USFS or BLM office and all adopted measures from the NEPA analyses are considered part of the work planning process.

Public Land Management Classifications

Planned Management Areas: Planned management areas are areas where WS-Wyoming is actively working or plans to work to limit agricultural or natural resource losses, damages to property, or threats to HHS. Planned activities are those which are anticipated to occur based on historical needs. Depredation management is most concentrated in areas where livestock are most abundant and during times when they are most vulnerable to predators (*e.g.*, during calving and lambing). Requests for assistance to reduce property damage and threats to HHS are by their nature, intermittent and thus less predictable.

Unplanned/Emergency Control Areas: Unplanned and emergency PDM may be provided in areas where no damage management is delineated in the work plan. The restricted zones are identified by the cooperating agencies during the work plan process and noted on maps using a color scheme. Where unanticipated local damage problems arise that threaten HHS or property, WS-Wyoming may take immediate action to eliminate or curtail the problem upon receipt of a request for assistance, provided the proposed management area is not located within a designated restricted activity zone. Emergency PDM activities are handled on a case-by-case basis, as the need arises. WS-Wyoming notifies the cooperating agency as soon as practical after the emergency action commences and the work is performed.

PDM by Entities Other Than WS-Wyoming: Although many landowners/managers request PDM assistance directly from the WS-Wyoming program, some individuals and agencies choose to implement PDM actions on their own, or seek the services of private organizations or contractors. In Wyoming, fully cooperating counties are those in which the PMDs have signed cooperative service agreements with WS-Wyoming for at least one full-time dedicated WS Specialist to resolve problems within the designated county. Other counties which do not have dedicated full-time WS Specialists oftentimes request services for certain activities (e. g., aerial shooting, control of ravens with DRC-1339, etc.). Some counties choose not to contract with WS-Wyoming for any PDM activities. County PMDs have the option to directly hire and supervise their own employees ("county trappers"). Private individuals, agencies and tribes do may conduct PDM on their own without WS except for aerial shooting activities (see Chapter 1. For example in 2016, 21 of the 23 counties have agreements with WS-Wyoming for varying

degrees of PDM assistance, the other two counties occasionally use WS-Wyoming but do not have formal contracts. About 15 of the 21 counties that have agreements with WS-Wyoming have requested all PDM services including county-specific personal; the other 7 or so just request specific services, primarily the use of aircraft for PDM. Counties that only request partial services or no assistance from WS use county trappers (usually full, but sometimes part-time, employees) in the employ of, and supervised by, the county predatory animal districts (i.e., county level predator boards). Non-WS entities or individuals do not have the same reporting requirements to WGFD or the public for PDM activities. However, the WDA does require annual reporting of predators taken via aerial shooting through its permit process (e. g., permits issued to pilots and gunners for conducting aerial predator control).

All nonlethal techniques and strategies are available for use by non-WS entities. All lethal techniques and strategies, except DRC-1339 are also currently available to non-WS entities, including traps, snares, shooting, M-44s, and aerial shooting. In 2015 there were permits for aerial shooting issued within Wyoming to 23 private pilots and 70 gunners to conduct aerial shooting operations (Kent Drake, WDA, pers. comm. 2016). These teams are required to report take, and in 2015 shot approximately 1,300 coyotes from aircraft.

Under this alternative, the avicide DRC-1339 could be used to address livestock and other agricultural losses and predation on sage-grouse or other sensitive wildlife species by common ravens. However, such applications of DRC-1339 are currently restricted to WS.

3.1.2 Alternative 2 - No WS PDM Program in Wyoming

This alternative would eliminate all WS wildlife damage management activities (operational and technical assistance) on all land classes in Wyoming. Information on future developments in nonlethal and lethal management techniques developed by the NWRC (the research branch of WS) would not be as readily available to producers or resource owners. However, local, state, tribal and other federal agencies, as well as private individuals may provide PDM assistance, as is already the case in some counties in Wyoming. The probability that PDM methods and devices could be applied by people with little or no training and experience, and with limited professional oversight or monitoring for effectiveness and associated environmental risks is higher for this alternative than for any of the other alternatives.

All nonlethal methods and most lethal methods would be available to non-WS entities. DRC-1339 is registered for use exclusively by WS-Wyoming personnel and would not be available under this alternative. DRC-1339 is the primary method used to take ravens, crows and magpies. The average annual take of ravens, crows and magpies for the calendar year time period 2010-2014 was (655, 574 and 31 birds per year respectively) with maximum anticipated take of 3,000 ravens, 3,600 crows and 100 magpies per year. With no access to DRC-1339, individuals seeking to use lethal methods to remove ravens and crows would need to rely on more labor intensive methods, such as shooting and live-capture/euthanasia. Total annual reported take of ravens by non-WS entities (i.e., non-DRC-1339 take) for the same period was 31 ravens. No equivalent data is available on take of crows. Given the high proportion of take of ravens with DRC-1339 by WS-Wyoming, the low take of ravens by non-WS entities, and the more labor intensive nature of raven and crow removal using methods other than DRC-1339, we anticipate that annual take of ravens and crows for damage management will decrease under this alternative. The USFS also prohibits use of aerial hunting and M-44s by non-WS entities on FS lands. These methods are used to remove coyotes and red foxes. As noted in Table 4.9 no red foxes have been

taken on USFS lands by WS in the last 5 years and coyote take (all methods combined) has averaged 99 coyotes per year (range 60-155 coyotes). Some of this take was conducted through use of aerial shooting and M-44s, but this number also includes take with traps, snares and shooting. Even if all of this take was accomplished with aerial shooting and M-44s, given the relatively low number of animals taken, alternative methods such as shooting, trapping and snares could be used by non-WS entities on federal lands to take equivalent numbers of coyotes from FS lands.

A portion of funding for WS PDM operations comes from federal appropriations. In FY 2015, approximately 35% of the funding for all WS-Wyoming activities in the State (including wolf damage management and bird damage management not addressed in this EA) comes from federal appropriations to the WS-Wyoming program. If the WS-Wyoming program were discontinued, there would likely be an initial decrease in overall organized PDM efforts. However, because of the importance of PDM to livestock producers, it is likely that alternative systems for funding PDM in the state would be established. As a case study, Congress eliminated funds for the WS-South Dakota program in 2013. The State responded by legislating a $1 increase in license tag sales to generate over $300,000 to be used by the State's game department to conduct the work that was discontinued when federal funds were lost. The State could also respond to the loss of WS PDM funding by working administratively to assist private PDM efforts, including facilitating permitting for PDM (where applicable) or by helping to coordinate volunteers to assist producers with lethal removal of depredating animals similar to the system that was implemented in Minnesota to help with wolf damage management when the Great Lakes distinct population segment of wolves was delisted. In Wyoming, county PMDs have the authority to direct PDM activities, within the constraints of federal and state laws and regulations, at their discretion and, as noted for Alternative 1, several already provide complete or partial PDM services without using WS-Wyoming. Given the number of entities other than WS authorized to use aerial shooting to remove coyotes, it is also likely that counties will be able to obtain alternative sources for aerial hunting assistance.

3.1.3 Alternative 3 – Technical Assistance Only Program

This alternative would discontinue WS-Wyoming operational PDM. WS-Wyoming would provide only technical assistance and make recommendations when requested. All other aspects of this alternative would be as described for Alternative 2, including the ability of counties to develop PDM programs in the absence of operational assistance from WS-Wyoming. However, the probability that PDM methods and devices could be applied by people with little or no training and experience, and with no professional oversight or monitoring for effectiveness, is lower than Alternatives 2 and 4 because WS-Wyoming would be available to provide training and guidance on all PDM methods. However, overall risks would still be higher than Alternative 1.

3.1.4 Alternative 4 - Nonlethal Management Only

This alternative would allow WS-Wyoming to use or recommend only non-lethal methods, such as guard dogs, frightening devices, chemical repellents, harassment, fencing, exclusion, animal husbandry, modification of human behavior, habitat modification, and limited use of cage traps/chemical immobilization where relocation would be feasible. WS-Wyoming could also loan equipment to the public for implementation of various nonlethal management strategies. Information and training on lethal methods would not be provided by WS-Wyoming. In situations where non-lethal methods were impractical or ineffective to alleviate damage, WS-

Wyoming would refer requests for information regarding lethal methods to the county, state, local animal control agencies, or private businesses or organizations. Property owners or managers may choose to implement non-lethal recommendations made by WS-Wyoming on their own or with the assistance of WS, but may also implement lethal methods on their own, or request assistance (non-lethal or lethal) from a private or public entity other than WS-Wyoming. In addition to other government agencies taking lethal actions in some situations, lethal PDM methods and devices could be and likely would be applied by some persons with little or no training or experience. Reduced program efficacy and increased environmental risks associated with PDM conducted by individuals with little or no training or experience in PDM would be higher than Alternative 1, but lower than Alternative 2 because WS would be able to provide technical and operational assistance with nonlethal PDM methods which would likely result in less use of lethal methods than would occur under Alternatives 2 and 3.

As with Alternatives 2 and 3, all nonlethal methods and most lethal methods except DRC-1339 would be available to non-WS entities. As explained for Alternative 2, non-WS entities conducting PDM under this alternative are likely to compensate for lack of access to DRC-1339 with less effective methods that are likely to result in a decline in total raven and crow take for PDM.

As with Alternative 2, we would expect an initial decline in lethal PDM by non-WS entities in the early years of implementation of this alternative while systems become established to provide lethal PDM services no longer available through WS-Wyoming. Individuals experiencing predator damage would still have access to nonlethal and lethal PDM methods as allowed under applicable state, federal and tribal laws. Federal funding for the aerial component of current WS-Wyoming PDM activities would not be available for other WS-Wyoming activities. Remaining federal funding for implementation of an operational program would remain as for Alternative 1. It is unclear whether the non-WS entities that currently provide approximately 65 % of the funding for PDM would continue to support the WS-Wyoming program. Given that many livestock producers in Wyoming feel that an integrated program that includes lethal methods is important for effective resolution of their conflicts, they may choose to allocate their funds to different entities that could provide a fully integrated program or could assist only with lethal methods not available from WS. It is likely that most if not all counties will elect to switch to a system involving use of county trappers similar to that already employed by several Counties (See Alternatives 1 and 2). As mentioned in Section 3.2.2, county PMDs in Wyoming have the authority to direct PDM activities, within the constraints of federal and state laws and regulations, at their discretion. The PMDs in many of these counties hire and supervise their own employees, and respond to PDM issues using primarily lethal methods.

3.1.5 Alternative 5 - Nonlethal Required before Lethal Control

This alternative would require that: 1) livestock grazing permittees, landowners or resource managers show evidence of sustained and ongoing use of nonlethal or husbandry techniques aimed at preventing or reducing predation prior to receiving WS-Wyoming assistance with lethal PDM methods; 2) employees of WS-Wyoming use or recommend appropriate nonlethal techniques in response to a confirmed damage situation prior to using lethal methods; and 3) lethal techniques be used only when the use of husbandry or nonlethal techniques has failed to keep livestock losses below an acceptable level as indicated by the cooperator. Lethal preventive predation management for livestock protection would not be conducted by WS-Wyoming under this alternative. Producers and the general public would still have the option of implementing

lethal control measures, including preventive predation management on their own as already occurs in some counties (See discussion of Alternatives 1 and 2) and WS-Wyoming could continue to recommend lethal control when and where appropriate.

3.1.6 Summary of Alternatives

The five alternatives discussed above would allow the use of different PDM methods. The methods that could be used or recommended under the different alternatives are summarized in Table 3-1.

Table 3-1. Summary of PDM Methods which could be used or recommended by WS-Wyoming under each of the Alternatives

PDM Method	Alternative 1 Current Program	Alternative 2 No Federal Program	Alternative 3 Technical Assistance	Alternative 4 Nonlethal Methods Only	Alternative 5 Mandatory Nonlethal Before Lethal
TECHNICAL ASSISTANCE:					
Animal Husbandry	X		X	X	X
Crop Selection /Planting Schedule	X		X	X	X
Habitat Management	X		X	X	X
Exclusion	X		X	X	X
Close Storage Containers	X		X	X	X
Chemical Repellents	X		X	X	X
Guard Animals	X		X	X	X
Frightening Devices	X		X	X	X
OPERATIONAL ASSISTANCE:					
Foothold Traps	X		X[2]	X	X[4]
Cage Traps	X		X[2]	X	X
Neck/body snares	X		X[2]	X[3]	X[4]
Foot snares	X		X[2]	X	X[4]
Catch Pole	X		X[2]	X	X
Quick-kill traps	X		X[2]		X[4]
Calling/Shooting	X		X[2]		X[4]
Aerial shooting	X				X[4]
M-44	X				X[4]
DRC-1339[1]	X				X[4]
Gas Cartridge	X		X[2]		X[4]
Denning	X		X[2]		X[4]
Hand Capture	X		X[2]	X	X
Dogs	X		X[2]	X	X
Euthanasia	X		X[2]		X[4]

[1] Use of DRC-1339 is restricted to WS and would not be available for use under Alternatives 2-4.
[2] WS-Wyoming would only provide technical assistance on use of these methods
[3] When used as live capture devices, snares must have stops to limit the extent to which the loop can close.
[4] Would not be used for lethal preventive predation management.

3.2 PDM STRATEGIES AND METHODOLOGIES AVAILABLE TO WS-WYOMING

The strategies and methodologies described below are common to Alternatives 1, 3 and 4. Under Alternative 3, WS-Wyoming personnel would only provide technical assistance recommendations and conduct demonstrations. Alternative 4 would allow WS to only use those methods that are generally considered non-lethal. Alternative 2 would terminate both WS technical assistance and operational PDM in Wyoming. The methods used or recommended by WS-Wyoming would be supported by the WS Decision Model (Slate et al. 1992, Directive 2.201).

3.2.1 Integrated Wildlife Damage Management

The current program uses an IWDM approach, which is described in WS Directives 2.101 and 2.105. It analyzes a variety of methods which could be implemented based on the WS Decision Model (Figure 3-1). The discussion that follows contains further information intended to foster understanding of the current WS-Wyoming program.

Over the course of more than 90 years of resolving wildlife damage problems, WS has considered, developed, and employed numerous methods to mitigate such damage. These methods are the result of research and development and the implementation of effective strategies to resolve wildlife damage.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and reduction of damage caused by wildlife based on local problem analyses and the informed judgment of trained personnel. WS applies IWDM, commonly known as Integrated Pest Management (WS Directive 2.105), to address damage situations through the WS Decision Model (Slate et. al. 1992, WS Directive 2.201).

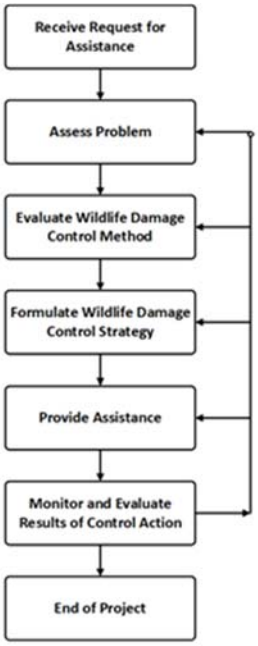


Figure 3-1. APHIS-WS Decision Model.

The philosophy behind IWDM is to implement effective management techniques in a cost-effective manner, while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. IWDM draws from the largest possible array of options to create a combination of techniques appropriate for the specific circumstances. IWDM may incorporate cultural practices (*i.e.,* animal husbandry), habitat modification, animal behavior (*i.e.,* scaring), local population reduction, or any combination of these, depending on the characteristics of the specific damage problems. WS Directives 2.105 and 2.201 describe the procedures used by WS personnel to determine what management strategies or methods are applied to specific damage problems. As depicted in the Decision Model (WS Directive 2.201; Figure 3-1), consideration is given to the following factors before selecting or recommending management methods and techniques:

- Species responsible for damage
- Magnitude, geographic extent, frequency, and duration of the problem
- Status of target and non-target species, including T&E species
- Local environmental conditions
- Potential biological, physical, economic, and social impacts
- Potential legal restrictions including Native American Treaty Rights
- Costs of control options[6]
- Prevention of future damage (lethal and nonlethal techniques)

3.2.2 WS Decision Making Process

The WS decision making process is a standardized procedure for evaluating and responding to damage complaints (WS Directive 2.201). WS-Wyoming personnel are frequently contacted only after requesters have tried the available nonlethal techniques and found them to be inadequate for alleviating or reducing damage to an acceptable level. WS-Wyoming personnel evaluate the appropriateness of different PDM methods in the context of their availability (legal and administrative) and suitability based on biological, economic and social considerations (WS methods are described in Appendix C). Following this evaluation, the method(s) deemed to be practical for the situation are formed into a management strategy. Once implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for additional management is ended.

On most ranches or allotments, predation can occur whenever vulnerable livestock are present. This continual threat exists because there is no cost-effective or socially acceptable method or combination of methods to permanently stop or prevent livestock predation. When damage continues intermittently over time, the WS Specialist and rancher (or resource manager) monitor and periodically reevaluate the situation. If one method or combination of methods fails to stop damage, a different strategy is implemented.

In terms of the WS Decision Model, most damage management efforts consist of a continuous feedback loop between receiving the request and monitoring the results, with the management strategy reevaluated and revised periodically (Figure 3-1). The cost of PDM can be secondary to overriding environmental, legal, HHS, animal welfare, or other concerns.

> **Integrated Wildlife Damage Management Strategies:** The strategies used to resolve wildlife problems in the current program include technical assistance (education, information and advice), and operational management. Technical assistance is the primary method used in responding to requests for assistance. Individuals calling for assistance are given advice and information on ways to reduce predation on livestock, damage to property or ways to avoid attracting nuisance wildlife onto their property. Operational management assistance is provided by WS personnel after visiting the damage site and attempting to resolve the problem using methods such as shooting or trapping and euthanasia. The methods available for use to resolve damages by key species are shown in Table 3-3.

[6] The cost of management may sometimes be secondary due to overriding environmental, legal, public health and safety, animal welfare or other concerns.

Information and Educational Efforts: Information and education (I&E) is an important element of the WS program because successful wildlife damage management is achieved by finding balance and coexistence between the needs of people and wildlife. I&E programs are an essential component of wildlife management and critical toward responsibly shaping the public's views toward damage management and wildlife. In addition to the dissemination of recommendations and information to requesting individuals or organizations, lectures, instructional courses, and demonstrations are provided to producers, homeowners, state and county agents, colleges/universities, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS personnel, other wildlife professionals, and the public are periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies.

3.2.3 The IWDM Strategies That WS Employs

Technical Assistance Recommendations: WS personnel provide information, demonstrations, and advice on many of the available damage management techniques. Technical assistance includes demonstrations on the proper use of management devices (*i.e.,* propane exploders, cage traps, etc.) and information and advice on animal husbandry practices, habitat management, and animal behavior modification devices. Technical assistance is generally provided by WS personnel following an on-site visit or verbal consultation with the requester. Generally, several management strategies are described to the requester for short- and long-term solutions to damage problems. These strategies are based on the level of risk, the abilities of the requester, need, and practical application. Technical assistance may require substantial effort by WS personnel in the decision making process, but implementation is generally the responsibility of the requester.

Operational Assistance: Operational assistance is implemented when the problem cannot effectively be resolved through technical assistance and when work initiation documents and, if necessary, cooperative service agreements, provide for WS operational assistance. The initial investigation defines the nature and history of the problem, extent of damage, and the species responsible for the damage. Professional skills of WS personnel are often required to effectively resolve problems, especially if restricted-use pesticides are proposed, or if the problem is too complex and requires the direct supervision of a wildlife professional. WS considers the biology and behavior of the damaging species and other factors using the WS Decision Model (Slate et al. 1992, WS Directive 2.201). The recommended strategy or strategies may include any combination of proactive and reactive actions that could be implemented by the requester, WS, or other agency, as appropriate. Two strategies are used by WS:

Proactive Damage Management: Proactive damage management is the application of PDM strategies prior to damage occurrences, based on historical occurrence of damage. As requested and appropriate, WS personnel provide information, conduct demonstrations or take action to prevent these historical problems from recurring. For example, in areas where substantial lamb depredation has occurred on lambing grounds, WS may provide information about guard dogs, fences or other husbandry techniques, or be requested to conduct operational PDM prior to lambing. Proactive PDM can take place on most lands without special authorization. On federal lands, WS must receive a request from the resource owner or individual that is experiencing the damage and a work plan must be in place.

Reactive (Corrective) Damage Management: Reactive PDM is the application of management actions in response to an incurred loss with the intent of abating or reducing further losses. As requested and appropriate, WS personnel provide information and conduct demonstrations or, with the appropriate signed agreement, take action to prevent additional losses from occurring. For example, in areas where lamb depredations are occurring, WS may provide information about guard dogs, fences or husbandry techniques, and conduct operational PDM to prevent further losses.

3.2.4 PDM Methods Available for Use

Under the current statewide program, WS-Wyoming receives requests for assistance and may enter into cooperative agreements with private landowners, livestock managers, tribes, cooperating counties, BLM, USFS, WGFD, and other federal, state, county, and municipal agencies. The methods[7] used/recommended in the current program include technical assistance (*e.g.*, animal husbandry, fencing, frightening devices, chemical repellents, and harassment) and operational methods, which include the use of foot-hold and cage traps, snares, shooting, calling and shooting, aerial shooting, M-44s, gas cartridges, and trained dogs. Most PDM methods have inherent strengths and weaknesses relative to each specific damage situation. WS-Wyoming personnel can determine, for each PDM activity, what method or combination of methods is most appropriate and effective using the WS Decision Model (Slate et al. 1992, WS Directive 2.201). A number of methods are generally available for consideration in this process. WS conducts operational activities on private, municipal, county or other government lands only where signed work initiation documents have been executed. These documents list the intended target animals and methods which can be used.

Nonlethal Methods: These methods are primarily used by livestock producers and other resource owners and consist of animal husbandry, as well as habitat and animal behavior modification. Producers are encouraged to use these methods, based on the level of risk, need, and professional judgment relative to their effectiveness and practicality (Slate et al. 1992). In addition, some methods, such as the use of foot-hold and cage traps, can be used non-lethally or lethally, depending on the species involved and the circumstances. Target animals are usually not relocated, especially abundant species such as coyotes and striped skunks. Relocation of wild animals is discouraged by WS policy (WS Directive 2.501) because of stress to the relocated animal and poor survival rates due to intraspecific strife with established resident animals of the same species, and because of difficulties in adapting to new locations or habitats. Relocation of captured problem animals is also opposed by the American Veterinary Medical Association, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists because of the risk of disease transmission among wild mammals (WS Directive 2.501). WGFD does not have a specific statute for relocation of trophy game, but does have a grizzly bear relocation regulation (W. S. §23-1-1001). A Chapter 10 permit is required for possession, confinement, or transportation of any living wildlife, except as specifically exempted in the regulation for such things as hawks and falcons held under falconry permits, amphibians, imported game birds, etc.

Lethal Methods: Lethal management methods are most appropriately used by WS personnel trained and certified to use them. The public, in general, does not have the capability or the necessary training to use many of these techniques, nor does it have access to them. Tools that

[7] A detailed description of each of these methods is provided in Appendix C.

are used lethally include neck snares, firearms, aerial shooting, M-44s (sodium cyanide ejector mechanisms), and gas cartridges (Table 3-3). If nonlethal capture techniques (*e.g.*, foot-hold or cage traps) are used and a target animal is to be lethally removed, AVMA-approved euthanasia methods are employed (AVMA 2013).

Table 3-2. Summary of PDM methods authorized for WS-Wyoming use by land class

Method	Private	State	BLM	BLM WA	BLM WSA	USFS	USFS WA	USFS WSA	Tribal
Nonlethal	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Immobilization	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Frightening	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Preventative Aerial shooting	Yes	Yes	Yes	Yes [1]	No	Yes [4]	Yes [6, 7]	Yes [9]	Yes [10]
Lethal	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Traps, Foot-hold	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Traps, Cage	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Aerial shooting	Yes	Yes	Yes	Yes [1]	Yes [1,2, 3]	Yes	Yes [6, 7]	Yes [9]	Yes [10]
Calling/Shooting	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Denning	Yes	Yes	Yes	No	No	Yes	No	No	Yes [10]
Dogs	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Foot Snares	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
Neck Snares	Yes	Yes	Yes	Yes [1]	Yes [1,2]	Yes	Yes [6]	Yes [9]	Yes [10]
M-44s	Yes	Yes	Yes	No	No	Yes [5]	Yes [6, 8]	Yes [9]	Yes [10]
Gas Cartridge	Yes	Yes	Yes	No	No	Yes	No	No	Yes [10]

1 Requires notification to BLM point of contact as soon as practical
2 WS PDM activities on WSAs are subject to BLM Manual 6330 Management of Wilderness Study Areas (BLM 20
3 Requires approval by BLM State Director
4 Will be coordinated with FS District Ranger
5 Regional Forester must pre-approve pesticide use per USFS Manual, May 4, 1995 Sect. 2151, but may rely on exp WS per Sect. 2650.3.
6 Forest Supervisor must pre-approve PDM in WAs per USFS Manual May 4, 1995 Sect. 2323, but again, may expertise of WS
7 Requires approval from the Forest Supervisor
8 Could only be used for federal T&E species protection, if requested by a management agency
9 Only in emergency situations and with the approval of the District Ranger or Forest Supervisor
10 Requires approval by Tribal Council

Table 3-3. Methods Available for Use by WS-Wyoming to Resolve Damage Issues by Wildlife Species in Wyoming.

Method	Badger	Black bear	Grizzly bear	Bobcat	Feral cat	Common Raven	Coyote	Mink	Mountain lion	Opossum	Porcupine	Raccoon	Red Fox	Skunks	Weasels
Animal Husbandry	Y	Y	Y	Y		Y	Y		Y	Y		Y	Y	Y	Y
Crop Selection		Y	Y			Y	*				Y	Y		*	
Planting Schedule		Y	Y				*					Y		*	
Habitat Management	Y									Y	Y	Y		Y	Y
Fencing	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
Entrance Barricades					Y					Y	Y	Y		Y	Y
Close Storage Containers		Y	Y			Y	Y			Y		Y		Y	
Guard Animals		Y	Y				Y		Y				Y		
Frightening Device	Y	Y	Y	Y		Y	Y		Y	Y			Y	Y	
Foot-hold Traps **	Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
Cage Traps	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y
Neck/body snares	Y			Y	Y		Y	Y	Y	Y		Y	Y	Y	Y
Foot snares	Y	Y		Y	Y		Y	Y	Y		Y	Y	Y		Y
Shooting	Y	Y		Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	
Gas Cartridge							Y						Y	Y	
M-44							Y								
DRC-1339						Y									
Aerial shooting							Y								
Tracking Dogs							Y		Y					Y	

* It is possible that this approach might be used to reduce damage.
** Padded foot-hold traps are used to protect T&E species and HHS.

3.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

Several alternatives were considered but not analyzed in detail. These were not considered because of problems associated with their implementation as described below.

3.3.1 Compensation for Predator Damage Losses

WGFD pays compensation for damage caused by big game animals, trophy game animals (including grizzly bears and wolves) and game birds (WYSA s) and 01). This includes livestock or bees damaged or killed by trophy game animals and damage to cultivated crops and stored crops, including honey and hives, seed crops, improvements and extraordinary damage to grass. A landowner shall not be eligible to receive an award for damage caused by big game animals, trophy game animals, or game birds unless the landowner has permitted hunting during authorized hunting seasons for the species for which the verified claim has been filed on his

privately owned or leased land and adjoining Federal or State land within the herd unit in which the damage occurred. From state FY 2010 through 2015, WGFD paid $4.51 million for 847 claims. Livestock accounted for 82% of payments, growing/cultivated crops 13%, stored crops 3%, seeds 1% and bees, honey and hives <1% (WGFD 2016).

The Agricultural Act of 2014 (i.e., the Farm Bill) has provisions 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, due to attacks by animals reintroduced into the wild by the federal government or protected by federal law, including wolves and avian predators. Payments are equal to 75% of the market value of the applicable livestock on the day before the date of death. For purposes of this EA, the act could provide indemnity payments for livestock losses to grizzly bears (while federally protected under the ESA) and ravens.

Although the compensation programs listed above are helpful, data from NASS livestock loss reports indicate that known losses to grizzly bears and ravens comprised only a small portion of total livestock losses to predators - less than 8% of sheep, 4% of lambs, 16% of cattle and 8% of calf losses (Tables 1-2 and 1-3)). In contrast, there is no compensation program for losses to coyote predation, which accounted for 64.7% of sheep losses, 71.9% of lamb losses, 19.8% of cattle losses and 46.5% of calf losses.

The compensation alternative would require the establishment of a system to reimburse resource owners for predation or other losses. This alternative was eliminated from further analysis, in part because no federal or state laws currently exist to authorize expenditure of funds that are appropriated for WS-Wyoming for this purpose. Under such an alternative, WS-Wyoming would not provide any direct control or technical assistance. Additional reasons for not considering this alternative in detail include:

- It would require larger expenditures of money and labor to investigate and validate all losses and determine and administer appropriate compensation.
- It would be difficult, if not impossible, to assess and confirm losses in a timely manner for all requests and, therefore, many losses could not be verified and compensated. Additionally, compensation would most likely be below full market value.
- Compensation would give little incentive to livestock and other resource owners to limit predation or damages with PDM strategies such as improved animal husbandry practices and fencing. 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 (Nyhus et al. 2003).
- Not all ranchers would rely completely on a compensation program and PDM activities including lethal control would likely continue as permitted by State law. In the absence of changes in state requirements for reporting of PDM take, information and opportunities for public and tribal involvement in PDM for many species would be substantially reduced, similar to the situation in Alternative 2 and reports by Larson (2006) for the Marin County Program.
- Reviews of compensation programs indicate that these programs do not generally improve tolerance of the species causing damage (Naughton-Treves et al. 2003) 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).
- Compensation is not an effective or appropriate response to situations involving risks to human health and safety from predators.

3.3.2 Bounties

Payment of funds for killing predators (bounties) suspected of causing economic losses is not supported by Wyoming state agencies such as WGFD and ADMB. However, some county predatory animal districts (i.e., predator boards) occasionally offer bounties on coyotes. WS-Wyoming does not support the bounty concept for the following reasons:

- Bounties are generally not effective in controlling or reducing damage, especially over large geographic areas.
- Circumstances surrounding the take of animals are typically arbitrary and completely unregulated.
- No process exists to prevent paying for animals from outside the management area(s).
- WS does not have the authority to establish a bounty program.

3.3.3 Eradication and Long Term Population Suppression

An eradication alternative would direct all WS-Wyoming efforts toward total long-term eradication of coyotes and possibly other predator species in cooperating areas or larger defined areas in Wyoming. Eradication of predator species is not a desired goal of either WS or state and other federal agencies. However, predator species in Wyoming may be taken year-round with no restriction and furbearers can be taken at any time if they are found to be depredating livestock or poultry. This can be justified from the standpoint that current population levels of these species can generally sustain high levels of removal without long term negative consequences. Some landowners would prefer that some species of predators be eradicated. However, eradication as an objective for WS PDM will not be considered in detail because:

- WS opposes eradication of any native wildlife species.
- WGFD, USFWS, BLM, and USFS oppose eradication of any native wildlife species.
- The eradication of a native species or local populations would be extremely difficult, if not impossible to accomplish, and cost-prohibitive in most situations.
- Eradication is not acceptable to most members of the public.

Suppression would direct WS-Wyoming efforts toward managed reduction of certain problem predator populations. In localized areas where damage can be attributed to predation by specific groups of individuals, WGFD has the authority to regulate hunting seasons and tag quotas. When a large number of requests for PDM is generated from a localized area, WS-Wyoming would consider suppression of the local population or groups of the offending individuals, if appropriate.

It is not realistic, practical, or permissible under present WS policy to promote large-scale population suppression as the basis of any WS program. Typically, WS activities would be conducted on a very small portion of the area. In Wyoming, WS has active cooperative agreements on 40,719,596 acres (about 65 % of the State's total acreage) on which target animals could potentially be taken. Due to the nature of the work conducted by WS-Wyoming (responding to requests for assistance), in reality, a very small proportion of this total is actually

worked in any given year. Under the current program and any program analyzed in this EA, eradication or long term population suppression is unrealistic, considering the number of animals removed and the number of acres that are generally worked on an annual basis.

3.3.4 Lithium Chloride as an Aversive Agent

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 (Conover et al. 1977, Sterner and Shumake 1978, Burns 1980, 1983, Burns and Connolly 1980, 1985, Horn 1983, Johnson 1984). In addition, lithium chloride is not currently registered by EPA or WDA for this use, and therefore cannot be used or recommended for this purpose.

3.3.5 Exhaust All Feasible Non-lethal Methods Before Using Lethal Methods

This alternative would require that all non-lethal methods or techniques described in Appendix C be applied to all requests for assistance to reduce damage and threats to safety from predators in Wyoming. If the use of all non-lethal methods fails to resolve the damage situation or reduce threats to HHS at each damage situation, lethal methods would be employed to resolve the request. Non-lethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by those persons experiencing predator damage but would only prevent the use of those methods by WS until all feasible non-lethal methods had been employed.

People experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of non-lethal methods can be evaluated. The proposed action (Alternative 1) is similar to a non-lethal before lethal alternative because the use of non-lethal methods is considered and given preference where practical and effective (WS Directive 2.101). Alternative 4 evaluates the impacts of an alternative in which WS would be restricted to only using non-lethal methods. A non-lethal before lethal alternative would have impacts similar to the current program already analyzed. Consequently, analyzing this alternative in detail would not add substantive new information to the analyses in the EA.

3.3.6 Trap and Translocate Predators Only

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 foot-hold traps, body snares, immobilizing drugs, or some other type of live capture method. All predators live-captured through direct operational assistance by WS would be translocated. Translocation sites would be identified and have to be approved by the WGFD and the landowner/manager where the translocated predators would be placed prior to live-capture and translocation.

The translocation of predators that cause damage in new areas following live-capture generally would not be effective or cost-effective. Translocation is often ineffective because problem predators can be highly mobile and can return to damage sites, suitable habitat in other areas is generally already occupied, and translocation can result in recurrence of the problem behavior at

the new location. In addition, dozens or possibly hundreds of predators would need to be captured and translocated to solve some damage problems over time and translocation would not be logistically viable in these situations. Translocation of wildlife is also discouraged by WS policy (WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988). Furthermore, there are potential disease risks associated with wildlife translocations (Cunningham 1996).

Live-capture and translocation may be conducted for select species in certain situations as part of Alternatives 1 and 4 for trophy game species (black bear, grizzly bear, mountain lion), but WGFD would assume full responsibility for such actions.

3.3.7 PDM in Wilderness, Proposed Wilderness or WSAs Should Be Eliminated to Preserve the Intrinsic Values of Such Places

Under the current WS-Wyoming program (Alternative 1), the amount of PDM activities that would occur in wilderness, proposed wilderness and WSAs is minimal. Such work is not common, and does not happen even on an annual basis. PDM activities are conducted by WS-Wyoming only upon request of the respective land management agency on a case-by-case basis, and typically consist of ground-based control (except that no M-44s or toxicants can be used). No preventive control is implemented, and aerial work is permitted only at the discretion of the supervising agency authority as permitted under the land management agency's policies for activities in WAs and WSAs. Overall impacts of this alternative would be similar to the "No WS-Wyoming PDM on federal public lands" alternative discussed below (3.4.13). The minor amount of PDM activities that are or could be conducted by WS-Wyoming in wilderness, proposed wilderness, or WSAs conforms to legislative and policy guidelines as administered by the responsible land management agency. WS-Wyoming and the land management agency meet annually to review work plans that delineate what, when, why and where PDM would be conducted. For example, in BLM wilderness and WSAs, WS-Wyoming uses the minimum control necessary when conducting wildlife damage control activities. To the extent possible, the control of wildlife causing livestock loss is limited to the individual(s) causing the damage; such control activities would not diminish wilderness values.

3.3.8 Immunocontraception or Sterilization Should Be Used Instead of Lethal Predator Control

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

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

Bromley and Gese (2001a, 2001b) conducted studies to determine if surgically sterilized coyotes would maintain territorially and pair bond behavior characteristics of intact coyotes and if predation rates by sterilized coyote pairs would decrease. Their results suggested that behaviorally, sterile coyote pairs appeared to be no different than intact pairs except for predation rates on lambs. Reproductively intact coyote packs were six times more likely to prey on sheep than were sterilized packs (Bromley and Gese 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's (2001a, 2001b) studies: (1) they captured as many coyotes as possible from all packs on their study area; (2) they controlled coyote exploitation (mortality) on their study area and survival rates for coyotes were similar to those reported for mostly unexploited coyote populations, unlike most other areas; and (3) they concluded that a more effective and economical method of sterilizing resident coyotes was needed to make this a practical management tool for application on a large scale (Bromley and Gese 2001b).

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

Potential environmental concerns associated with the use of chemical sterilization would still need to be addressed, including safety of genetically engineered vaccines to humans and other wildlife. At this time, chemical sterilization is controversial among wildlife biologists and many others. In any event, no contraceptive agents or methods are currently registered and therefore, this method is not legal for use on predators. Should this technology become available in the future, WS-Wyoming could consider it as another potential control method. Any additional NEPA analyses deemed necessary at such time would be completed. The use of contraceptives is not realistic at this point, since effective and legal methods of delivering contraceptives to predators are not yet available for operational use.

3.3.9 Nonlethal Taste Aversion Methods Should Be Used Instead of Lethal Predator Control

Nonlethal taste aversion techniques should be considered as an alternative to lethal predator control. Avery et al. (1995) evaluated the use of methiocarb (i.e., Mesurol)-treated eggs as an aversive conditioning measure to reduce raven predation on California least tern (*Sterna antillarum browni*) eggs and concluded that this is a feasible method of protecting this species from raven predation. California least terns are a colonial nesting species, with nesting colonies characterized by high densities of birds occupying relatively small areas. This nesting behavior made it relatively easy to ensure that most ravens in the local area were exposed to treated egg baits prior to initiation of nesting by least terns. Sage-grouse, on the other hand, are highly dispersed nesters and occur at relatively low densities over expansive areas of nesting habitat. Avery et al. (1995) found that if a raven consumed a number of Mesurol-treated egg baits and began developing a taste aversion, but then consumed an untreated egg (which did not make the raven ill), that predation would resume.

In order for this aversive conditioning approach to be effective, it would be important that: 1) treated egg baits be very similar in appearance to sage-grouse eggs; 2) that treated egg baits be widely distributed and maintained in adequate quantities throughout the treatment area so as to ensure exposure; and, 3) that ravens or other predators not have an opportunity to eat any untreated sage-grouse eggs, which would likely begin negating any aversion that may have been established. Even if it were possible to obtain enough eggs that were similar enough in appearance to sage-grouse eggs and to distribute them widely enough and in great enough quantities to ensure bait consumption, it would still be impossible to prevent predators from finding and "testing" actual sage-grouse eggs. However, the primary reason for not implementing this approach is that even if predators could be successfully conditioned not to consume sage-grouse eggs, it would do nothing to prevent predation on sage-grouse chicks, which can be a more significant problem than nest predation (Taylor et al. 2016).

3.3.10 Management Activities Would Only Be Conducted After Damage Has Occurred

Impacts of an alternative in which lethal preventive predation management is not conducted for livestock protection are considered in Alternative 5. This proposal would preclude all preventive predation management. Managing damage proactively and reactively are the general approaches to alleviating damage caused by predators (Baker et al. 2008). Proactive damage management would be the application of methods to target predators prior to damage occurrences based on historical damage occurrence (i.e., based on the threat of damage). As requested and appropriate, WS-Wyoming would provide information, conduct demonstrations or take action to prevent damage from recurring. For example, in areas where substantial lamb depredation has occurred on lambing grounds, WS-Wyoming could provide information about guard dogs, fences or other husbandry techniques or be requested to provide direct operational assistance to remove predators. Reactive damage management would be the application of methods targeting predators in response to an incurred loss with the intent of abating or reducing further losses (i.e., after damage has already occurred). Under this alternative, WS-Wyoming would only provide reactive assistance and only conduct activities after damage has occurred and no proactive assistance would be provided. WS-Wyoming would only conduct activities based on a requests for assistance. In some situations, proactive damage management is already prohibited (e. g., proactive management cannot occur on WSAs managed by the BLM).

This alternative would preclude all preventive predation management, including technical assistance recommendations of strategies to reduce the risk of predation. Discontinuing such strategies would be counterproductive and would likely result in increases in the total number of coyotes taken during reactive damage management. Implementation of this alternative would also preclude PDM to address excessive predation on sensitive species based on documented loss until such time as actual losses to predators have been documented again. This would significantly impair the ability of the agency to respond to the need for action. Most actions to address risks to human health, and safety (e.g., disease transmission) are preventive by nature, because waiting for adverse impacts to happen before action is taken is undesirable. WS-Wyoming would not be able to participate in PDM actions to monitor or prevent risks to human health and safety under this alternative.

3.3.11 WS-Wyoming Should Adopt an Experimental, Exclusively Nonlethal Predator Control Program for a 5-Year Period, Similar to the Program in Marin County, California

Following public controversy over the use of lethal methods to control coyote predation, the Marin County, California Board of Supervisors replaced a cooperative program involving the California Department of Food and Agriculture and the U.S. Department of Agriculture with a county-administered, nonlethal program supervised by the County Agricultural Commissioner. Under the current nonlethal Marin County Program, qualified ranchers are provided funding to assist in the implementation of nonlethal management methods to reduce depredation [e.g., through new fence construction or improvements to existing fences, use of guard animals, scare devices or changes in animal husbandry (Larson 2006)]. The program works on a cost-share basis to provide funds for purchasing fencing materials and guard animals (Larson 2006). To qualify for the program, ranchers must have at least 25 head of livestock and must utilize two nonlethal methods to deter predation, as verified by the Marin County Agricultural Commissioner.

Initially, producers who qualified for the program could receive compensation for livestock lost to predation. However, the program was unable to pay the cost of all losses to predation and in 2003, compensation payments were capped at 5% of the number of adult animals in the herd. However, when Marin County Department of Agriculture was asked for records reflecting whether and to what extent the Program addresses or pays for depredation or damage commonly caused by wild animals (e.g., coyotes, mountain lions, feral swine, feral and free roaming dogs, gray foxes, striped skunks, spotted skunks, opossum, etc.) in a December 2014 California Public Records Request, the county indicated that the Livestock Protection Program was only a cost share program to provide limited funds for purchasing fencing materials and guard animals. Producers who participate in the program commonly use guard dogs and fences as their main means of livestock protection (Larson 2006).

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 (Project Coyote 2013, Fox 2008). This opinion is not necessarily shared by the Marin County or the greater California livestock community (Larson 2006). Amongst other things, it may be difficult to transfer the program to other regions based on “geographic and demographic differences” (Larson 2006). There are fundamental differences between the types of predators and nature of livestock production in Marin County compared to the State of Wyoming. The Marin County program primarily addresses conflicts with coyotes and most livestock is kept in fenced pastures whereas in Wyoming, livestock commonly are grazed on open range during at least a portion of the year. Marin County does not have prevalent mountain lion or black bear populations or conflicts with these species. Between 1972 and 2013, only four depredation permits were issued for lions in Marin County and none were taken (CDFW 2015a). Similarly, between 2006 and 2011, no permits were issued for black bears in Marin County (CDFW 2015b). In contrast, for the FY 2011-FY 2015 time period, WS-Wyoming recorded 147 work tasks involving verified conflicts with bears and 133 work tasks involving verified mountain lion conflicts. Nonlethal methods typically effective for reducing conflicts with small to medium predators and livestock in fenced pastures are not always applicable effective for situations involving range bands of sheep on public lands or conflicts with bear and mountain lions.

Although Marin County's program is touted as a "nonlethal approach" and, when taken at face value, appears to be less lethal, 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 Program, as compared to the standard Wildlife Services 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 (Larson 2006). 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). Larson (2006) also indicated that it is likely that some ranchers are taking more coyotes than when the Wildlife Services program was in place. Research conducted in nearby Mendocino County, California indicates that dominant coyote pairs, the most difficult to control by snaring or trapping, cause the majority of lamb losses (Sacks 1999). Experienced Specialists from 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 in expert trapping techniques and are more likely to capture non-target species during their efforts (Larson 2006). Because the Marin County Program has no means of collecting data from landowners on use of lethal methods or take numbers, there is no way to quantify the take of target and non-target populations nor evaluate the environmental impacts of such take. The WS IWDM program uses the MIS program to effectively track the hours, equipment, 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 nonlethal program's implementation found that on average the program cost the county 1.2 times the amount that the WS-California IWDM program cost the county in its highest year (Larson 2006). These budget evaluations only record the county cost for implementation and do not capture the additional landowner costs associated with this program. The inability of the program to pay compensation for all livestock losses and the need to cap loss indemnity payments is also noteworthy.

This EA analyzes an alternative which restricts WS-Wyoming involvement in PDM to only using and recommending nonlethal PDM methods (Alternative 4) in detail in Chapter 4. Environmental impacts of the Marin County proposal are likely to be similar to those of Alternative 4. Additionally, although Alternative 1 allows for use of lethal methods in an integrated PDM strategy, it does not require the use of lethal methods for all projects. WS-Wyoming could implement a nonlethal only program if requested by a cooperator under Alternatives 1.

The Marin County program does not address several of the needs for action identified in Chapter 1. The Marin County program is limited to providing assistance with nonlethal damage management techniques to protect livestock. The program does not provide assistance with damage to other types of property or agricultural resources caused by predators or respond to risks to human health and safety.

Based on the limitations of the Marin County program, as noted by Larson (2006), the failure of the program to address all needs for action presented in Chapter 1 and the similarity of this program to the nonlethal only alternative (Alternative 4) analyzed in detail, WS-Wyoming 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.

3.3.12 Require Cooperators to Pay 100% of the Cost of Lethal Removal, Thereby Increasing the Availability of Federal Funds for Nonlethal Control

This alternative is a modification of Alternatives 1 and 5 in which WS-Wyoming would use an integrated PDM approach, including the use of nonlethal and lethal management techniques, to address conflicts with predators. Under Alternative 1, preference is already given to use and recommendation of nonlethal methods when practical and effective. Alternative 5 would require sustained use of nonlethal before lethal methods could be implemented. Implementation of this proposed alternative, although appealing to individuals who are opposed to the use of federal funds for lethal PDM, would have unintended adverse consequences in terms of unequal access to federal assistance with PDM. In many instances, cooperators contact WS-Wyoming after attempting practical nonlethal methods most likely to be effective for their situation on their own and failing to resolve their damage problem. In a 2011 NASS report, nationwide, livestock producers reported spending an estimated $188.5 million on nonlethal PDM methods in 2010 just to reduce depredation on cattle (NASS 2011). Under this alternative, these cooperators would have to bear the fiscal burden of lethal PDM even though they had made a good-faith effort to implement appropriate nonlethal methods. However, a producer who had not implemented nonlethal PDM methods or only limited use of nonlethal PDM on their own prior to contacting WS-Wyoming would qualify for federal assistance with nonlethal PDM methods. Additionally, the availability and efficacy of damage management methods are not equal for all types of damage. For example, more nonlethal methods are available and may be more effective for livestock in fenced pastures than for livestock grazing on open range and fewer nonlethal methods are available to protect range cattle grazing on open range from bear and lion predation than to protect flocks of sheep. Consequently, under this proposal, federal assistance with implementation of PDM would be unequally distributed to individuals experiencing conflicts with predators based on the availability of suitable effective nonlethal methods and not on actual need for assistance or effort in seeking to implement nonlethal PDM on their own.

This proposal is also problematical when considered in context of EO 12898 Federal Actions to Address Environmental Justice. In this case, access to lethal PDM assistance from WS-Wyoming would be predicated on the ability of the producer to afford to pay expenses. Low-income producers may not have the funds to pay for lethal PDM assistance from WS, particularly if they have already recently paid to implement new nonlethal methods. It is the policy of the WS-Wyoming program to use available public funds for PDM to provide assistance to all producers equally based on need for action, not ability of individuals to pay for services. This proposal will not be considered in detail because of the problems associated with unequal access to federal fiscal assistance with PDM.

3.3.13 No WS-Wyoming PDM on Federal Public Lands

Access to lethal methods for PDM on federal public lands by WS-Wyoming is determined by state regulations and the management plans and policies of the respective federal agency. Producers leasing grazing allotments, natural resource managers working to protect sensitive species and agency officials responding to threats to human safety associated with predators on federal lands have legal access to the same types of damage management methods as would be used by WS-Wyoming. The primary exceptions are that use of DRC-1339 is restricted to WS-Wyoming and that the USFS does not allow entities other than WS to conduct aerial hunting or use M-44s on forests in Wyoming (See Section 3.1.2). No M-44s have been used on any National Forest lands within the past 10 years, so loss of WS-Wyoming access to this method will

not substantively impact PDM on USFS lands. Given the limited take of coyotes and red foxes on USFS land, equivalent numbers of animals could be taken by non-WS entities on USFS lands using traps, snares, and shooting in the absence of aerial shooting (See Section 3.1.2).

The only use of DRC-1339 that would occur on federal lands would be to address common raven, American crow and black-billed magpie predation on sensitive species or on newborn livestock. Discontinuation of use of DRC-1339 on federal lands would likely decrease impacts to crows and ravens, as noted for Alternatives 2, 3, and 4, although alternative methods may be used to make up some of the difference. Analyzed risks to non-target species from DRC-1339 are already very low and discontinuation of this method is unlikely to substantively impact non-target species populations, although some projects with the potential to benefit other wildlife populations may not be conducted or may not be as effective in the absence of DRC-1339 use (e.g., sage-grouse nest protection projects).

PDM activities are conducted on federal lands by county trappers (i.e., employees of county PMDs) and by private ranchers and their employees. Depending on the training and experience of the individuals conducting the work, selectivity of these actions for target species and target animals (e.g., older territorial adult coyotes that can be more difficult to capture than younger individuals) may be lower than for a program conducted by trained personnel from WS-Wyoming (Sacks et al. 1999, Larson 2006). Traps and snares that might be used on USFS lands under this alternative in lieu of aerial shooting by WS-Wyoming have greater risks to non-target species than aerial shooting. Traps, snares and shooting are more likely to be used as corrective PDM methods during the summer months when recreation on USFS lands is likely to be greatest and the greater frequency of use of these methods increases the probability of negative interactions between PDM actions and other site uses. Given that the risks to target and non-target species and recreation on federal lands have the potential to be greater than for the current and proposed alternative, that selection of this alternative would likely reduce public access to information on the PDM conducted on federal lands; and that the impacts of this alternative would be intermediate to alternatives already addressed in detail (e.g., Alternative 1 and Alternative 2 or Alternative 5 and Alternative 2), this alternative was not selected for detailed analysis in the EA.

3.4 STANDARD OPERATING PROCEDURES (SOPs) FOR WILDLIFE DAMAGE MANAGEMENT TECHNIQUES

Mitigation measures are any aspects of an action that serve to prevent, reduce, or compensate for negative impacts that otherwise might result from that action. The current program, both nationwide and in Wyoming, uses many such mitigation measures which are built into the program. Key mitigating measures are incorporated into all the alternatives as applicable, except the no federal program alternative (Alternative 2). Most mitigation measures are instituted to abate specific issues while some are more general and relate to the overall program. Mitigation measures include those recommended or required by regulatory agencies, such as EPA, and these are listed where appropriate. Additional specific mitigation measures to protect resources such as T&E species are addressed below.

3.4.1 Standard Operating Procedures (SOPs)

- WS-Wyoming activities are consistent with national WS mitigation measures, and comply with guidance established by USFS LRMPs, BLM RMPs and Interim Management Guidelines for WSAs.

- National MOUs with the BLM and USFS delineate expectations for PDM on public lands administered by these agencies. WS-Wyoming work plans are developed in coordination with BLM Field Offices and USFS NFs. Work plans detail activities, target species, and mitigation measures to be implemented on allotments where PDM is needed. This minimizes potential impacts on recreational and cultural resources, hunting, sensitive species, wildlife viewing and other land uses.
- WS-Wyoming coordinates with tribal officials to identify and resolve any issues of concern to Indians on tribal lands.
- The use of PDM methods, such as traps and snares, conform to current rules and regulations promulgated by WGFD.
- Pesticide use complies with EPA rules and regulations administered in Wyoming by WDA.

3.4.2 WS Measures Specific to the Issues

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

3.4.2.1 Effects on Target Predator Species Populations

- PDM is directed toward localized problem predator populations or individual offending animals, depending on the species and magnitude of the problem, and is not an attempt to eradicate populations in the area or region.
- WS-Wyoming Specialists use specific trap types, lures, and trap placement techniques that have a high probability of capturing the target animal(s).
- WS-Wyoming take is reported to WGFD and is monitored. Consideration of total harvest and estimated population numbers of key species are used to assess cumulative effects to maintain the magnitude of harvest below the level that would impact the viability of populations of native species (see Chapter 4). WS-Wyoming provides data on total take of target predator numbers to PMDs and to the BLM and USFS in annual work plan meetings.
- WS-Wyoming shall consult with appropriate WGFD personnel prior to implementing any control action to address trophy game animal conflicts with private property, livestock or when HHS is at risk, unless the WGFD has already provided prior written approval to WS-Wyoming.
- WS-Wyoming currently has agreements for PDM on 65.0% of the land area in Wyoming and generally conducts PDM activities on 46.2% of the land area in any one year (for FY2010-FY2014 reporting period), and therefore, has no impact on target predator species on approximately 54% of the land area in Wyoming.

3.4.2.2 Effects on Non-target Species Populations, Including T&E Species

- WS-Wyoming personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with minimal effect on non-target animals/species.
- Traps and snares are not set within 30 feet of exposed carcasses to avoid capturing scavenging birds. The only exception to this policy is for the capture

of mountain lions and black bears because the size of these two target species adequately allows for the adjustment of foot capture device tension adjustments to exclude capture of smaller non-target animals.

- Foot-hold trap pan tension devices are commonly used by WS to minimize the capture of non-target species that weigh less than the target species.
- Breakaway snares designed to open and release pressure under the tension exerted by larger non-target animals such as deer, antelope and livestock have been developed and are being refined. These snares are employed by the WS-Wyoming program, as appropriate.
- Non-target animals captured in foot-hold traps or foot snares are released at the capture site unless it is determined by WS-Wyoming Specialists that the animal is seriously injured and/or will most likely die if released.
- WS-Wyoming Specialists use specific trap types, lures and placements that have a high probability of capturing the target animal, while minimizing potential non-target species captures.
- WS-Wyoming personnel engage in cooperative research to continue to improve the selectivity and effectiveness of management devices.
- WS-Wyoming avoids wild horses by directing aerial shooting operations conducted below 500 feet away from herds. WS-Wyoming strives to maintain a distance of ½ mile or more from wild horse herds detected during the foaling season (March 1 through June 30).
- WS has adopted and implemented all reasonable and prudent alternatives to protect T&E species that were identified by USFWS in their Biological Opinion (USFWS 1992) during a nationwide WS program consultation and determined to be applicable to WS. In addition, WS-Wyoming conducted an informal consultation with USFWS for wildlife damage management activities (USFWS 2015). WS-Wyoming has adopted the recommendations made by USFWS to protect the federally listed gray wolf, Canada lynx and grizzly bear.
- WS personnel will contact either the local WGFD office or the appropriate USFWS regional or field office to determine nest and roost locations of bald eagles.
- The appropriate USFWS office will be notified within 5 days of finding any dead or injured bald eagle. Cause of death, injury, or illness, if known, will be provided to appropriate USFWS personnel.
- Foot-hold traps (except those used to trap mountain lions) shall be placed a minimum of 30 feet from above-ground bait sets.
- When bald eagles are in the immediate vicinity of a proposed PDM program, WS personnel will conduct daily checks for carcasses or trapped animals.

3.4.2.3 Impacts on Special Management Areas

- WS-Wyoming conducts PDM on SMAs only upon request when and where a need exists. All PDM activities conducted in SMAs, including WAs and WSAs, are in accordance with MOUs between WS-Wyoming and other agencies, enacted rules and regulations, and the respective land management agency's policies and procedures.
- WS-Wyoming personnel follow guidelines specified in work plans developed in cooperation with the respective land management agency. These plans include

delineation of areas where certain methods may not be used during certain time periods when conflicts with recreational events may occur. If it were necessary to work in areas outside of the planned area, WS personnel would contact the area manager or their representative.

- WS-Wyoming conducts PDM activities in accordance with, and in the areas specified in, BLM RMPs and USFS LRMPs.
- Vehicle access would be limited to existing roads, unless off-road travel is specifically authorized by the land management agency, as reflected in the relevant LRMPs and RMPs.
- PDM in WAs would be implemented in accordance with wilderness policies and MOUs.
- WS-Wyoming does not anticipate conducting PDM in National Parks. The potential exists that a request could come from the National Park Service or WGFD for responding to a threat to HHS or for research purposes.
- Should any of BLM's existing WSAs be officially designated as WAs in the future, PDM will be performed in accordance with the BLM Wilderness Management Policy of 1981 and the enacting legislation, as well as the 2012 MOU between WS and the BLM.
- PDM in Wilderness Areas and Wilderness Study Areas would be conducted in accordance with each land management agency's Wilderness Policies and guidance documents (e.g., BLM Manual 6330, and 6340) and MOUs and the provisions identified in AWPs.
- Should any of BLM's existing WSAs be officially dropped as a WSA, PDM would follow standard procedures for public lands, as specified in the work plan.

3.4.2.4 Effects on the Socioeconomic Environment

Humaneness of Damage Management Techniques

- When practical, chemical immobilization and euthanasia procedures to reduce stress are used by certified WS-Wyoming personnel.
- WS-Wyoming personnel euthanize captured target animals slated for lethal removal as quickly as possible. In most field situations, a shot to the brain with a small caliber firearm causes rapid unconsciousness, followed by cessation of heart function and respiration8.
- Traps are set and inspected in accordance with WGFD regulations and WS-Wyoming policy.
- Ongoing research addresses the goal of improving the humaneness of PDM devices.
- The most appropriate management tools are used by skilled WS Specialists, who are highly successful at capturing targeted individual animals.

Effects on Recreation

- Work plans provided by WS-Wyoming to BLM and USFS and the associated maps provided by BLM and USFS delineate the areas where and when PDM can occur and the methods that can be utilized on public lands. The work plans

[8] A well-placed shot to the head is one method that meets the AVMA's definition of euthanasia. In some situations, accepted chemical immobilization and euthanasia methods are used.

define zones where PDM will be limited or not allowed because of potential conflicts with other land uses including recreation.

3.4.2.5 Impacts on Human Safety

- A formal risk assessment reported that hazards to the public from PDM devices and activities are low (USFWS 1992).
- Public safety zones are delineated and defined on work plan maps by BLM and USFS during the review phase. The public safety zone is ¼ mile, or other appropriate distance, around any residence or community, county, state or federal highway, or developed recreation site. PDM conducted on federal lands within identified public safety zones will generally be limited to activity aimed at the protection of HHS. However, the land management agency could request PDM activities in the public safety zone for an identified need. Land management agencies will be notified of potentially controversial PDM activities that involve methods such as firearms, M-44s, dogs, and traps before these methods are used in a public safety zone, unless specified otherwise in the work plan.
- All pesticides used by WS-Wyoming are registered with EPA and WDA. WS-Wyoming employees will comply with pesticide directions and label guidelines, and EPA and WDA rules and regulations.
- WS-Wyoming Specialists who utilize restricted-use chemicals (i.e., pesticides, immobilizing agents) are trained and certified in the safe and effective use of these controlled substances and pesticides under EPA and WDA guidelines. WS-Wyoming employees using restricted-use chemicals participate in continuing education/training programs to keep abreast of developments and to maintain their certifications.
- M-44s are used by WS-Wyoming personnel who have received state certification through the WDA. PDM activities that involve the use of sodium cyanide in association with the M-44 device are conducted in accordance with both state and federal EPA regulations and label restrictions (WS Directives 2.401, 2.405, 2.415).
- Conspicuous, bilingual warning signs alerting people to the presence of PDM tools are placed at major access points where such tools are deployed in the field, or as more specifically required for the respective method.

3.4.2.6 Impacts on the Environment from the Use of Aircraft

- WS-Wyoming avoids wild horses by directing aerial shooting operations conducted below 500 feet away from herds.
- WS-Wyoming strives to maintain a distance of ½ mile or more from wild horse herds detected during the foaling season (March 1 through June 30).

3.4.2.7 Effectiveness of WS-Wyoming

- The WS Decision Model (Slate et al. 1992, WS Directive 2.201) is designed to identify effective wildlife damage management strategies and their impacts. Agency personnel routinely employ the WS Decision Model in their daily decisions while conducting PDM activities.

- The cost effectiveness of different PDM methods and actions will be considered in the WS planning and decision making process. In addition to total monetary costs, consideration will also be given to other values more difficult to quantify, such as selectivity and humaneness, and non-consumptive values of wildlife, given the constraints of the financial resources available.

3.4.2.8 Indirect and Cumulative Impacts

- WS-Wyoming personnel consult with BLM, USFWS, USFS, WGFD, and other appropriate agencies regarding program impacts. BLM and USFS are contacted as needed when conducting PDM on public lands administered by these agencies. WS-Wyoming coordinates with WGFD and USFWS concerning the wildlife species being targeted and numbers taken.
- PDM is directed at local populations of problem animals or specific problem individuals in order to resolve issues.
- WS-Wyoming take is monitored and evaluated in relation to the estimated population numbers of key species. These data are used to assess cumulative effects so as to maintain the magnitude of harvest below the level that could adversely affect the viability of a population.
- WS-Wyoming consulted with the Wyoming State Historic Preservation Office on October 30, 2015, and received a response that the program is not likely to adversely affect historic properties or archeological sites per Section 106 of the National Historic Preservation Act and Advisory Council regulations 36 CFR § 800.3(a)(1). WS-Wyoming consults with cultural resource specialists from BLM and USFS to determine the potential for adverse effects of PDM activities to historic or cultural resources on public lands and the need for any mitigation measures.

3.5 COORDINATION WITH OTHER AGENCIES

PDM is based on interagency relationships, which require close coordination and cooperation because of related or overlapping authorities and legal mandates. The WS-Wyoming program cooperates closely with other federal agencies, including BLM, USFS and USFWS, as well as state agencies, including ADMB, WDA, WDH, WGFD, and WLB to protect public health and safety, property, agriculture and natural resources.

BLM and USFS: Frequent contact is made with the BLM and the USFS when WS-Wyoming is conducting PDM on public lands administered by these agencies. The BLM and USFS are interested in the numbers of livestock killed, injured and harassed by predators and the PDM methods used to stop or limit losses. Actions are consistent with WS mitigation and guidance established in USFS Land Resource Management Plans (LRMP) and BLM Resource Management Plans (RMP).

The WS-Wyoming program is conducted under cooperative service agreements and MOUs with federal and state agencies. National MOU's with the USFS, BLM, and USFWS delineate expectations for wildlife damage management. WS work plans are developed with BLM offices and National Forests to detail the activities, target species, and mitigation measures to be implemented on allotments where PDM is needed.

Wyoming Game and Fish Department: WS-Wyoming has entered into a cooperative service agreement for trophy game animals in 2015 to provide wildlife damage management services to protect agricultural, industrial and natural resources, and to safeguard HHS. WS-Wyoming recognizes WGFD as being primarily responsible for determining the means by which resident wildlife causing damage or are a hazard to HHS may be taken on both private and public lands.

Wyoming Department of Agriculture: WS-Wyoming has entered into an MOU to cooperate with WDA to conduct wildlife damage management to prevent or minimize damage caused by wildlife to agriculture, horticulture, animal husbandry, forestry, or other property. The authority that allows WDA to participate with WS-Wyoming and provide assistance in wildlife damage management is outlined in Wyoming State Statutes WYSA §11-6-101 through WYSA §11-6-108.

Wyoming Department of Health: WS-Wyoming has entered into an agreement through an MOU with WDH which fosters a partnership for discharging wildlife damage management to monitor and reduce risk of wildlife-borne diseases that can be transmitted to humans.

3.6 MONITORING

WS-Wyoming, in coordination with the appropriate state agencies, would monitor any program resulting from this EA. The impacts discussed in this EA would be monitored and evaluated in two ways:

1) WS-Wyoming would determine if any additional information that arises subsequent to a NEPA decision from this EA would trigger the need for additional NEPA compliance. WS-Wyoming would review program results and the related NEPA documents annually, or as needed, to ensure that the need for action, issues identified, alternatives, regulatory framework, and environmental consequences are consistent with those identified in the final NEPA documents.

2) WS-Wyoming, in coordination with WGFD, would monitor impacts on target and non-target wildlife populations through the MIS database maintained by WS-Wyoming. MIS information would be used to assess any localized and cumulative impacts of the program on specific wildlife populations. WS-Wyoming would provide detailed information on animals removed to WGFD and WDA to assist those agencies with managing species and resources under their jurisdictions.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when selecting a management alternative to meet the need for action described in Chapter 1. This chapter analyzes the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2 in comparison with the proposed action/no action alternative to determine if the potential impacts are greater, lesser, or similar. Cumulative effects are discussed in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from methods employed, and including summary analyses of potential cumulative impacts to target and non-target species, including T&E species.

4.1 ENVIRONMENTAL CONSEQUENCES

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

- *Direct effects* are caused by the proposed action and occur at the same time and place.
- *Indirect effects* are caused by the proposed action and are later in time or further removed in distance, but are still reasonably foreseeable. Indirect effects may include factors such as impacts on prey species, scavengers or ecosystems resulting from the removal or relocation of target predators.

4.1.1 Evaluation of Significance

All major issues are evaluated for each alternative including direct, indirect and cumulative impacts. NEPA regulations describe the elements that determine whether or not an impact is "significant." Significance is dependent upon the context and intensity of the action. WS considers the following factors when reviewing the context and intensity of the proposed actions:

- **Magnitude of the Impact.** Magnitude relates to the size, number, or relative amount of the impact. It is a measure of intensity. Magnitude as it relates to impacts on wildlife populations may be assessed as a measure of the number of individual animals or species removed in relation to their abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative analyses are preferred when possible; however, some issues do not lend themselves to quantitative analysis (e.g., some sociological issues), or quantitative data may not be available. In these instances, qualitative analyses incorporating information such as population trends, modeling, and available studies and other publications (e.g., for review of most sociological issues) may be used.

- **Duration and Frequency of the Impact.** The duration and frequency may be temporary, seasonal, or year round. Duration and frequency of impact is a measure of intensity.

- Likelihood of the Impact. The likelihood of an impact is a measure of its intensity by estimating the possibility that an activity or impact may occur.

- **Geographic Extent.** The consideration of the geographic extent of an effect may be site-specific including local (within a given management area), state/tribal, regional and/or national levels as appropriate depending on species biology and management practices and regulations. Geographic extent may also consider the range and movement patterns of animal species. The geographic extent of an effect is a contextual consideration.

- **Legal Status.** The legal status of an affected resource is a contextual consideration. Legal status may range from fully protected by federal law, such as an endangered species, to not protected by law, as is the case for coyotes, fox, skunks, and raccoons in Montana.

- **Conformance with Statutes, Regulations, and Policies.** Statues, regulations, and policies provide contextual information in the analysis. Compliance with applicable statutes, regulations, and policies can also serve as mitigation to ensure that certain types of adverse impacts on the environment do not occur.

4.1.2 Scale of Analysis Area

The scope of analysis for the proposed PDM activities is limited to the State of Wyoming because this is the scale at which the majority of the regulatory, funding, and wildlife management activities involving species addressed in this EA occur. Specifically, WGFP is the primary management authority for almost all wildlife species addressed in this EA except species federally-listed under the ESA, MBTA, and Bald and Golden Eagle Protection Act. State-level management of resident wildlife is typical across the country and is sufficient for most species with relatively limited movements and is the scale at which management plans and regulations for these species are promulgated. Therefore, we have chosen a similar scale for this impact analysis. Impacts on highly mobile species such as migratory birds are considered in context of state and regional populations. Similarly, impact on T&E species (e.g., grizzly bears) are discussed in context of overall USFWS management plans for the recovery of the species. Although the specific location where PDM occurs cannot be consistently predicted, local consequences of management actions are also addressed where applicable.

4.2 ISSUES ANALYZED IN DETAIL

The environmental consequences of the alternatives are discussed below with emphasis on the issues presented in Chapter 2. The alternatives will be compared to make a selection of the most appropriate one for WS-Wyoming compared to the current one. The damage management methods used in Wyoming to meet the purpose and the needs of the program (as identified in Chapter 1) are also included in this discussion.

4.2.1 Alternative: 1 Continue the Current Federal PDM Program

The methods used to target predators in a given damage situation depend on the species causing the damage and other factors, including location, weather, and time of year, as discussed in section 3.2 and Appendix C. These methods include foot-hold traps, padded-jaw foot-hold traps, cage traps, aerial shooting, M-44s, shooting, calling and shooting, neck snares and denning (involving the use of gas cartridges). All methods used in Wyoming are described in Appendix C of this EA.

4.2.1.1 Effects on Target Predator Species Populations

WS-Wyoming damage management activities target a relatively small number of wildlife species in the state. Section 1.2 lists these species and discusses their general biology, ecology, statutory classification and management authority as well as target status within WS-Wyoming. The primary target species taken yearly are the coyote, raccoon and striped skunk. Most other target predators are taken by WS-Wyoming only on an occasional basis, as the situation dictates. Annual take of target species by WS-Wyoming for FY 2010-FY 2014 on all land classes is presented in Table 4-1. Coyotes represented the majority of the take at 64.43%, raccoons 19.90%, common ravens 5.97% and striped skunks 4.56%. PDM-related take of predators can, and often does, vary from year to year because many factors can influence population dynamics, including availability of prey, disease, and climatic conditions such as drought. For most target species, the level of effort WS-Wyoming applies toward wildlife conflict resolution is typically proportional to the number of requests for assistance, as well as limitations of conducting damage management activities within available funding constraints. In general, when predator populations increase, damage complaints increase, which in turn leads to increased damage management efforts and, ultimately, take.

Table 4-1. Target Predators most commonly taken by WS-Wyoming during PDM activities by District from FY2010 thru FY2014 (MIS 2014).

	2010	2011	2012	2013	2014
East District					
Badger	46	36	39	21	12
Black Bear	0	0	0	0	0
Bobcat	21	14	14	22	8
Coyote	3,268	3,102	3,043	2,558	1,998
Mtn. Lion	2	2	5	1	0
Opossum	6	6	11	1	2
Porcupine	13	31	31	16	13
Raccoon	552	413	607	291	186
Red Fox	147	100	123	125	81
Skunk	373	203	160	103	80
Raven	0	0	83	9	10
Feral Cat	134	34	54	22	19
Northwest District					
Badger	4	3	5	3	1
Black Bear	2	0	2	0	2
Bobcat	1	0	0	0	0
Coyote	1,791	1,671	1,493	1,449	1,189
Mtn. lion	2	1	1	2	1
Opossum	0	0	0	0	0
Porcupine	14	7	8	3	4
Raccoon	2,295	1,693	1,620	1,305	1,597
Red Fox	204	127	129	61	64
Skunk	278	208	357	270	202
Raven	111	5	26	51	43
Feral Cat	129	175	90	62	45
Southwest District					
Badger	30	23	29	15	11
Black Bear	3	2	1	5	0
Bobcat	1	6	7	3	1
Coyote	3,166	3,104	2,712	2,528	2,132
Mtn. lion	0	0	0	0	0
Opossum	0	0	0	0	0
Porcupine	6	2	3	2	4
Raccoon	58	79	74	60	41
Raven	594	326	397	779	829
Red Fox	116	95	89	48	38
Skunk	42	40	76	61	37
Feral Cat	7	7	13	20	10

Likewise, when predator populations decrease, damage complaints tend to decrease accordingly, resulting in less

damage management activity and take (Conover 2002). Because of this close association between damage complaints and response events, take tends to be consistent with increases and decreases in target species population levels in a given locale or area.

WYSA(§23-1-101(a)(iii)), adopted by the Wyoming Fish and Wildlife Commission classified badgers, beavers, bobcats, martens, minks, muskrats, and weasels (long-tailed, short-tailed and least) as furbearers with harvest seasons and take regulations set by WGFD. For comparison and cumulative impacts analysis, the furbearers taken in the 2009-2014 Wyoming fur seasons are compiled in Table 4-2 (Frost and Tessmann 2014). Fur harvest reflects the value of the fur, the relative abundance of the species, and the level of effort (i.e., number of trappers involved). WYSA(§23-1-101(a)(iii)), adopted by the Wyoming Fish and Wildlife Commission classified coyotes, jackrabbits (black-tailed and white-tailed), porcupines, raccoons, red foxes, skunks (striped, eastern spotted and western spotted) and stray cats as predatory animals. These predatory species may be taken throughout the year without a license in any numbers (i.e., no limits). Individuals are not required to report take to WGFD.

Table 4-2. Number of Furbearers Taken in Wyoming, 2009/2010–2013/2014 Seasons (Frost and Tessmann 2014).

# Animals Taken					
Species	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Badger	1,603	1,003	795	896	563
Bobcat	1,609	1,606	1,875	1,872	1,571
Mink*	300	250	610	720	563
Weasel*	152	42	55	98	288

*2009-2010 through 2012-2013 take estimated from Figure 13 (mink) and Figure 15 (weasel) in Frost and Tessmann 2014; 2013-2014 data from Table 10 (mink) and Table 14 (weasel) in Frost and Tessmann 2014.

For each of the target species analyzed below, we provide an estimate of the maximum annual take that could occur annually (Table 4.3). This estimate provides a limit on the number of animals that could be taken by WS-Wyoming and helps to facilitate impact analysis. A number of factors can influence the rate of conflicts with predators, and there can be considerable variation in the amount of requests for PDM involving any given species from year to year. The estimates of maximum annual lethal removal by WS-Wyoming, takes this variation into consideration. In most cases, annual take will be less than the maximum set for the alternative. Under no circumstances should the maximum level of take be interpreted as the target number of animals WS-Wyoming seeks to remove. WS gives preference to nonlethal methods where practical and effective. The WS program works to resolve conflicts with wildlife while minimizing risk of adverse impacts on a case by case basis. When lethal methods are needed, efforts focus on removing specific depredating individuals or reducing local populations. PDM activities are not conducted with the intent to cause large scale population reductions. It would never be the goal of the WS-Wyoming program to take the maximum number of animals listed for each species.

Estimating wildlife populations over large areas can be extremely difficult, labor intensive and expensive (e.g., Gese and Terletzky 2009). Wildlife management agencies have limited resources to conduct wildlife population surveys and monitor population

trends. Available resources are allocated to species of greatest conservation need, popular game species with limited populations, and/or where available information indicates a harvested species may be particularly vulnerable to over-harvest. States may also monitor population health using factors such as sex ratios and age distribution of the population. Indices of abundance such as Breeding Bird Surveys also serve as measures of population health and the cumulative impact of all environmental factors on the population. This EA uses the best available information to assess wildlife population size and status. When determining impacts of program activities, as noted above, we use maximum estimates of potential take but conservative estimates of population size. In this way, the population impact assessments listed below adjust for imperfect data by erring in favor of over-estimating potential impacts on wildlife populations.

Table 4-3. Total Wyoming target predators killed during damage management activities and maximum annual take anticipated under Alternative 1. Non-target take during all WS-Wyoming wildlife damage management activities (e.g., PDM and wolf damage management) is noted in parentheses. Non-target take specifically associated with PDM activities is listed in Table 4-6.

	Fiscal Year					**Average Annual Take**	**Maximum Annual Take**
Species	**2010**	**2011**	**2012**	**2013**	**2014**		
American Crow	5	245	137	468	2,013	574	3,600
Badger	80	62 (4)	73 (27)	39 (7)	24 (10)	65	100
Bald Eagle	0	0	0	0	0	0	0
Black Bear	5	2	3	4 (1)	2	3	15
Black-billed Magpie	0	53	34	68	0	31	100
Bobcat	23	20	21 (12)	25 (6)	9 (3)	24	50
Common Raven	705	331	506	839	892	655	2,500
Coyote	8,225	7,877	7,248 (1)	6,535	5,327	7,042	10,000
Feral Cat	270	216	157 (3)	104	74	164	300
Golden Eagle	0	0	0 (1)	0 (1)	0 (1)	<1	0
Grizzly Bear	1	0	0	0	0	<1	2
Mink	0	0	0 (1)	0	0	<1	10
Mountain. Lion	4	3	6 (1)	3	1	4	15
Opossum	6	6	11	1	2	5	30
Porcupine	33	40	42 (6)	21	21 (10)	35	75
Raccoon	2,905	2,190	2,301 (6)	1,656	1,824 (3)	2,177	3,500
Red Fox	486	325	349	234 (3)	186 (12)	319	1,000
Spotted Skunk	0	0	0	0	0	0	10
Striped Skunk	695	451 (6)	593 (13)	434	319 (4)	503	800
Weasels (long-tailed, Short-tailed, Least)	0	0	0	0	0	0	10

Coyote Population Impact Analysis

Coyotes are found throughout the continental United States (Gese and Terletzky 2009). They are common throughout Wyoming, even in urban areas. The coyote's ability to

adapt to changing environmental conditions and its opportunistic nature has allowed it to expand its range. Coyote populations have increased substantially in both abundance and distribution during the past several decades (Mastro 2011), and populations now exist in most large metropolitan areas (Malmlov et al. 2014). This species is characterized by a unique resilience to change because of its ability to adapt to adverse conditions and persevere.

Under WYSA (§23-1-101(a)(viii)(A)), coyotes are classified as predatory animals and may be taken year round. Due to this statutory classification, WGFD does not track coyote populations or harvest levels. In areas where coyotes prey on domestic livestock, WS involvement in PDM includes technical assistance on nonlethal strategies to reduce or prevent predation and, if appropriate, removal of offending individuals to prevent further losses. Most coyote damage management is limited to removal of chronic depredating animals.

Many researchers have estimated coyote populations throughout the western United States and elsewhere (Clark 1972, Knowlton 1972, Camenzind 1978, USFWS 1979, Pyrah 1984, Gese and Terletzky 2009). The most recent population estimate for the state was provided by Gese and Terletzky (2009). After reviewing relevant scientific literature and analyzing data from scat deposition transects scattered across the state, they arrived at a peak statewide population estimate of 86,601 $\pm$ 22,718 for the point in the year preceding any natural or anthropogenic mortality. There can be considerable annual variation in coyote population size. For the time period following removal of adults and prior to pup dispersal (minimum population), the population estimate was 49,854 $\pm$ 22,718.

WS-Wyoming has taken an annual average of 7,042 coyotes statewide (about 14.1% of the estimated minimum population) from FY 2010 through to FY 2014 (Table 4-3). The data indicate that WS-Wyoming coyote take has remained relatively stable, with fluctuations ranging from 5,327 (11.0%) to 8,225 (16.5% of the estimate fall population) coyotes taken per year over the last 5-years. Based on the number of cooperative agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-Wyoming expects that the past number of coyotes removed in recent years would be similar in subsequent years with maximum annual take not to exceed 10,000 coyotes per year or 20% of the estimated minimum population. Some of the take each year includes young of the year taken during denning and fall and winter PDM activities. These individuals are not included in the minimum population estimate, so the actual impact of WS' actions on the population would be less than the maximum of 20% used for our analysis.

Coyotes are highly prolific and able to recover rapidly from intense harvest pressure. While removing animals from small areas at the appropriate time can protect vulnerable livestock, immigration of coyotes from surrounding areas quickly replaces the animals removed (Stoddart 1984). Take can be up to 60% of population for a sustained time because recruitment annually replaces breeders (Pitt et al. 2001, 2003). A population model (Pitt et al. 2001, 2003) assessed the impact of removing a set proportion of a coyote population during 1-year and then allowing the population to recover. In the model, all populations recovered within 1 year when <60% of the population was removed. Recovery occurred within 5 years when 60-90% of the population was

removed. Pitt et al. (2001, 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. These models did not include immigration from surrounding areas, and, as a result are likely a conservative estimate of the level of harvest that could be sustained in a local area.

In a study by Gese (2005) approximately 44-61% and 51-75% of an estimated coyote population was removed from a 131 mi^2 project area using aerial shooting and trapping. Removals resulted in substantial reductions in coyote pack size and an associated decrease in density, but both pack size and density rebounded to pre-removal levels within 8 months. Radio collar data and shifts in age structure support the hypothesis that the coyotes colonizing the area after control were non-territorial individuals and young of the year from adjacent packs. Consistent with the predictions of the models of Pitt et al. (2001, 2003), the coyote population in the removal area had a younger age structure than the control area. Home range size did not vary for coyotes remaining after coyotes in adjacent territories were removed. Mean litter size did not differ substantially after the first year of winter and spring coyote removals but increased the second year. Average litter size correlated with the density of coyotes entering the breeding season. Increases in available prey the second year of the removals also have influenced coyote reproductive success, with a significant positive correlation between prey per coyote and litter size. However lagomorph abundance increased in both the area with coyote removal and the control area without coyote removal and was not the result of coyote removals.

Cumulative Impacts

Private coyote take may legally occur at any time in Wyoming. For example, the WDA reports that approximately 1,300 coyotes were shot from aircraft in 2015 by non-WS entities (K. Drake, WDA, pers. comm. 2016). However, it is reasonable to assume that much of the private take of coyotes by private hunters/trappers occurs in the winter season when furs are in the best condition for sale to fur-buyers. Except for records of take via aerial shooting, WGFD does not collect data on take of coyotes by entities other than WS. Given the conservative estimate of WS take as a proportion of the minimum coyote population estimate, take by non-WS entities would have to be roughly twice that of the maximum annual take by WS-Wyoming to approach the threshold at which harvest would not be within sustainable thresholds for the population (e.g., approximately 40% of the estimated population or 20,000 coyotes. A review of harvest report data from Montana and Idaho indicates that total annual coyote take over the period of 2010 to 2014 did not exceed 21,000 coyotes per year. In general, as harvest of animals by non-WS entities increases, requests to WS for assistance with lethal removal as a depredation management tool decrease Given this information, we do not anticipate that coyote take by entities other than WS would reach levels that would result in cumulative impacts that would exceed levels that could be sustained by the population. Therefore, WS-Wyoming concludes that cumulative impacts on the coyote population in Wyoming would have a moderate level of impact on the coyote population. Although temporary local reductions in coyote density could occur, these impacts are anticipated to be short-term and localized

and would not jeopardize the long-term viability of the coyote population. This conclusion is consistent with the U.S. General Accounting Office (GAO 1990) assessment regarding the impacts of WS on coyote populations in the western U.S.

Some individuals have expressed concern regarding the potential for lethal PDM to actually cause increased coyote populations and increased predation because of compensatory reproduction. Assessing the effect of damage management programs on coyote populations requires an understanding of the mechanisms and behaviors involved in regulating coyote demographic processes (Knowlton et al. 1999). Coyotes are territorial with territories spaced contiguously across the landscape like pieces of a puzzle, and coyotes are territorial year-round residents, living in summer where they can survive in winter (Weaver 1979, Gantz 1990, Shivik et al. 1996). Hence, territory density remains relatively constant (Knowlton et al. 1999) with each territory maintained and controlled by a dominant pair of coyotes (alpha pair) with associated coyotes, including pups (beta coyotes) (Gese et al. 1996a, 1996b). In a study by Gese (1998) the alpha pair was lost, and within a few weeks, the territory had been taken over by individuals from a neighboring pack. Populations also include transient and dispersing individuals. In addition, coyotes are monestrous with only the dominant breeding pair typically producing a single litter per territory each spring (Kennelly and Johns 1976); beta females may also produce offspring, but this rarely occurs (Gese et al. 1996a). Because stable populations require that breeding adults on average only recruit enough surviving offspring into the breeding population to replace themselves, normally less than 10% of the young from a given pair of coyotes need to survive and reproduce to maintain the population (Knowlton et al. 1999). The other 90% die, disperse, or fail to reproduce.

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

Dispersal of “surplus” young coyotes is the main factor that keeps coyote populations distributed throughout their habitat. Such dispersal of subdominant animals removes surplus animals from higher density areas and repopulates areas where artificial reductions have occurred. Several studies (Connolly et al. 1976, Gese and Grothe 1995, Conner 1995, Shivik 1995, Sacks 1996, Shivik et al. 1996, Gese 1999) investigated the predatory behavior of coyotes and determined that the more dominant (alpha) animals (adult breeding pairs) were the ones that initiated and killed most of the prey items. Concerns that coyote removal activities might exacerbate predation on livestock appear to be unfounded because the removal of local territorial (dominant, breeding adult) coyotes actually removes the individuals that are most likely to kill livestock and

generally results in the immigration of subdominant coyotes that are less likely to prey on livestock.

Black Bear Population Impact Analysis

The distribution and abundance of black bears is somewhat limited in Wyoming. Black bears primarily utilize habitats on lands administered by USFS, NPS, and BLM, although some habitat does exist on private lands, either directly adjacent to public lands or along riparian habitats. Black bears are found in forested areas of all major mountain ranges in Wyoming. Populations are presumed highest in northwestern Wyoming, where higher seasonal moisture creates more abundant forage. The Bighorn Mountains in northern Wyoming also contain a robust black bear population. The Snowy, Sierra Madre, Laramie Peak, and Uinta mountain ranges of southern Wyoming all contain black bear populations, although in lower densities (WGFD 2007).

Suitable habitat in Wyoming is typically more arid than in other western states[9]. As such, the production and availability of preferred bear foods is lower, resulting in larger home ranges and lower bear densities (Mack 1988, Goodrich 1990, Beck 1991, Beecham and Rohlman 1994, Grogan 1997). Although black bear densities in some areas of Wyoming appear to be lower than surrounding states (Beecham and Rohlman 1994, Beck 1991, Grogan 1997), it appears black bears in Wyoming are meeting their nutritional requirements as age at first reproduction, breeding interval, cub production and body weight are comparable to other western states (Jonkel and Cowen 1971, Beecham and Rohlman 1994, Costello et al. 2001).

Monitoring of black bear populations is very difficult. Therefore, WGFD uses sex and age classes in the annual harvest to monitor trends in black bear populations. All reported black bear mortalities in Wyoming are recorded by the WGFD. WGFD collects information on type of mortality, location, hunter identification and activity and bear sex, age and condition. WGFD will continue to record black bear harvest information and adapt black bear management (WGFD 2007).

Based on WGFD analysis of teeth from 384 female black bears harvested in Wyoming from 1988-2005, the average age of first reproduction of female black bears was 5.2 years. These data show that by their 5th summer, 70% of female black bears have produced a litter. Using the same cementum annuli technique, the average of 632 birth intervals of 384 females was 2.2 years. Although in more productive habitats females may produce up to 5 cubs per litter, females usually produce between 1 and 3 cubs per litter in Wyoming. Mean litter production from 16 female black bears handled in winter dens from 1995-2005 was 1.9 cubs/litter.

WGFD uses a range of harvest criteria to assess black bear harvest impacts in Wyoming. These include the percent of adult males in the harvest, the percent of females in the harvest and the percent of adults in the female segment of the harvest (WGFD 2007). All data are analyzed using 3-year averages compiled over a 10-year period to assess long-term trends and will continue to use a female quota system to regulate harvest of black bears in Wyoming. All human-caused mortality has an effect on black bear populations

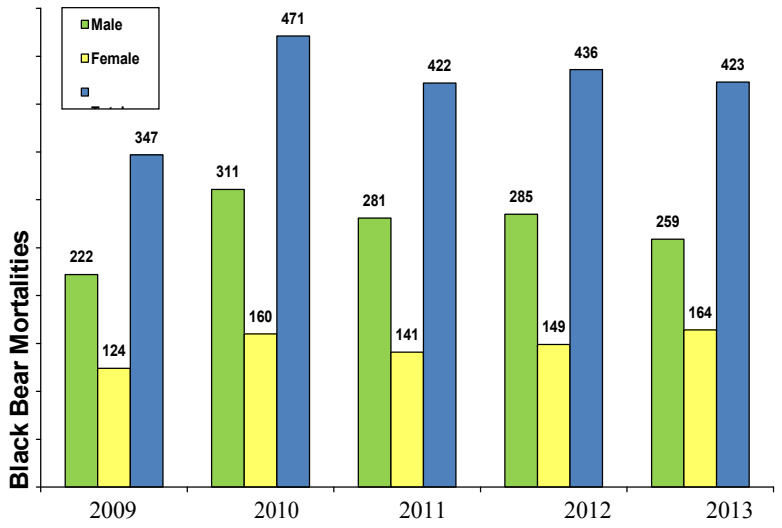
[9] In North America, there are an estimated 750,000 to 918,000 black bears, and the population seems to be increasing in size and distribution.

and female non-harvest mortality comprises up to 9.8% (mean 3.2%) of all human-caused female mortality in Wyoming. In addition to harvest criteria, the WGFD monitors annual average human-caused black bear mortality per area of suitable habitat for each hunt area as this index provides for a more localized impact of human-caused mortality on black bear populations. With future population density estimates, this metric may also be used to gauge the proportion of the black bear population harvested annually (WGFD 2007). Black bear populations will be maintained in all suitable habitats in Wyoming, and will be managed to provide public hunting opportunity and to minimize black bear damage and human/black bear conflicts (WGFD 2007).

Since 1994, the WGFD has used a female harvest limit system to regulate black bear harvest. Harvest limits and hunting seasons are assigned to either individual or grouped hunt areas and total harvest is considered (Figure 4-3). Bear Management Units or hunt area harvest levels are monitored and regulated by requiring all successful black bear hunters to present the skull and pelt of their harvested bear to WGFD personnel within 72 hours of taking the animal. Harvested female bears are counted against the female harvest limit for the hunt area(s) in which they were killed. Upon meeting its seasonal female harvest limit, a hunt area(s) is closed to harvest for the remainder of that season.

Figure 4-1. Annual statewide black bear mortalities* (all causes) by sex, 2009-2013 (WGFD 2014).

B- Beneficial



*There was one mortality of unknown sex in 2009 and two in 2012.

In response to depredation events, WS-Wyoming killed an average of 3.4 black bears from FY 2010- FY 2014 (Table 4-3). WGFD's black bear management objectives and hunt quota restrictions ensure that black bear populations remain healthy and viable in Wyoming (WGFD 2007). The sport harvest averaged about 420 black bears during the 2009-2013 hunting seasons, and WS-Wyoming take was about 0.8% of the known hunting harvest during this time period (Figure 4-3). Maximum annual cumulative take of black bears by WS-Wyoming is not anticipated to exceed 15 bears per year or approximately 3.6% of licensed harvest. The impact of WS-Wyoming removal on the black bear population in Wyoming is only a small portion of total harvest permitted and monitored by WGFD in mortality reports (D. Bjornlie, WGFD, pers. comm.). WGFD has decision authority over

the take and disposition of all black bears in Wyoming and, therefore, WS-Wyoming only responds to WGFD's requests to take bears causing damage and only under strict adherence to statutes and guidelines as described in WGFD (2007). WGFD monitors the black bear population closely, and, therefore, the impact of WS-Wyoming on the population has a built-in check system to assure that efforts by WS-Wyoming have a low cumulative impact on the Wyoming black bear population.

Grizzly Bear Population Impact Analysis

The grizzly bear (*Ursus arctos horribilis*) is one of two subspecies of the brown bear (*Ursus arctos*) which occupy North America. Grizzly bears have great metabolic demands requiring extensive home ranges. Home range sizes varies from 50 square miles to a few hundred square miles, and the home ranges of adult grizzly bears frequently overlap. Most areas currently inhabited by the species are represented by contiguous, relatively undisturbed mountainous habitat exhibiting high topographic and vegetative diversity. The grizzly bear was listed as a threatened species on July 28, 1975. Historically, the grizzly bear ranged from the Great Plains to the Pacific Ocean and from the northern United States border with Canada to the southern border with Mexico. Currently in the contiguous United States, the grizzly population has been reduced to roughly two percent of its former range, presently occupying only parts Montana, Idaho, Wyoming, and Washington.

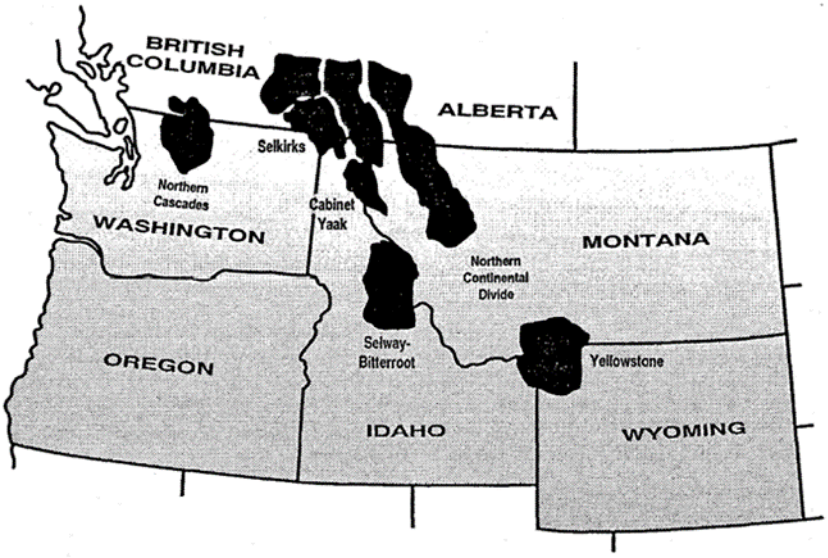


Figure 4-2. Grizzly bear ecosystems in the conterminous 48 States (USFWS 1993).

The grizzly bear is an opportunistic feeder that uses a wide variety of plant and animal food sources (IGBST 2013). The grizzly bear diet varies seasonally and yearly depending on the availability of high-quality foods. In spring, grasses, sedges, roots, moss, and bulbs are primary food sources. During summer and early autumn, berries are essential, and bulbs and tubers are also eaten. Individuals sometimes travel hundreds of miles during the autumn to reach areas of favorable food supplies, such as areas of high berry production (USFWS 1993). They also consume insects, fungi, and roots and dig mice,

ground squirrels, and marmots (*Marmota* spp.) out of their burrows year-round. Spawning fish and army cutworm moths (*Euxoa auxiliaries*) are important food sources where they are abundant. Grizzly bears consume whitebark pine seeds contained in red squirrel (*Tamiasciurus hudsonicus*) cone caches (Mattson and Jonkel 1990). Studies have shown that during poor whitebark pine seed years grizzly bears selected less for whitebark pine stands (Costello et al. 2014) and consumed more animal matter, boosting their fat levels to match those measured in years of high cone production (Schwartz et al. 2014). With this shift in habitat use studies have documented an exponential increase in human-grizzly bear conflicts (Mattson et al. 2001).

In an effort to facilitate consistency in the management of grizzly bear habitat within and across ecosystems, the Interagency Grizzly Bear Guidelines were developed by the Interagency Grizzly Bear Committee (IGBC) (51 FR 42863, November 26, 1986) for use by land managers. The IGBC developed specific land management guidelines for use in each of the ecosystems south of Canada. Six recovery zones have been established for the grizzly bear and include areas large enough and of sufficient habitat quality to support a recovered grizzly bear population within each of these ecosystems (Figure 4-2). The Greater Yellowstone Ecosystem (GYE) recovery zone is the only recovery zone that includes portions of Wyoming.

The 9,209-square mile GYE recovery zone includes portions of Wyoming, Montana, and Idaho, portions of five National Forests (Beaverhead-Deer Lodge, Bridger-Teton, Custer-Gallatin, Shoshone, and Caribou- Targhee), Yellowstone and Grand Teton National Parks, John D. Rockefeller Memorial Parkway, portions of adjacent private and state lands, and lands managed by the BLM. Using the revised demographic recovery criteria, the estimated population size for the 2014 grizzly bear population in the Greater Yellowstone Area was 757 grizzly bears (95% confidence interval = 674-839) (Haroldson et al. 2014) and has been proposed for delisting. A decision on delisting will be made in late 2016 at the earliest. If delisting occurs, management of bears in the GYE will transition to the States of Idaho, Wyoming, and Montana in collaboration with the Interagency Grizzly Bear Study Tem (IGBST). Management of grizzly bears in the GYE would be conservative, with an emphasis on minimizing conflicts between bears and people, while allowing bears to occur where they are tolerated. Grizzly bear mortalities, including any harvest limits, will be set with the goal of maintaining the GYE population size above recovery criteria (see population impact analysis below for further details).

The USFWS, in cooperation with WGFD, the USFS, National Park Service (NPS), BLM, and Eastern Shoshone and Northern Arapahoe Tribes, currently manages grizzly bears in Wyoming with the ultimate goal being a secure and recovered population of grizzly bears in the western part of the state. Cooperative management is directed by the Interagency Grizzly Bear Committee (IGBC) within which all agencies and tribes are partners. Management goals within Wyoming have been largely defined by the USFWS's Grizzly Bear Recovery Plan (1993). In general, the ultimate goal this endeavor is to manage for a recovered grizzly bear population in Wyoming and to provide for continual expansion of that population into areas that are biologically suitable and socially acceptable.

WGFD has developed a grizzly bear management plan (February 2002, amended July 2005) to affirm the State's ongoing commitment to the continued recovery of the species (Moody et al. 2005). Issues related to recovery of the grizzly bear in Wyoming include:

human health and safety, public education, habitat/population monitoring and management, hunting opportunities, livestock conflicts, property damage, range expansion, and long-term funding (Moody et al. 2005). According to details of the plan (Moody et al. 2005), WGFD will have full management authority inside and outside of the grizzly bear recovery zone (except Yellowstone National Park, Grand Teton National Park, and the Wind River Indian Reservation). Outside of the recovery zone, grizzly bears will be managed in the context of multiple use, while the focus will favor grizzly bears within the recovery zone. WGFD recognizes that successful recovery of grizzly bears requires an integrated approach that balances and incorporates the biological requirements of the bear within a broader social, economic and political framework. The success of grizzly bear management in Wyoming will be contingent upon the ability of WGFD to address these issues in a way that builds social support for grizzlies. This should allow WGFD to achieve and maintain population levels that support managing the grizzly bear as a game animal and provide regulated hunting opportunities when and where appropriate.

The best available information demonstrates that the grizzly bear population has expanded its range into areas outside the recovery zone. This expansion into previously unoccupied areas has resulted in increased grizzly bear-human conflicts. Much of the recent grizzly bear mortality is associated with conflicts arising from attractants on private lands and mistaken identification and self-defense during hunting season. However, the population is stable to slightly increasing and it continues to expand outward in the ecosystem, particularly into peripheral areas. Grizzly bears achieved recovery goals in the mid-1990s, despite long term, ongoing human-related activities throughout the GYA including purposeful removals to address damage and risks to human safety (USFWS 2015). Therefore, while the proposed action may have adverse effects on a small number of individual grizzly bears, considering the large size of the recovery zone, management within the recovery zone, overall sustainable mortality levels, and a grizzly bear population that has achieved recovery goals, it is reasonable to assume that the grizzly bear population can sustain adverse impacts that may result from the WS-Wyoming wildlife damage management program.

Mortalities of grizzly bears inside the GYE and the buffer area (Demographic Monitoring Area (DMA)) are limited by the USFWS (Frey 2015, Kasworm 2015, Costello et al. 2016, and USFWS 2016a, b) and federal regulations (50 CFR 17.40(b)). In all recovery zones, mortality limits are set as a percentage of population size. The GYE is currently estimated at 674 bears (Frey 2015). Given the current mortality limits of 7.6% of females that are at least 2 years old, 7.6% of dependent young, and 15% of males years old or older, up to 77 bears could be killed before surpassing the annual mortality limit (Frey 2015). If the GYE population is delisted, mortalities, including discretionary mortality such as hunter harvest, will be managed by the guidelines of the 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem (USFWS 2016a) which uses a sliding scale relative to population size to set limits on human-caused mortality with the goal of maintaining the population in the DMA near 674 bears (USFWS 2016a, b). If population size is estimated as fewer than or equal to 600 in any year, no discretionary mortality will occur unless necessary for human safety (USFWS 2016a, b). The 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem also states there will be no increase in the acreage of active

livestock grazing allotments nor an increase in sheep animal months relative to what existed in 1998 (USFWS 2016a). Existing sheep allotments will be monitored, evaluated, and phased out as the opportunity arises. Thus, it is unlikely that damage to livestock and grizzly bear take to protect livestock will increase substantially in the GYE if delisting occurs.

Depredation of cattle was the most frequent type of grizzly bear conflict documented in Wyoming in 2014 (79% of 164 conflicts documented in 2014 were attributed to livestock depredation) (DeBolt et al. 2014). Many issues relating to conflicts with grizzly bears may be resolved using nonlethal methods. Consequently, despite the frequency of conflicts with grizzly bears, relatively few offending grizzly bears are lethally removed by WGFD from the population in any year. The annual variation in livestock depredation incidents is not easily explained. Although most human-bear conflicts are correlated with natural food abundance, the number of cattle and sheep killed annually in Wyoming does not follow the same pattern . Currently, WGFD takes the lead on all grizzly bear conflicts in Wyoming. WS-Wyoming does not regularly address issues of grizzly bear livestock depredation; however, this relationship could change, and it is possible that WS-Wyoming could play a more active role in grizzly bear conflict management in the future. Should this occur, WS-Wyoming would coordinate all PDM actions with WGFD prior to commencing any management activities. WGFD continues to explore options to reduce grizzly bear-livestock conflicts (DeBolt et al. 2014). In the past 5 years, only one grizzly bears has been taken by WS-Wyoming (Table 4-3). While federally listed, all grizzly bear operational activities conducted by WS-Wyoming require specific authorization from the USFWS Grizzly Bear Recovery Coordinator and WGFD. These approvals are granted within the parameters of the regulations and management plans for grizzly bears including the limits discussed above. WS-Wyoming anticipates that requests to use lethal methods to resolve damage by grizzly bears will be extremely rare and will not exceed 2 grizzly bears per year (Table 4-3), with no take occurring in most years. Regardless of the limit on take by WS-Wyoming established in this EA, grizzly bear take will not be allowed to occur at levels that would result in cumulative human-caused mortality in excess of the limits set in the 2016 Conservation Strategy for the Grizzly Bears in the Greater Yellowstone Ecosystem, which includes discretionary take. Consequently, take by WS-Wyoming could be capped at levels lower than 2 bears per year. Based on this information we conclude that WS-Wyoming participation in grizzly bear damage management in the state will not adversely impact the state or regional grizzly bear population.

If delisted, would no longer received protection under ESA; however, the 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem and its protections described above would become the guiding document for grizzly bear management. WGFD has discussed the possibility of a grizzly bear hunt at some time once the bears are delisted. However, cumulative human-caused mortality, including take for damage management by WGFD and WS-Wyoming, must remain within the parameters set by the 2016 Conservation Strategy (USFWS) which aim to maintain the population at 674 bears. WS-Wyoming does not anticipate that take for grizzly bear depredation management would increase above the level predicted (2 bears) if grizzly bears are delisted.

Mountain Lion Population Impact Analysis

An important factor when evaluating management and long term viability and public acceptance of mountain lion populations is assessing mountain lion/human interactions (Apker et al. 2011). Public sentiment and support for large carnivores are influenced by localized conflicts where mountain lions threaten property/human safety/livestock (Thompson 2013). In Wyoming there are regional differences of attitudes where some residents view mountain lions as a nuisance and threat, versus viewpoints where mountain lions are revered and considered beyond the realm of ordinary wildlife conservation and management, and all variations in between (Thompson 2013). Factors such as mountain lion density as it relates to human and livestock density and prey availability/density can impact how mountain lions are viewed and react behaviorally to encounters with humans and livestock (Sweanor and Logan 2010, Bodenchuck 2011). It is WGFD's responsibility to manage and minimize mountain lion depredation to pets and livestock and reduce the potential for HHS risks (WGFD 2006). This is generally accomplished through site-specific removal of offending individuals (WYSA §23-1-101(a)(xii)(A), WGFD 2006). These types of management actions (*i.e.*, lethal removal, relocation) are taken into account when analyzing mountain lion population demographics and during the development of harvest limits on a hunting area and management unit level in Wyoming (WGFD 2006). WGFD's goal of mountain lion management is to sustain mountain lion populations throughout core habitat at varying densities depending on management objectives to provide for recreational/hunting opportunity, maintain ungulate populations at established objectives or in line with current habitat conditions, and minimize mountain lion depredation to pets and livestock and reduce the potential for HHS risks (WGFD 2006). WGFD uses adaptive management based on local biological and social conditions and management is modified/adapted over time relative to management criteria suggesting whether or not objectives have been met, to achieve balance between predator and prey populations, and address changing social factors related to depredation incidents and human-mountain lion interactions[10] (WGFD 2006).

Two important considerations in mountain lion management are biological carrying capacity and social tolerance levels. Social behavior of mountain lions likely evolved to maximize individual survival and reproductive success (Logan and Sweanor 2001). Biological carrying capacity is defined as the maximum number of individuals a given unit of habitat can support over time; mountain lion carrying capacity is dependent on prey abundance. Social tolerance levels require WGFD to weigh biological and social considerations when establishing population objectives. A key objective in Wyoming's mountain lion management strategy involves minimizing conflict between humans and mountain lions (WGFD 2006).

[10] Harvest structure is based on mountain lion mortality quotas. Mountain lion mortality data include information obtained from harvest or other documented mortality (*e.g.*, natural causes, damage removals, road kills). Mountain lion mortality data are used to assess: 1) population status, 2) age and sex structure of harvest, 3) distribution of mortalities, 4) effort expended per lion harvested, and 5) to account for and set quotas. Mortality quotas are established by WGFD for each management area, and the harvest season is closed when the quota is met (WGFD 2006). Hunters must contact WGFD within 72 hours of harvest so data can be recorded. Mortality quotas are established every 3-years by WGFD and consider annual data analyses and summary, internal review and recommendations at the regional level, public review of the recommendations, and final approval by the WGF Commission.

Various studies on mountain lion population dynamics provide insights into harvest levels that can be sustained by populations. Ashman et al. (1983) believed that under "moderate to heavy exploitation of 30%-50% removal", mountain lion populations for their study area in Nevada had the recruitment (reproduction and immigration) capability of rapidly replacing annual losses. Logan et al. (1996) determined the average annual rate of increase in the adult mountain lions in a New Mexico study varied from 5-17% during a 7-year period without exploitation that followed 4 years of intensive mountain lion management, to 21-28% in a population where harvest and management was simulated by removing half of the lions from the study area. They concluded that rates of increase in mountain lion populations are density dependent, meaning that, as a population declines in relation to carrying capacity, the rate of increase becomes greater. This is a natural mechanism of wildlife populations that serves to protect species by enhancing the ability of populations to recover from declines. Logan et al. (1996) suggested that, for a mountain lion population to remain at or near the maximum supported by the habitat, no more than 11% of the adults should be harvested per year. Logan's study was based on a relatively isolated population in the San Andres Mountains. An important distinction to be made is that the mountain lion population in Wyoming is not isolated and is hunted, and currently occupies most timbered and tall-shrub covered regions statewide (WGFD 2006). Logan et al. (1996) suggested that, for a population managed for control, the harvest level might needs to exceed 28% per year to cause the population to decline substantially. It appears that a viable population can be maintained at about 50% of carrying capacity with harvest levels that are at or below 21% or, in some years, as high as 28%.

Mountain lion populations have also demonstrated the ability for rapid growth and recovery from reduction and populations are resilient to hunting pressure because of their reproductive potential. Robinette et al. (1977) reported a total annual mortality of 32% of the population in Utah, while Ashman et al. (1983) noted a sustained total annual mortality of at least 30% in Nevada. Ashman et al. (1983) believed under "moderate to heavy exploitation (30%-50% removal)" mountain lion populations on their Nevada study areas had the "recruitment capability of rapidly replacing annual losses." Lindzey et al. (1992) documented that a population of mountain lions in Utah recovered from a reduction of approximately 42% in only 9 months. Similarly, mountain lion populations recovered from comparable reductions in New Mexico and Wyoming in 31 and 36 months, respectively (Logan and Sweanor 2001, Anderson and Lindzey 2005). Anderson and Lindzey (2005) concluded mountain lion populations would be stable or increasing as long as adult female harvest was ≤ 25% of the harvest, and with an annual harvest of more than 25% of the total mountain lion population. Anderson and Lindzey (2005) found after a 66% population reduction by hunting in Wyoming, the mountain lion population recovered in numbers within 3 years with about 18% of the mountain lion population harvested annually. Ross and Jalkotzy (1992) documented a population increase of approximately 40% in an Alberta mountain lion population from 1984-1989, following a decline in hunter harvest. Logan and Sweanor (2001) found a peak annual growth rate of 28% for adult mountain lions following removal of 58% of the independent mountain lions (adults and subadults) and the population recovered in 31 months.

Although population estimates have traditionally been lacking, evidence based on professional experience and opinion (*i.e.*, local wildlife biologists, game wardens),

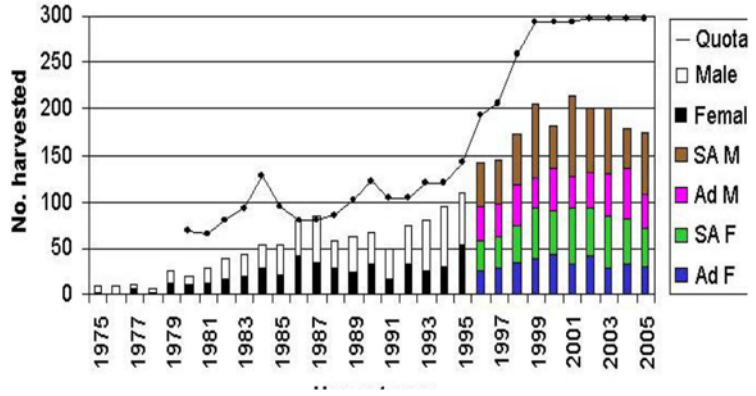
increasing mountain lion harvest levels, hunter observations, sightings, and non-harvest-human caused mortalities indicate mountain lion populations have increased in Wyoming over the past 30 years (WGFD 2006). Current WGFD harvest quota maximizes management flexibility by maintaining high hunting opportunity and controlling harvest by assigning total and sometimes female subquotas by hunt area depending on local management objectives. Rarely are harvest quotas exceeded in Wyoming, but heavily roaded areas are more prone to multiple hunters harvesting mountain lions at the end of the season, thereby exceeding harvest quotas. If exceeding harvest quotas becomes a recurring problem, WGFD could implement limited entry seasons in those areas or quotas could be adjusted anticipating additional harvest similar to past seasons (WGFD 2006).

Although mountain lion populations have previously been monitored with intensive capture efforts over relatively small areas, reliable and affordable techniques to monitor mountain lion populations for large-scale management programs are lacking. Mountain lion management has traditionally employed harvest strategies. Conceptually, the likelihood of a specific sex or age class of mountain lion being harvested would reflect its relative abundance in the population and its relative vulnerability based on daily movement patterns. Evidence, based on professional experience and opinion (*i.e.*, local wildlife biologists, game wardens), increasing mountain lion harvest levels, hunter observations, sightings, and non-harvest-human caused mortalities indicate mountain lion populations have increased in Wyoming over the past 30 years (WGFD 2006).

WS-Wyoming removed 17 mountain lions during the FY 2010-FY 2014 time period for the protection of livestock and HHS. Total mountain lion take by WS-Wyoming varied over this time period, from a low of 1 in FY 2014 to a high of 7 in FY 2012, and is very low when considered as a percentage of the sport harvest (Table 4-3). Analysis of the combined mountain lion take by WS-Wyoming and other entities/individuals shows that the percentage of the population annually removed has been less than the established quota by WGFD (Figure 4-3).

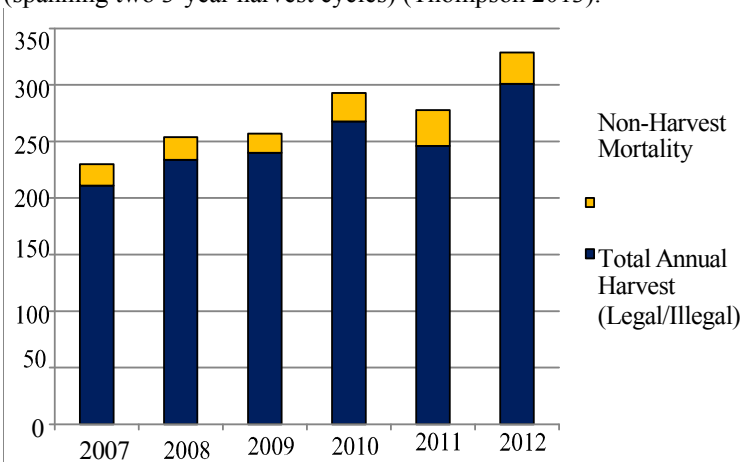
Overall, mountain lion harvest increased from 1975 through 2003 during the Wyoming harvest seasons, largely driven by increased and/or sustained harvest in the northeast and north-

Figure 4-3. Wyoming Mountain Lion Harvest by Sex and Age Class (subadult = SA, adult = Ad; 1996-2006) and Annual Quotas (1980-2006) (Thompson 2013).



central MLMUs[11]. In total, adult females comprised 16.9% of the harvest (total female harvest of 41.9%), with an overall density of 6.31 human-caused mortalities/1,000 km^2 of mountain lion habitat. Based on Wyoming's current management criteria, these statistics are indicative of a stable to increasing mountain lion population (Thompson et al. 2013, Figures 4-3, 4-4). Current harvest management appears to have been successful at maintaining long term viability of the species, while allowing directed harvest pressure in areas where needed (Thompson 2013).

Figure 4-4. Mortality for Mountain Lions in Wyoming 2007-2012 (spanning two 3-year harvest cycles) (Thompson 2013).



WGFD does not estimate mountain lion numbers to manage populations. Rather, population trends are assessed through sex and age composition of mortality data (hunter-caused and other forms of mortality). The use of WGFD's source/stable/sink harvest management criteria accounts for transient sub-adult mountain lions (Sweanor 1990, Thompson and Jenks 2010) and results in repopulation of vacant home ranges by new individuals (Robinson et al. 2008, Newby et al. 2013). In addition, WGFD continues to collect data to better manage mountain lions and increase their knowledge of the species' role and function in Wyoming (Thompson 2013)[12].

WS-Wyoming concluded that damage management activities would have minimal effects on any local populations or the statewide population of mountain lions in Wyoming. During the past 5 years (FY 2010 through FY 2014), WS-Wyoming lethally removed (intentional and unintentional take) an average of 4 mountain lions per year in Wyoming (Table 4-1 and Table 4-3). The total take by WS-Wyoming, when combined with other forms of lethal take (*i.e.*, the cumulative take), remains well below the acceptable level for sustaining a viable population in Wyoming (i.e., harvest quota) and is only a small portion of authorized take by hunters. WGFD has indicated that WS-Wyoming has had no adverse effect on the mountain lion population in Wyoming (D. Thompson, WGFD, pers. comm.). Even in the unlikely event that WS-Wyoming takes the maximum anticipated number of animals (15) per year, total removal by WS in combination with all

[11] Across Wyoming, harvest fluctuated annually, depending on tracking conditions, mortality limits, lion densities, and local hunter effort.

[12] Currently, WGFD is working collaboratively with the Teton Cougar Project to assess efficacy of multiple noninvasive monitoring techniques for possible use in conjunction with current harvest analyses to evaluate population trend. WGFD is similarly exploring the use mark-recapture analyses using genetic sampling methods to estimate abundance and movement of mountain lions on a landscape level such as multiple hunt areas or potentially management units depending on effort. Results of these efforts will be incorporated into annual reports and, if proven effective, potentially used to more accurately monitor mountain lions in the state.

other factors would still be within allowable threshold for the population as set by WGFD.

WS-Wyoming would continue to coordinate management activities with WGFD and remove only problem mountain lions on a case-by-case basis. WGFD (2006) relies on a mountain lion conflict procedure to address damage situations. Although WYSA allows for the take of mountain lions depredating livestock, aesthetic value, trophy value, and removal costs are also considered when making removal decisions (Lindzey 1987). In Wyoming, there are currently two approaches to reduce mountain lion damage: 1) remove the offending individual, and 2) increase take through sport hunting. Even under this scenario, WS-Wyoming would not expect the level of mountain lion removal to increase substantially; however, in the unlikely event that it did, take would be coordinated with WGFD, and actions would only occur with concurrence from WGFD, such that, when combined with other forms of take, would be expected to be well below allowable harvest levels.

The fact that the mountain lion population in Wyoming has been able to sustain harvest levels at steady to increasing rates for so long a period of time is testimony to the efficacy of the efficacy of WGFD's management strategy. Therefore, from this evidence, it is determined that WS-Wyoming is not having a direct or cumulative adverse impact on the mountain lion population in Wyoming and the impacts are considered to be of low magnitude.

Red Fox Population Impact Analysis

Red fox are the most common and well-known species in the genus *Vulpes* and are the most widely distributed nonspecific predator in the world and occurs statewide in Wyoming (Voigt 1987). Red fox are regarded as nuisance predators in many regions, preying on wildlife and livestock, and have become notorious in many areas of the world as carriers of diseases (Andrews et al. 1973, Tabel et al. 1974, Tullar et al. 1976, Pils and Martin 1978, Sargeant 1978, Voigt 1987, Allen and Sargeant 1993). Red fox have been the subject of many studies during the last 25 years and investigations have revealed that red fox are extremely adaptive and diverse in their behavior and habitats (*e.g.*, Cyper 2003).

The density of red fox populations is difficult to determine because of the secretive and elusive nature of this species. However, the red fox has a high reproductive rate and dispersal capacity similar to coyotes, and can withstand high mortality within the population (Allen and Sargeant 1993, Voigt 1987, Voigt and MacDonald 1984, Harris 1979, Pils and Martin 1978, Storm et al. 1976, Andrews et al. 1973, Phillips and Mech 1970). Storm et al. (1976) stated that 95% of the females (43.6% were less than 1 year old) bred successfully in a population in Illinois and Iowa. Litter sizes averaged about 4.7 for 13 research studies and litters with as many as 14 and 17 offspring have been reported (Storm et al. 1976, Voigt 1987). Ables (1969) reported that more than one female was observed at the den and suggested that red fox have "helpers" at the den, a phenomena observed in coyotes and other canids. Reported red fox population densities have been more than 50 per mi^2 (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986) where food was abundant; Ontario population densities are estimated at 2.6 animals per mi^2 (Voigt 1987), and Sargeant (1972) reported 1 fox den per 3 mi^2 in North Dakota.

Red fox dispersal serves to replace and equalize fox densities over large areas and over a wide range of population densities (Lieury et al. 2015, Allen and Sargeant 1993, Phillips and Mech 1970). Annual harvest in localized areas in one or more years will likely have little impact on the overall population in subsequent years, but may reduce localized predation (Allen and Sargeant 1993). Phillips 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 state that habitat destruction that reduces prey numbers, water, and cover will affect fox populations to a greater extent than short-term harvest. Lieury et al. (2015) tested several strategies for reducing red fox numbers in 5 areas measuring 630 mi2 (+ 136 mi^2). The authors found strong compensatory density feedback, primarily through immigration, that enabled fox populations to withstand relatively high culling rates. In general, culling was ineffective in reducing late winter fox densities below 25-32% of estimated biological carrying capacity for their project area (3.8 foxes per mi2). On average, an annual removal of 45% of the pre-breeding population was required to maintain fox densities at 2.6 foxes per mi^2 although there was substantial variation among sites. Required culling rate to maintain a reduced fox population dropped to 25% if removals could be conducted in winter after the primary fox dispersal period.

The red fox is classified by Wyoming State statute §23-1-101(a) (viii) (A) as a predatory animal. As such, public take of red foxes is not tracked by WGFD. WS-Wyoming take of red foxes for damage management averaged 319 for the FY 2010 – FY 2014 time period (Table 4-1 and Table 4-3) (MIS 2014). If it is estimated that red foxes occur at a density of about 1/mi^2 in Wyoming, this would amount to a statewide population of about 97,000 red foxes. The average annual take 319 by WS-Wyoming for the FY 2010 through FY 2014 period is about 0.36% of the estimated statewide population. Davis (1974) determined the sustainable harvest level for red fox to be 70% of the total population and red fox population studied by Lieury et al. (2015) was able to sustain harvest of up to 45% of the population. Consequently, WS-Wyoming take is well within thresholds which may be sustained by the population. Similarly, the maximum annual take of 1,000 red fox per year (1% of estimated population) would be well within the levels which could be sustained by the population. Although no data on red fox take by non-WS entities is available, total take would need to exceed approximately 42,000 red foxes per year for a cumulative impact of 45% of the population which is highly unlikely. Therefore, WS-Wyoming take is considered a low magnitude impact and could increase markedly before an impact on the population is realized.

Common Raven Population Impact Analysis

The common raven, the largest bodied passerine, is geographically and ecologically one of the most widespread naturally occurring birds in the world. The current raven population level in the western United States is considered to be higher than it has ever been recorded and raven numbers are rebounding in some of the raven's eastern range (Boarman and Heinrich 1999, Sauer et al. 2014).

In many areas of the West, the raven is seen as an indicator of human disturbance because it is often associated with garbage dumps, sewage ponds, highways, agricultural fields, urbanization, and other typical signs of human-altered landscapes (Boarman 1993,

Kristen and Boarman 2003). Supplemental food sources such as garbage, crops, road-kills, etc., may give the raven an advantage over other less opportunistic feeders and appear to have allowed the raven population to increase precipitously in some areas. In western California, portions of the Mojave Desert raven populations have increased 1500% over the last several decades consistent with urban growth in the region (Kristin and Boarman 2003). In Wyoming raven abundance has increase significantly from 1970 to 2012 (Figure 1-1).

The majority of raven take by WS-Wyoming has been the result of requests for the protection of livestock and natural resources with most ravens taken by use of DRC-1339-treated baits.

The Breeding Bird Surveys (BBS) is one of the primary methods used to track trends in bird abundance. The BBS is a large-scale inventory of North American birds coordinated by the U.S. Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2014). The BBS is a combined set of over 5,000 roadside survey routes primarily covering the continental United States and southern Canada. The BBS was started in 1966, and routes are surveyed in June by experienced birders. The stated primary objective of the BBS has been to generate an estimate of population change for all breeding birds. The BBS analyzes bird population trends at the national, regional, and state levels and for Bird Conservation Areas (based on physiographic characteristics). Populations of birds tend to fluctuate, especially locally, as a result of variable annual local habitat and climatic conditions. Trends can be determined using different population equations and statistically tested to determine if a trend is significant. The breeding bird survey uses a 95% confidence interval as the credible interval for trend estimates.

To use the BBS, though, a few assumptions need to be accepted:

- All birds within a ¼ mile of the observer are seen at all stops on a BBS route; this assumption is faulty because observers often cannot see a ¼ mile in radius at all stops due to obstructions such as hills, trees, and brush and because some bird species are elusive. Therefore, the birds seen per route would provide a conservative estimate of the population.

- The chosen survey routes are fully representative of habitats in the survey area. Routes are randomly picked throughout the survey areas, survey rules allow the observers to make stops for surveys based on better quality habitat or convenient parking areas, even though the survey sites are supposed to be spaced a ½ mile apart. Therefore, if survey areas had stops with excellent food availability, such as a landfill site or waterfowl nesting habitat where birds may congregate, the count survey could be biased. This would tend to overestimate the population. However, if these sites were not on a route at all, the population could be underestimated.

- Routes are randomly selected. Routes are randomly picked throughout the survey areas, but are placed on the nearest available road. Some birds tend to congregate along roadsides and others avoid roadside areas. Additionally, most BBS routes are selected because they are “off the beaten path” to enable the observer to hear birds without interruption from vehicular noise, so they may under-represent birds that have adapted to urban areas.

- Birds are equally distributed throughout the survey area. Each bird species has its own specific habitat requirements. This assumption is likely to be less of a problem for habitat generalists and birds such as ravens which use relatively abundant habitat types than for birds such as shorebirds and waders.

WS recognizes the statistical variability of the data and believes that the BBS represents the best available commercial and scientific data available to evaluate bird populations and population trends. WS also recognizes that the BBS may under-sample birds not readily found along survey routes, those which are more active at other times of the year, or active at night.

In most areas ravens are a year-round resident. There is no evidence of migration from radio-tagged or marked populations in North America and Iceland (Boarman and Heinrich 1999); however, ravens have been known to move into areas just outside their typical range during non-breeding season. Further, there is some question as to whether some of the birds in flocks of floaters may be migrants (Boarman and Heinrick 1999). The BBS data are intended for use in monitoring raven population trends, but it is also possible to use BBS data to develop a general estimate of the size of the raven population. Population trend and distribution information obtained from the BBS can be particularly valuable in impact analyses because it can serve as a measure of the cumulative impact of all environmental factors on the species in question. BBS data for the period of 1966-2012 indicate a statistically significant increasing trend for common raven populations in Wyoming (4.96% per year, Figure 4-5), the Western Breeding Bird Survey Region (2.4% per year) and Nationwide (2.8% per year; Sauer et al. 2014).

Partners in Flight (PIF) compiles a database of bird populations in North America. Initially focusing on Neotropical migrants that breed in North America and winter in Central and South America, the database has expanded to all landbird species. The PIF database uses the Breeding Bird Survey as the base of its data set. The population estimates are determined using the BBS average observations per route multiplied by the area of the region that is sampled (Blancher et al. 2013). This estimate is further refined with parameters that include detection distances, pair adjustments, and time of day adjustments to come up with an estimate of the population (Blancher et al. 2013). Using methods adopted by PIF to estimate population size with BBS data yields an estimate of 1,700,000 ravens in the United States and 40,000 ravens in Wyoming (PIF 2013).

Raven nesting numbers are not precisely known over broad areas, and densities in Wyoming probably vary throughout the state depending on the availability of food, water, and the presence of human disturbance (Boarman and Heinrich 1999). Knight and Call (1981) summarized a number of studies on raven territories and home ranges in the western U.S. Nesting territories ranged in size from 1 pair/3.62 mi^2 - 15.7 mi^2 in Wyoming and Oregon. In coastal California where an abundant food supply was available, raven nesting pair density was found to be 1 pair/1.7 mi^2 - 2.0 mi^2 (Linz et al. 1990, 1992). The densities in the Linz et al. (1990, 1992) studies were probably very high as a result of human food "subsidies" and were not representative of all of California. It is likely that Wyoming also has sites with similar high nesting densities, although these sites are probably less common than in the more human-populated State of California. Based on nesting pair densities for Wyoming noted in Knight and Call

(1981), the raven territorial pair density in Wyoming could be estimated to be at least 1 pair/3.62mi^2 or about 27,000 (median = 36,500 pairs) territorial pairs.

Information on raven mortality including age-specific mortality rates and causes of mortality is limited. Current data from the Mojave Desert in California indicate 38% fledgling survival, 47% survival in the first year, 81% survival in the second year, 83% survival in the third year, and 83% survival for adult birds (Webb et al. 2004). Some information on the longevity of ravens in the wild is available in banding records. The oldest known wild raven from band data was 13 years and 4 months old (Klimkiewicz 2002). However, ravens have been known to live much longer in captivity (Boarman and Heinrich 1999). Mortality factors for ravens are not well known and probably include predation (including nest predation by other ravens), weather-related factors, disease, and human-induced mortality such as shooting. Illegal shooting is not likely to be a major contributor to the cumulative mortality because ravens quickly learn to avoid humans with firearms after witnessing a fellow raven being shot.

For purposes of this analysis, the following equation was used to calculate the number of fledglings produced annually in the raven population.

F = (N) x (Pb) x (Fls)

Where F represents the number of fledglings produced per year, N is the number of nesting pairs, Pb is the probability of nest success, and Fls is the average number of young fledged per successful nest.

The number of territorial raven pairs in Wyoming estimated above is 27,000 territorial pairs in any one year. Boarman (USGS, 2004, personal communications) estimates that only 80% of territorial pairs will nest in a given year, which would yield an estimate of 21,600 nesting pairs in Wyoming. Studies have shown a 58% to 100% nesting success rate for ravens, with an average of 72.7% success (Boarman and Heinrich 1999). At the 72.7% average level, Wyoming would have 15,700 productive nests per year. Average (± SD) clutch size reported by Boarman and Heinrich (1999) was 5.4 ± 0.42, but average fledgling success (Yf) was 2.5 ± 0.48 birds. Using the average nesting success rate (72.7%) and fledging success data (2.5) yields an estimate of 39,258 fledglings produced annually. Calculations using minimum values for nest success (58%) and fledgling success (2.5 – SD = 2.02) yield an estimate of 25,306 fledglings produced per year (Table 4-4).

The population estimate generated by the model above including the number of territorial pairs (27,000 pairs), the number of fledglings produced per year (between 22,765 and 39,258), is higher than the PIF estimate of 40,000 ravens in Wyoming, and it does not include non-breeding adult birds. For the purposes of this analysis the more conservative population estimate of 40,000 ravens will be used.

The number of young ravens successfully fledged each year is the annual production. The annual production combined with the estimated pre-breeding population represents the post-fledgling population (Table 4-4). Assuming no immigration into the population, the estimated number of ravens produced is also the number of ravens (fledglings, sub-adults, and adults) that must either die or emigrate annually in a stable population (i.e.,.

no growth or decline in raven density). The annual mortality (a composite of juvenile, sub-adult, and adult mortality/emigration) for ravens in Wyoming, assuming a stable population, would be 24% (low) – 33% (avg.) of the post-fledging population density (Table 4-4).

Table 4-4. Estimated raven population and annual mortality for Wyoming using different assumptions**.**

	Low Nesting and Fledging Success	Average Nesting and Fledging Success
Pre-breeding Raven Population (Year 1)	40,000	40,000
# of Territorial Pairs	27,000	27,000
# of Nesting Pairs	21,600	21,600
% of successful nests	58%	72.7%
# Young Fledged/Successful Nest	2.02	2.5
Total Fledglings (annual production)	25,306	39,258
Total Population Post-Fledgling	65,306	79,258
Total Population Post-Fledgling adjusted for average mortality	48,979	53,102

Table 4.5. Population impact analysis of WS-Montana's raven take and other known raven mortality in Montana.

	2010	**2011**	**2012**	**2013**	**2014**	**5-Year**
WS-Wyoming's Take	705	331	506	839	892	655
Projected Maximum Annual take by WS-	3,000	3,000	3,000	3,000	3,000	3,000
Ravens Killed in Montana by Non-WS Entities Under USFWS Permits[2]	0	28	48	48	32	31
Cumulative Total Mortality from all Known Causes	705	359	554	888	924	686
Projected Total Statewide Mortality if Maximum Take by WS-Montana	3,000	3,028	3,048	3,048	3,032	3,031
Estimated Statewide Population[3]	40,000	40,000	40,000	40,000	40,000	40,000
WS-Montana's Take as % of Estimated Population	1.8%	0.82%	1.3%	2.1%	2.2%	1.6%
Cumulative Total Mortality as % of Estimated Population	1.8%	0.9%	1.4%	2.2%	2.3%	1.7%
Projected Cumulative Take as % of Estimated Population if Maximum Take by	7.5%	7.6%	7.6%	7.6%	7.6%	7.6%

[1] Numbers may not add up to 100% due to rounding.
[2] Data from USFWS Species Tracking Summary Report compiled 8/29/2016
[3] Partners in Flight Science Committee (2015).

WS-Wyoming take, especially take associated with congregation sites such as calving grounds, airports, and landfills, would likely impact the floater segment of the raven population more than the less mobile territorial pairs. Boarman and Heinrick (1999) cite Sherman (1993) as reporting that nesting ravens in the Mojave Desert of California spent 75% of foraging time within 437 yards of the nest. Dorn (1972) also reports that, in many areas, breeders probably remain near their territories throughout the year.

WS-Wyoming provides technical assistance for raven damage. Effective nonlethal preventive techniques are harassment, use of effigies, and lethal reinforcement to keep the nonlethal hazing effective. To achieve all this WS-Wyoming often recommends individuals seek a depredation permit from the USFWS. To date, the majority of WS-Wyoming's take of ravens has been the result of requests where technical assistance has not worked for the protection of livestock. The majority of ravens are taken by use of avicide (DRC-1339) treated egg-baits. Treated egg-baits are placed in areas where ravens have been found depredating or harassing newborn livestock. The methodology used by WS-Wyoming to place treated egg baits is described in Spencer (2002). WS-Wyoming has received inquiries relative to conducting raven removal for the protection of sage-grouse nests, and has set the maximum number of ravens that could be taken per year (2,500) based on these requests.

WS-Wyoming Specialists monitor the raven numbers at baiting sites and then place an appropriate number of eggs needed to reduce the number of ravens at the site to stop further damage from occurring. At the conclusion of the treatment period, the WS-Wyoming specialist collects the unconsumed eggs and disposes of them in accordance with label directions. DRC-1339, which causes death primarily due to kidney failure, is relatively slow-acting, and birds do not die at the treatment site. This makes it necessary for the attending WS-Wyoming Specialist to estimate the number of ravens killed. To estimate the number of ravens killed, WS-Wyoming Specialists use a combination of monitoring the number of ravens at a site before and after treatment, watching ravens during treatment, and monitoring the number of eggs consumed. Each of these strategies has its strengths and weaknesses. The number of birds at a site may decrease for reasons not related to the use of DRC-1339 (*e.g.*, a roadkill carcass or spilled food attracts scavenging ravens); the amount of avicide needed for a lethal dose varies among individual ravens (each egg contains approximately 1.5 times the amount needed to kill half the birds tested (LD_{50})), and ravens may consume or cache more than one egg.

The number of egg-baits taken per raven taken varies, ranging from about 1 to 4. The National Wildlife Research Center (NWRC) using data and input provided by Wyoming and several other western states conducted computer simulations of baiting efficacy for raven management using DRC-1339 egg baits. This analysis looked at several scenarios to account for differences in feeding behaviors at the bait site and the resulting dose consumed. The simulations used a bioenergetics model to predict the caloric requirement for corvids for any geographic location in the contiguous United States (Stahl et al. 2008). The development of the model is an effort to provide an alternative to estimate efficacy based on bird feeding behavior at the bait site and the resulting dose consumed. The researchers concluded that "simulations of baiting ravens with DRC-1339 provide an efficient means of estimating consumption of a lethal dose by a bird" (Stahl et al. 2008). WS-Wyoming and the NWRC would like to conduct more research on the different

variables involved in estimating take using DRC-1339 treated egg baits. Another variable that WS-Wyoming would like to incorporate into raven take estimates would be consumption of treated egg baits by non-target species such as ground squirrels. Recent research using videography indicates that the traditional 1:2 ratio (ravens to missing eggs) used by managers to estimate raven take may result in substantial overestimation, especially if ground squirrels begin consuming egg baits (Coates et al 2007). This research enforces WS-Wyoming belief that it may be overestimating raven take. It is unlikely that the ground squirrels that consume the egg baits are affected by DRC-1339 as the LD_{50} for similar sized small mammals is very high. In fact, the amount needed to kill a fasted female albino rat (1170 mg/kg) is essentially more than would be placed out during an entire project. Conservatively, at the concentration that the DRC-1339 is used, a ground squirrel would have to consume 50 treated eggs at one sitting which is not physically possible.

The maximum annual WS-Wyoming raven take allowed by USFWS permits varies from year to year and is not expected to exceed 3,000 birds in any year. WS-Wyoming annual take of ravens has varied between 14 and 239 birds since 2010(Table 4-3), and there has be no unintentional take over this time (MIS 2015). This represents only 0.5% of the post-fledging population estimates of about 85,000. Under this alternative, future WS-Wyoming annual raven take would be an extremely low percentage of the raven population. For reasons noted above, population trend data from the Using the BBS estimated rate of population increase from the Wyoming of 4.5% per year and the estimate of 40,000 ravens in Wyoming, approximately 1,984 ravens per year are added to the Wyoming raven population annually, even with current rates of raven removal. At an estimated annual average of 5.9% per year, the estimated maximum rate of raven removal would exceed the estimate of birds added per year less annual removals already accounted for in existing population trends (average 686 ravens per year, Table 4-3). As noted in Section 1.3, the relatively high rate of increase in the raven population in Wyoming and other similar western states is believed to be the result of human-generated food and habitat subsidies and the current raven population is likely well in excess of that which would otherwise be sustained by the native ecosystem. As such, any reductions that might result from WS removals would likely serve to reduce local populations to levels closer to those which could be sustained by the natural system. The estimate of take provided above may be high relative to cumulative impacts on the population because it does not take compensatory mortality into consideration. Mortality attributable to WS-Wyoming is likely at least partially compensatory to other forms of mortality. For example, WS-Wyoming often takes ravens from flocks of “floaters” at raven congregation sites. Many of these birds are young birds without breeding territories. Data from Webb et al. (2004) indicates that first year birds have much lower survival than older birds. In other wildlife populations with high mortality rates for young non-territorial individuals, human caused mortality is often compensatory to other forms of mortality, and it seems likely that this would also be true for ravens. The USFWS is charged with maintaining healthy, sustainable populations of migratory birds including common ravens, and monitors raven take by all entities including WS. The USFWS also sets the limits on the number of ravens which may be taken. At present, permits issued by the USFWS currently allow maximum annual raven take of 3,000 birds although WS-Wyoming has not needed to take that many birds (Table 4-3). With monitoring and oversight by the USFWS, any reductions in raven populations which might result from cumulative impacts on the population would not reduce the population

below historic (pre human subsidy) norms for the species and ecosystem. Consequently, we conclude that WS actions would have a moderate effect on the state raven population and would not jeopardize the health and sustainability of the state or regional raven population.

Bobcat Population Impact Analysis

Bobcats are distributed throughout the contiguous United States, southern Canada, and much of Mexico. Bobcat populations are estimated to have increased since the late 1990s, with a U.S. population between 2.4 and 3.6 million individuals (Roberts and Crimmins 2010).

Bobcats reach reproductive maturity at approximately 9 to 12 months of age and may have one to six kittens following a two-month gestation period (Crowe 1975, Koehler 1987). Reported bobcat densities, as summarized by McCord and Cardoza (1982), range between 0.1 and 7.0/mi^2. They may live up to 14 years, but annual mortality can be as high as 47% (Rolley 1985). Knick (1990) estimated that bobcat densities on his study area in southeastern Idaho ranged from 0.35/mi^2 during a period of high jackrabbit densities, to about 0.04/mi^2 during a period of low jackrabbit densities. Bailey (1974) estimated bobcat densities in the same area to average about 0.14/mi^2. A statewide estimate of the bobcat population in Wyoming ranges from 2,481-13,783 individuals (Roberts and Crimmins 2010).

In Wyoming, the bobcat population is limited primarily by environmental conditions that affect prey availability. Based on a 25-year data set (through 2001-02), the estimated spring-to-fall survival of kittens is highly correlated ($r = 0.93$) with the abundance of the principal prey, cottontail rabbits (WGFD 2002b). Similarly, the proportion of juvenile (<1 year old) bobcats in the harvest, a measure of recruitment, is strongly correlated with prey abundance. Throughout this period, the annual harvest of bobcats did not exceed the estimated annual recruitment of kittens in the fall (WGFD 2002b).

Since 2003-04, WGFD has relied on harvest and effort indices, which provide an adequate and reliable assessment of bobcat population trends. WGFD will continue to rely on catch rate (trapper success) and catch effort (trap days per bobcat) as the two principal indices to monitor status of bobcat populations in Wyoming (WGFD 2014). Wyoming's management objective for bobcats is to maintain numbers and distribution in available habitat. WGFD has established a harvest objective of 1,800, a conservative figure based upon prior population analyses (WGFD 2002b). This harvest objective figure merely represents harvest realized under "average" conditions. In reality, the number of bobcats available for harvest depends on their abundance and reproductive success in any given year. Harvests that exceed the objective are not necessarily detrimental to the population, but can serve to identify years in which bobcats are especially abundant (WGFD 2014).

During the last 5 trapping seasons (2009-2010 through 2013-2014) seasons, reported bobcat take by licensed trappers averaged 1,707 bobcats statewide (range: 1,571-1,875). WS-Wyoming killed (target and non-target take) an average of 24 bobcats in Wyoming during the same time period (FY 2010-FY 2014), or approximatly 1.4% of the sport harvest (Table 4-1 and Table 4-3). Thus, WS-Wyoming take is a minor component of overall known bobcat mortality. Maximum estimated take of 50 bobcats would be

approximately 3% of trapper harvest and would not contribute substantively to impacts of hunter harvest monitored and regulated by WGFD. Given that all WS-Wyoming take of bobcats is reported to WGFD and WGFD monitoring and adjustment of bobcat harvest as needed, the current program would have a low level of impact and would not adversely affect the state bobcat population.

Striped Skunk Population Impact Analysis

Striped skunks are currently distributed throughout the U.S. and the southern provinces of Canada into northern Mexico (Godin 1982, Honacki et al. 1982). Striped skunks are most abundant on agricultural lands where there is an ample supply of food and cover (Hamilton and Whitaker 1979). They also adapt to life in urban areas under houses and garages (Rue 1981, Rosatte 1986a, b). Skunks in recent decades, like raccoons and opossums, have been expanding their distribution northward. They are seldom found above 5,900 feet, although they have been recorded at 13,730 feet (Rue 1981). Populations of striped skunks may experience high annual turnover and fluctuation, which may partially result from disease outbreaks.

Longevity of striped skunks is only 2 to 3½ years in the wild (Linduska 1947, Verts 1967) with populations characterized by a high turnover rate. Mortality factors include predation, trapping, shooting, motor vehicles, disease, and farm machinery. Raptors are probably the major predator of skunks, although larger mammalian predators may prey on skunks. Unlike spotted skunks, however, striped skunks become dormant in northern latitudes during winter.

Because the striped skunk is classified as a predatory animal under Wyoming statute (WYSA §23-1-101(a) (viii) (A), harvest figures, trend data and population estimates are not available for this species. 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, Hansen et al. 2004). Many factors may contribute to the widely differing population densities, including type of habitat, food availability, disease, season of the year and geographic area (Storm and Tzilkowski 1982). Specific population density estimates for striped skunks in Idaho are not available because, although managed by the IDFG, their population is not counted. For purposes of this analysis, we will conservatively estimate skunk densities at 0.3/mi^2 throughout Idaho, for an estimated population of about 29,350 animals.

Striped skunk take by WS-Wyoming averaged 503 individuals/year between FY 2010 and FY 2014 (Table 4-1 and Table 4-3) or approximately 1.7% of the population. Skunk populations can reportedly sustain a 60% annual harvest level (Boddicker 1980), and the maximum annual WS take of 800 striped skunks would still only be 2.7% of the conservatively estimated population (Table 4-7). Although take of striped skunks is low, given the high level of harvest the population could sustain and the fact that skunks are generally not a preferred species for trappers, it is highly unlikely that cumulative take of skunks would reach levels that could not be sustained by the state striped skunk population. Thus, cumulative impacts on the state striped skunk population impacts are low and would not adversely impact the state striped skunk population.

Raccoon Population Impact Analysis

Raccoons are one of the most abundant mammals in North America. Their distribution extends from southern Canada to Panama and from coast to coast. Raccoons have been extending their range northward into the Canadian Prairie Provinces (Kaufmann1982), which may have long-term consequences for prairie-nesting waterfowl. Like many wildlife species, raccoons have been introduced in portions of Europe and Asia, which has had ecological and economic consequences. They are distributed throughout Wyoming (Pipas et al. 2014) in varying densities. Like opossums, raccoons are generalists that can persist under a wide range of environmental conditions and can subsist on a wide variety of food items. They are also well adapted to urban settings and may cause problems for landowners when raiding trash cans and seeking shelter in attics and chimneys as well as outbuildings.

Sanderson (1987) stated that absolute population densities of raccoons are difficult if not impossible to determine, because of the difficulty in knowing what percentage of the population has been counted or estimated, and the additional difficulty of knowing how large an area the raccoons are using. Riley et al. (1998) reported an extremely high raccoon density of up to 130/mi^2 in an urban national park in Washington, D. C. Other studies have found raccoon densities that ranged from 9.3/mi^2 to 80/mi^2 (Urban 1970, Sonenshine and Winslow 1972, Hoffman and Gottschang 1977, Rivest and Bergerson 1981). Sanderson (1987) reported the allowable harvest level for raccoons was about 49% of the total population.

WS-Wyoming averaged an annual take of 2,177 raccoons per year from FY 2010 through FY 2014, with a peak of 2,905 raccoons removed for game protection in FY 2010 at the request of the WGFD (Table 4-1 and Table 4-3). Because raccoons are classified as predators in Wyoming, take by entities other than WS-Wyoming is not reported to WGFD. Assuming raccoons are distributed throughout much of Wyoming and it is conservatively estimated that they occur across half of the state's land area at a density of 3/mi^2, there would be about 145,000 raccoons in the state. The average annual take of raccoons (for FY 2010-FY 2014) by WS-Wyoming is 2,177 raccoons; doubling this figure to incorporate non-agency take (a liberal estimate), results in a figure of 3% of the statewide population removed annually. Similarly, assuming the maximum estimated WS-Wyoming annual take of 3,500 raccoons and equal levels of public harvest would still yield cumulative take of only 4.8% of the population. Therefore, even under very conservative assumptions, cumulative take remains well below estimated sustainable harvest levels for the population. Based on the information above, we conclude that cumulative impacts on the raccoon population would be low and would not adversely affect the state raccoon population.

Feral Cat Impact Analysis

A feral animal is one that escaped from domestication and returned, partly or wholly, to a wild or semi-wild state. Rarely will the natural environment have evolved to accommodate the feral species into its established ecology. Therefore, feral animals can cause disruption or extinction to some indigenous species, reduce the quality of the environment (including fragile ecosystems) and often cause excessive damage to property or other protected resources.

Feral cats can be found in commensal relationships wherever people are found. In many suburban and rural areas, feral cats are the most abundant predator. They are opportunistic predators and scavengers that feed on rodents, rabbits, shrews, moles, birds, insects, reptiles, amphibians, fish, carrion, garbage, vegetation, and unmanaged pet food (Fitzwater 1994). Feral cats are fairly common in Wyoming, especially in the larger towns. Litters of 2-10 kittens can be born during any month of the year; adult females may produce three litters per year under ideal food and habitat conditions. Although primarily nocturnal, feral cats may be active during the day. After several generations of living in the wild, feral cats can be considered to be totally wild in habits and temperament (Fitzwater 1994).

The impact of feral cats on wildlife populations due to predation and competition for food has been tremendous (Coleman and Temple 1989). A study conducted in the United Kingdom and surveys revealed that free-ranging cats may kill millions of animals and birds annually (Churcher and Lawton 1987, Woods et al. 1987). In addition, feral cats serve as a reservoir for human and wildlife diseases, including cat scratch fever, distemper, histoplasmosis, leptospirosis, mumps, plague, rabies, ringworm, salmonellosis, toxoplasmosis, tularemia, and various parasites (Fitzwater 1994).

The domestic cat is now found on all seven continents, with 600 million cats worldwide and 148-188 million within the United States (TWS 2011). WS-Wyoming removed an annual average of 164 feral cats from FY 2010 through FY 2014 for HHS (Table 4-3). The removal of feral cats by WS-Wyoming is considered to be of no significant impact on the human environment because cats are not an indigenous component of ecosystems in Wyoming or any state in the U.S. WS-Wyoming may be requested in the future to remove additional feral cats for the protection of HHS and pet safety, or to protect sensitive or vulnerable wildlife species (up to 300 feral cats per year). Given the productivity of feral cats noted above and the abundance of feral cats in the state, the proposed action is not anticipated to substantially reduce the state feral cat population. Any damage management activities focused on feral cats would not occur at a level to cause a significant impact to the environment or the feral cat population statewide and therefore, no further analysis of population impacts is necessary. In actuality, the effect of feral cat removal would likely be positive, especially for sensitive and vulnerable wildlife species. Even if program take increased, the resultant figure would be minor compared to the number of cats killed by animal control and humane organizations in Wyoming each year. Based upon the above information, limited removal of feral cats by WS-Wyoming will have no adverse effect on overall populations and of a low magnitude of impact on this species in Wyoming.

Badger Population Impact Analysis

Four subspecies of badgers exist in North America, with *Taxidea taxus jeffersonii* the most common subspecies occurring throughout the western United States and the only subspecies occurring in Wyoming. The geographic range of this species extends from the southern Canadian provinces southward into Mexico and from the Pacific coast eastward through the Midwestern states. The badger's range may be expanding eastward from its former boundaries within the Midwest; observations of range expansion in Missouri, southern Illinois, Indiana, and Ohio suggest that agricultural practices have converted previously forested areas to more suitable badger habitat (Leedy 1947, Mumford 1969, Hubert 1982, Mumford and Whitaker 1982, Long and Killingley 1983, Gremillion-Smith

1985, Whitaker and Gammon 1988).

Although badgers are rarely seen, their digging activities are often obvious, and may cause damage to agricultural operations. However, a fresh badger hole is certainly not a guarantee that a badger is in the immediate area, as they often move over large areas. Home range sizes of adults averaged 1.6 and 2.4 km^2 for females and males in Idaho (Messick and Hornocker 1981) and ranged from 1.4 to 6.3 km^2 in Utah (Lindzey 1978). Home ranges of two radio-tracked females in Minnesota were 8.5 and 17.0 km^2 (Sargeant and Warner 1972, Lampe and Sovada 1981). Although results have varied somewhat among these studies, average densities have ranged from 0.98-12.95 badgers/mi^2. Little is known about badger densities other than for a few intensely studied populations. Lindzey (1971) estimated that the Curlew Valley on the Utah-Idaho border supported 1/mi^2 and Messick and Hornocker (1981) found 13/mi^2 in southwestern Idaho. For purposes of this analysis, we will conservatively use the low density estimate of 1/mi^2 for Wyoming. Habitat requirements for badgers (treeless regions with relatively deep soils) (Clark and Stromberg 1987) exist across a minimum of ½ of the state's land area of 97,818 mi^2, providing suitable badger habitat for an estimated total of about 49,000 badgers.

Badger populations can sustain an annual harvest rate of 30-40% annually (Boddicker 1980). Badgers are classified as furbearers in Wyoming, but can be killed by landowners when causing damage to private property; the badger trapping season is yearlong. Because statistics are not kept for badgers taken for damage purposes, trapper harvest data are used to monitor trends in badger populations, keeping in mind that low catch rates often are more an indication of low fur prices than reductions in the population (S. Tessmann, WGFD pers. comm. 12/4/2014). Reported badger fur harvest averaged 1,434 annually for the 1981-1982 through 2013-2014 trapping seasons and averaged 1,046 badgers during the last 6 fur harvest seasons in Wyoming (Frost and Tessmann 2014, Table 4-2); WS-Wyoming removed an additional 335 badgers during FY 2010- FY 2014), or an average of 65 badgers[13] per year (Table 4-1, Table 4-3). Although statewide badger harvest by private trappers has declined since the 2010-2011 trapping season, the statewide badger population is considered secure and fluctuates within a natural range of variation; hence, there is no indication that current levels of harvest are having a significant impact on the statewide population (Frost and Tessmann 2014). Badger populations may be reduced locally due to habitat conversions, management programs or disease outbreaks impacting prey populations (*e.g.*, sylvatic plague in prairie dogs), or damage management actions on private property by property owners (Frost and Tessmann 2014). Overall, WS-Wyoming accounted for 6.4% of the badger harvest in Wyoming and 0.14% of the estimated badger population in Wyoming. Maximum estimated annual take would increase WS-Wyoming take to 0.2% of the badger population and 9.6% of trapper harvest. Because WS-Wyoming take this is substantially less than the permitted statewide private trapper harvest level, and because the badger population in Wyoming is not declining (Frost and Tessmann 2014), cumulative impacts are of a low magnitude.

[13] Badgers are sometimes taken by WS-WYOMING as non-target species incidental to damage management activities.

Porcupine Impact Analysis
Because the porcupine is classified as a predatory animal under Wyoming statute (WYSA §23-1-101(a) (viii) (A), harvest figures, trend data and population estimates are not available for this species. Clark and Stromberg (1987) reported that porcupine densities of 1 to 8 (usually 3-5) per square kilometer are normal. Much of the land area in Wyoming is not ideal porcupine habitat. Therefore, making the assumptions that porcupines occur across half of the state's land area at a low density of $1/km^2$, the porcupine population in the state is approximately 126,674 porcupines. Porcupine damage management activities target single animals causing localized problems. Given the porcupine's low population density and discontinuous distribution in Wyoming, it is rarely targeted by WS-Wyoming for nuisance or PDM. During FY 2010-FY 2014, WS-Wyoming took an average of 33.2 individuals in Wyoming (Table 4-1). Given this level of annual take, limited removal of porcupines by WS-Wyoming would have no adverse impacts on the population of porcupines in the state and would result in a low magnitude of impact.

Opossum Impact Analysis
Opossums are classified as nongame wildlife under Wyoming statutes §23-1-103 and §23-1-302 Section 6 (b) and may be taken as pests under the authority of WDA Statutes §11-5-101 through §11-5-119. Opossum damage management activities target single animals causing localized problems. Given the opossum's limited distribution in Wyoming, it is rarely targeted by WS-Wyoming for nuisance or PDM. During FY 2010-FY 2014, WS-Wyoming took an average of 5 individuals in Wyoming (Table 4-1 and Table 4-3). Maximum annual removal rate would not exceed 50 animals per year. Despite the small size of the geographically restricted population in the state and the high natural turnover of the population (*i.e.,* short life span but high reproductive rate), limited removal of opossums by WS-Wyoming would have no adverse impacts on the population and would result in a low magnitude of impact.

Crow Population Information. Crows are distributed north to south from the Yukon Territory, Canada, to Baja, California and Gulf of Mexico and are found from the west coast to the east coast (Johnston 1961). They can be found throughout the year in Wyoming (Roberts 1992) and in both rural and urban environments.

From their spring nesting colonies, or autumn and winter roosts, they forage for insects, grain and carrion. Like magpies and ravens, crows are omnivorous and eat a wide variety of foods and readily adapt to new food sources. In the Northwest there is little doubt that crows have adapted well to urban life, with many cities supporting populations of crows. Johnson (1961) reports that crows reach their peak abundance in agricultural areas where there are wooded areas and have increased in numbers where agricultural practices have increased.

Crows use a variety of natural and human-altered habitat types including rangelands, riparian woodlands (Richards 1971), mixture of open field and woodlots (Johnson 1994), croplands, wetlands, fields, roadsides, pastures (Sullivan and Dinsmore 1992), beaches, shores of streams and lakes (Good 1952, Chamberlain-Auger et al. 1990), urban/suburban areas and golf courses (Chamberlain-Auger et al. 1990, Caffrey 1992). In general, crows thrive in areas of mixed habitat (open areas interspersed with woods) and thus, have responded well to human-altered habitats (Marzluff et al. 2001).

American crow territories tend to be smaller in urban than in rural areas (Dickinson 1998) and are highly variable in size. Territory sizes range from 0.04 km2 in suburban New York (Dickinson 1998) to 2.6 km2 in a waterfowl breeding area of Manitoba (Sullivan and Dinsmore 1992). Caffrey (1992) reported an extremely high breeding density of 0.8 pairs/ha on a golf course in Encino, California. This density may be explained by the abundant food and suitable nest sites (trees) available at this site. Emlen (1942) also documented high densities (111 nests in 44 ha) of nesting crows in a walnut orchard in California. In addition, Caffrey (1992) reported territories overlapped extensively and were not defended against conspecifics in southern California. However, in Florida, Kilham (1985) reported aggressive territorial defense during the breeding season. These observations suggest significant flexibility in territory use and defense. This complex territorial behavior is influenced by a number of factors including food availability, time of year, and relatedness of individuals and mating system.

Crows are managed by the USFWS as migratory birds under the MBTA and by the WGFD as a game bird. Nationally, the Breeding Bird Survey data from 2003 to 2013 suggests that crow numbers were relatively stable in Wyoming and the Western BBS region (Sauer et al. 2014). Crow populations in the Central BBS region which includes Eastern Wyoming decreased sharply in the early to mid-2000s but have been stable to increasing since that time. The PIF database estimates there are approximately 80,000 American Crows in Wyoming. Crow populations are healthy enough and the problems they cause great enough that the USFWS has included crows in the same standing depredation order that was established for blackbirds, cowbirds, grackles, crows and magpies (50 CFR § 21.43). Under this regulation, no federal permit is required by anyone to take crows (or the other species of birds identified above) if they are committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock or wildlife; or when concentrated in such numbers and manner that they are a health hazard or other nuisance.

WS-Wyoming has lethally removed an estimated average of 574 crows per year during 2010 to 2014 (Table 4.3) while conducting wildlife damage management activities. A substantial portion of this take is associated with damage reduction at landfills. Maximum annual take is could increase to 3,600 annually depending on future requests for assistance with crow damage management. The total amount of human- and non-human-related crow mortality is unknown, but the number of crows killed in Wyoming from recreational hunters and crows removed through the USFWS Depredation Order may account for several hundred crows annually.

Because crows are relatively abundant in Wyoming and USFWS oversight of migratory bird populations, WS-Wyoming's removal of 3,600 crows annually would likely result in moderate but not significant of cumulative impact on the state or regional crow population and will not jeopardize the viability of the State or regional American crow population because:

- crow population trend data from Wyoming, surrounding States and in the United States indicate that populations are relatively stable (Sauer et al. 2014);
- crows are very prolific and directly benefit from human-caused environmental changes and agricultural developments;

- crows are highly mobile and have the capacity to quickly repopulate an area where local populations have been reduced; and,
- WS-Wyoming operational control activities are conducted on relatively small geographic areas within the analysis area.

Black-billed Magpie Population Information. Like ravens and crows, magpies are omnivorous and very opportunistic in their feeding habits (Hall 1994). The black-billed magpie is common throughout Wyoming. Analysis of BBS data from 1966 to 2013, indicate high levels of annual variation in the population with no decreasing trends for the central and Western BBS Regions and a relatively stable population in Wyoming (Sauer et al. 2014). Data from more recent years (2003 to 2013 indicates no significant trend for the state or Central and Western BBS regions. Partners in Flight Science Committee (2015) estimate the magpie population in Wyoming at 190,000 birds.

Magpie populations are apparently healthy enough and the problems they cause are great enough that the USFWS has established a "standing depredation order" for magpies (50 CFR § 21.43). Under this regulation, no federal permit is required by anyone to take magpies if they are committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock or wildlife; or when concentrated in such numbers and manner that they are a health hazard or other nuisance.

During the past four years, WS-Wyoming has lethally removed an estimated average of 31 magpies per year (Table 4.3) and estimates that WS-Wyoming maximum annual take would not exceed 100 magpies annually depending on future magpie damage and requests for assistance. WS removal of 100 magpies per year would be less than 0.01 % of the estimated state magpie population. The total amount of human- and non-human-related magpie mortality from all causes is unknown, but the number of magpies in some years reportedly killed in Wyoming annually through the USFWS Depredation Order could account for several hundred magpies. Even if cumulative annual magpie take were to be 2,000 birds per year, total take would still only be approximately 0.01% of the estimated population in the state.

Because magpies are abundant in Wyoming, WS-Wyoming's maximum removal of one hundred magpies annually would likely result in no more than a low magnitude of impact and such impact would most likely be insubstantial to the magpie's overall viability and reproductive success.

Bald and Golden Eagle Population Information. Conflicts with bald eagles in Wyoming are relatively uncommon. Occasionally, a golden eagle will prey on livestock (calves and lambs; Tables 1.4 and 1.5) or either species could present a bird strike hazard at airports. WS-Wyoming responds to requests for assistance with technical and operational assistance with nonlethal methods. Methods may include use of frightening devices or, in rare situations, capture and relocation. WS-Wyoming also provides guidance on animal husbandry and habitat management practices to reduce eagle attractants at sites where conflicts occur. A depredation permit from the USFWS Migratory Bird Permitting Office is required to capture and relocate golden and bald eagles that are causing livestock depredations or creating hazards to aircraft. Population trend information from the BBS for bald and golden eagles reflects the cumulative impact of all factors on eagle populations, including non-purposeful take resulting from human

activities including collisions with vehicles, ingestion of lead ammunition used for hunting or PDM, habitat change and climate change. BBS population trend data indicate a generally increasing trend for bald eagles in Wyoming and the Central and Western BBS Regions (Sauer et al. 2014, which is also consistent with the general conclusions of a recent USFWS review of the status of eagle populations in the U.S. (USFWS 2016c). BBS population trend data for golden eagles indicate a relatively stable population in the Central and Western BBS region and stable to slightly increasing population in Wyoming. USFWS long term population estimation indicate a stable or slightly increasing population (1%) per year for eagles in the coterminous western U.S. (USFWS 2016c). However, a demographic population projection model appears to indicate that the western golden eagle population may be trending in the long-term toward a lower equilibrium (approximately 26,000 eagles) from current trend of approximately 30,000 (USFWS 2016c).

Protective measures and potential risks from PDM actions are similar for bald and golden eagles. Although the bald eagle is no longer protected under the federal ESA, WS-Wyoming continues to follow provisions for the protection of the bald eagle from former ESA consults with the USFWS because the bald eagle is still protected under the Bald and Golden Eagle Protection Act (BGEPA). These measures also work to reduce risks from PDM activities to golden eagles, which are also protected under the BGEPA. WS-Wyoming adheres to the WS policies for use of foothold traps and snares including not using visible bait at trap or snare sets and that trap set sites (except traps used for bears or mountain lions) will be no closer than 30 feet from a draw station. All animals shot on the ground by WS-Wyoming using lead bullets within immediate vicinity of bald and golden eagles will be retrieved whenever possible and/or disposed of in a manner that renders them inaccessible to eagles. WS-Wyoming will notify the appropriate USFWS office within 24 hours of the finding of any dead or injured bald or golden eagle. Cause of death, injury or illness, if known, will be reported to USFWS. WS-Wyoming will monitor for and routinely remove carcasses or trapped animals resulting from PDM activities conducted in the immediate vicinity of active bald or golden eagle sites to prevent attracting eagles to the immediate area of ongoing PDM activities.

Despite WS-Wyoming precautions, there continues to be a low level risk to non-target eagles from PDM activities. WS Wyoming has unintentionally captured and killed 3 golden eagles and no bald eagles over the period of 2010 to 2014. All eagles were captured in snares, with no more than one eagle taken per year. WS-Wyoming has developed state-specific guidance to help reduce risks to eagles from snares and continues to work to identify improved methods to reduce risks to eagles. Wyoming WS is currently working with the USFWS on a permit for non-purposeful take of eagles during predator damage management activities. In the interim, WS continues to implement protective measures established for eagles in consultation with the USFWS while eagles were federally protected as a threatened species. These measures include: use of pan-tension devices, and placing traps no less than 30 feet from any above ground bait sets. Additionally, Wyoming WS has added state specific guidance after review of past incidents of unintentional eagle take associated with management of species other than wolves. Typically eagles face and move into the wind or sit in an elevated position facing the wind, watching for potential prey or for the activity of other animals indicating the location of potential food. When scavenging carcasses, they most often land close to the food or fly past it to check it out ahead of circling back downwind and coming back

up to land on or near it. Most of the time they don't blindly fly in, their approach will be to come into the wind and land downwind of the food. The distance can be anywhere from several feet to a hundred yards from the food if they are shy about confronting another eagle or other scavengers (e.g., coyotes). Because the typical eagle approaches from downwind of the food anything previously taken out of a snare should be disposed of downwind and crosswind of the trap or snare set, so the set will not be between it and any food, or food scraps. Keeping carcasses downwind keeps the food between the eagle and the set. Eagles take off into the wind, and an eagle with a scrap of food may very well fly straight into the wind and land on a fence post or other object, right above or near the very device that caught the original food. Offsetting the carcass reduces the risk that an eagle will drop food on or near a trap.

Given the eagle population information noted above, WS unintentional take of golden eagles in Wyoming is not having a substantial adverse individual or cumulative impact on the state or regional eagle population. WS-Wyoming expects that unintentional take of eagles will continue to be very low. WS and the USFWS at the national level are in the process of developing guidelines to issue "Non-purposeful" permits that would satisfy the Bald and Golden Eagle Act when non-target eagles are inadvertently killed from WS PDM activities. It is expected that these guidelines will be developed in the next one to two years.

The public has expressed concerns that eagles could be at risk of secondary toxicity from feeding on carcasses of ravens, magpies or crows that have died after consuming DRC-1339. Given information on DRC-1339 in Section 4.2.1.2, risk of secondary toxicity from DRC-1339 to predators and scavengers are low because DRC-1339 is rapidly metabolized by birds targeted during control operations and the toxicity rate is far higher for eagles than for that of the target species (i.e., application dosage is minimal for control of those birds while being relatively safe for non-target species).

No non-target species have ever been known to have died or been otherwise adversely affected from eating DRC-1339 treated eggs or have died from secondary poisoning. Nationwide, in the decades that WS has been using DRC-1339, there have been only two reports of secondary toxicity associated with this method. In one instance, a crow may have scavenged the gut contents of recently treated pigeon(s) (APHIS 2001). A second instance was reported in 1995 in which a peregrine falcon died from secondary poisoning after eating starlings near a DRC-1339-baited site (USFWS, BO 1995). Both applications involved the use of grain baits applied so that multiple starlings or pigeons could obtain a lethal dose of DRC-1339 bait at a single feeding station. The risks associated with these applications are not similar to the egg or meat bait formulation proposed for use under this EA. As applied for raven damage management, the amount of bait available to a raven in a single feeding is limited. The volume of material in an egg also reduces the likelihood that a raven would be able to consume the amount of DRC-1339 necessary to adversely affect an eagle in a single feeding. Consequently, given the scarcity of incidence of secondary toxicity nationwide from all applications of DRC-1339, the nature of the bait application proposed for this project and the relatively high LD_{50} for raptors and the single eagle trial, risks to eagles from the proposed use of DRC-1339 are negligible.

There are also concerns about the risks to eagles from consumption of carcasses of

animals taken by WS that are killed with lead ammunition. (Stauber et al. 2010, Bedrosian et al. 2012, Haig et al. 2014). Much of the risk appears to be associated with eagles foraging on waterfowl that have ingested lead ammunition or fishing tackle or from foraging on offal piles (Bedrosian et al. 2012, Haig et al. 2014). However, Stauber et al. (2010), detected an increase in eagles at rehabilitation centers after the big game hunting season and hypothesized that the increase might have been associated with an increase in coyote hunting as hunters shifted from big game to coyotes at the end of hunting season although conclusive evidence documenting the increase in hunting was not provided. Multiple eagles and other scavengers can feed from single carcasses, and are at risk from ingesting lead fragments. WS-Wyoming disposes of carcasses of animals taken with lead ammunition in a manner that reduces risks to scavengers when possible. However, for some methods, such as removal via aircraft, burial or off-site disposal is not a safe or practical option (See discussion in Section 4.2.1.2 about Effects on non-target animals from consumption of lead fragments). The majority of coyotes taken by WS are taken via use of shotguns from aircraft. Investigations by Hayes (1993) indicate that this type of use may have lower risks to eagles than some other types of ammunition:

- In studies that documented lead shot consumption by eagles based on examining the contents of regurgitated pellets, the shot was associated with waterfowl, upland game bird, or rabbit remains, and was smaller than shot-sizes used in aerial activities. Lead residues have been documented in jackrabbits, voles (*Microtus* spp.), and ground squirrels, which could explain how eagles could ingest lead from sources other than lead shot.

- Personnel of the APHIS-WS program examined nine coyotes shot with copper plated BB shot to determine the numbers of shot retained by the carcasses. In total, 59 shot pellets were recovered, averaging 6.5 pellets per coyote. Of the 59 recovered pellets, 84% were amassed just under the surface of the hide opposite the side of the coyote that the shot entered, many exhibited minute cracks of the copper plating, and two shot pellets were split. The fired shot were weighed and compared with unfired shot and were found to have retained 96% of their original weight. Eagles generally peel back the hide from carcasses to consume muscle tissue. Because most shot retained by coyotes tends to end up just under the hide, it would most likely be discarded with the hide. Any shot consumed would most likely still have the nontoxic copper plating largely intact, reducing the exposure of the lead to the digestive system. Those factors, combined with the usual behavior of regurgitation of ingested lead shot indicate a low potential for toxic absorption of lead from feeding on coyotes killed by aerial operations.

Nonetheless, although no known instances of eagle mortality from WS use of lead ammunition have been reported, it is possible. Even accounting for this possibility, however, as noted above, cumulative sources of mortality are not adversely affecting bald eagle populations, which are continuing to increase in Wyoming and the western BBS region. Golden eagle populations appear to be stable to slightly increasing in the state and relatively stable in the region. Of known causes of anthropogenic mortality of golden eagles with satellite transmitters that were found dead, lead toxicosis was the least common form of eagle mortality (USFWS 2016c). Based on this information and the discussion below on lead impacts to non-target species, we conclude that WS-Wyoming use of lead ammunition could result in the death of some eagles, but that this impact is

low relative to other sources of lead poisoning, and it is not having a significant cumulative adverse impact on eagle populations. See discussion below on impacts to scavengers from lead ammunition for further details on WS use of lead ammunition and efforts to transition to lead-free ammunition.

There may also be concerns that WS' activities could result in the take or disturbance of eagles that may be near or within the vicinity of WS' activities. Under 50 CFR 22.3, the term "disturb", as it relates to take under the Bald and Golden Eagle Act, has been defined as "*to agitate or bother a Bald and Golden Eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.*" With the exception of possible but unlikely WS-Wyoming actions at airports to protect public health and safety from eagle activity on the airfield, activities that WS-Wyoming conducts would not fall into the category that would constitute disturbance of eagles as defined for the Act. The USFWS states that "Eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before an eagle pair nesting in a given area. For instance, if eagles build a nest near your existing home, cabin, or place of business you do not need a permit." (USFWS 2012). Therefore, activities that are species specific and are not of a duration and intensity that would result in disturbance as defined by the Bald and Golden Eagle Act would not result in non-purposeful take. Activities such as damage appraisals and trap checks are generally short term disturbances at sites where these take place.

WS-Wyoming will conduct its activities that are located near active eagle nests and Important Eagle Use Areas using the National Bald Eagle Management Guidelines (USFWS 2007). The categories that would encompass most of these activities are Categories D (Off-road vehicle use), F (Non-motorized recreation and human entry), and H (Blasting and other loud, intermittent noises). These categories generally call for a buffer of 330-660 feet for categories D and F, and a ½ mile buffer for category H. Based on the above information and protective measures, WS-Wyoming activities are not expected to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause a decrease in its productivity or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

In conclusion, based on BBS population trend information and information presented above, the current WS-Wyoming PDM program has not had an adverse individual or cumulative effect on bald eagle and golden eagle populations in Wyoming or the Western BBS region. Future impacts under this alternative are anticipated to remain as stated above.

Impacts on Other Predator Species

Other species[14] that may cause occasional damage problems in Wyoming are the western spotted skunk, mink, and long-tailed, short-tailed and least weasels. WS-Wyoming may receive requests to resolve damage involving these species and may conduct infrequent operational activities to remove offending individuals. No purposeful take of any of these species occurred during FY2010 to FY2014 and only one non-target mink was

[14] By Wyoming state statute, mink and weasels are classified as furbearers [§23-1-101 (a) (iii)].

taken. Unless equipment is specifically set to capture such individuals, WS-Wyoming Specialists can typically exclude these species with trap modifications (*e.g.*, pan-tension devices) and careful attention to bait/site selection. These species occur throughout Wyoming at varying densities in suitable habitat. During the 2013-2014 trapping season, fur harvesters took 563 mink and 288 weasels (Table 4-2). The maximum take anticipated for any of these species would be 10 individuals in a year and, given the distribution and range of these species, known licensed harvest, and that none of these species are listed as threatened or endangered, the proposed action would not have an adverse effect on these species.

4.2.1.2 Alternative 1: Effects on Non-target Species Populations, Including T&E Species

A common concern among members of the public and wildlife professionals, including WS personnel, is the possible impact of damage management methods and activities on non-target species, including pets and T&E species. WS' uses an IWDM approach and the WS Decision Model to reduce risk of adverse effects on non-target species' populations. The IWDM approach, Decision Model and SOPs for the protection of non-target species are described in Chapter 3.

To reduce the risks of adverse effects to non-target species, WS would select methods that are as target-selective as possible or apply such methods in ways to reduce the likelihood of adversely affecting non-target species populations. Prior to the application of DRC-1339, for example, pre-baiting is required to monitor for non-target species that may consume treated bait. If non-target species that could consume treated bait are observed, then the use of DRC-1339 would be postponed or not applied. For trapping activities, WS would select trapping locations that are used by the target species, traps that are species specific or set to target a particular species, and use baits that are preferred by the target species.

WS has consulted with the USFWS and WGFD regarding potential risks to federal and state listed T&E species from the proposed action. These consultations include a description of the types of methods which will be used, assessment of the potential for the proposed methods to impact federal or state listed species, proposals for preventing or reducing any risks, and an evaluation of the magnitude of impact on listed species with the protective measures in place. Special efforts are made to avoid jeopardizing T&E species and restrictions or mitigation measures are applied when necessary. A summary of the conclusions of these consultations is provided in Chapter 4 and a description of pertinent minimization measures are presented in Chapter 3.

Measures to avoid non-target impacts are built into Alternative 1 as SOPs and are described in section 3.5.1. These SOPs help ensure that non-target take by WS-Wyoming remains low. Captures of non-target species in Wyoming is recorded as unintentional target and non-target take. In addition, any non-target migratory birds taken during PDM are reported to the USFWS Migratory Bird Regional Office within 48 hours.

Unintentional target and non-target animals[15] killed by WS-Wyoming during damage management activities for the time period FY 2010-FY 2014 are listed in Table 4-6. Several of the species that are taken as non-target animals may be target animals for other projects (e.g., badger, bobcat, coyote, feral cat, mountain lion, opossum, porcupine, raccoon, red fox, striped skunk, golden eagle). Cumulative impact of WS target and non-target take of these species is addressed in Section 4.2.1.1 above and will not be addressed further. On average, 70.4 non-target animals were taken annually during this time period, with badgers, mule deer, red fox, porcupine and striped skunks being the most commonly captured (Table 4-6).

The swift fox (*Vulpes velox*) merits more detailed discussion. It is classified as a non-game mammal by state statute (WYSA §52-11) and a species of greatest conservation need by WGFD (Orabona et al. 2012). The distribution of the swift fox in the U. S. is the northern Great Plains, from the foothills of the Rocky Mountains across the prairies of the Dakotas, Nebraska, Oklahoma and west Texas (Clark and Stromberg 1987). The swift fox has recovered from human impacts across its range between the 19th and mid-20th centuries, including hunting, trapping, predator and rodent control programs and habitat loss (Samuel and Nelson 1982). The species was removed from the Endangered Species Act Candidate List in 2002 because of conservation efforts of western states and the Swift Fox Conservation Team (WGFD 2010). Within shortgrass prairie habitats (including associated wheat and irrigated hay fields, road berms and railroad banks) in the eastern portion of Wyoming (Laramie, Goshen, Platte, Niobrara, Converse, Campbell, Weston and Crook Counties, this species is considered common (occurring at densities of one pair/5-8 km^2; Orabona et al. 2012). Populations in the Shirley Basin have been increasing, but data for the balance of the state is lacking (WGFD 2010). State status as a species of greatest conservation need is based in part on sensitivity of the species to habitat loss (human activity and competition), concerns regarding use of the rodenticide Rozol, and uncertainty regarding the potential impacts of energy development (WGFD 2010). The swift fox is also very susceptible to trapping, poisoning and roadkill due to its curious and unwary nature (Samuel and Nelson 1982, Thacker and Flinders 1999, WGFD 2010). This is reflected in WS-Wyoming non-target unintentional take figures for swift foxes between FY10-FY14. During this time period, 24 swift foxes were taken (killed) by M-44s and three were killed in neck snares; one additional individual captured in a neck snare was released alive. Given species status as common within the occupied range of the state, the limited removal of swift foxes by WS-Wyoming (5.4 average per year for the FY2010-FY2014 time period) does not appear to be having a substantial adverse impact on the population.

As far as the other non-target species taken from FY 2011to FY 2014, no analyses are presented here for domestic cattle, mule deer, white-tailed deer, antelope, hares, cottontail rabbits, and sheep population impacts because some are domestic animals and the others are common in Wyoming and the minimal non-target take by WS-Wyoming PDM is low enough to be intuitively insignificant to those populations. The average number of non-target animals killed per year by WS-Wyoming while conducting PDM activities during FY 2011 to FY 2014 were relatively few compared to their overall populations in

[15] Unintentional target species are listed on the agreement as target species but are taken unintentionally during efforts to take other target species. Non-target species are not listed as target species on the agreement and are taken unintentionally during efforts to take target species.

Wyoming and impacts to these species would be considered negligible and impacts have been minimal. WS-Wyoming's take of non-targets continues to be low and not consequential to any population.

Table 4-6. Non-target Animals taken During PDM by WS-Wyoming, FY 2010-FY 2014 (MIS 2014).

FY	Badger	Bobcat	Coyote	Feral Cat	Cattle	Mule Deer	White-tailed Deer	Antelope	Hare	Mtn. Lion
2010	10	5	0	13	1	0	1	3	7	1
2011	8	3	0	0	0	7	0	3	2	1
2012	27	12	1	0	0	8	3	6	1	1
2013	7	6	2	3	0	9	2	0	2	3
2014	10	2	0	0	0	15	0	0	8	0
Total	62	28	3	16	1	39	6	12	20	6
Average	12.4	5.6	0.6	3.2	0.2	7.8	1.2	2.4	4	1.2

Table 4-6. con't.

FY	Opossum	Porcu-pine	Cottontail Rabbit	Raccoon	Red Fox	Sheep	Striped Skunk	Swift Fox	Domestic Dog	Golden Eagle
2010	1	11	0	8	10	0	4	8	3	0
2011	0	12	2	5	3	0	6	8	0	0
2012	0	6	0	6	8		13	3	1	1
2013	0	1	0	1	3	1	5	7	1	1
2014	0	3	0	3	12	1	4	1	1	1
Total	1	33	2	23	36	2	32	27	6	3
Aver-age	0.2	6.6	0.4	4.6	7.2	0.4	6.4	5.4	1.2	0.6

Effects from use of DRC-1339. DRC-1339 treated eggs are registered for use in reducing depredation on newborn livestock and eggs and young of T/E species or wildlife designated to be in need of special protection from common ravens, American crows and black-billed magpies. The EPA label requirements for the use of meat baits stipulate that the baits be observed continuously from a distance of no more than 1,000 yards to detect approaches by T/E species and other non-target or protected animals likely to eat bait. Non-target animals approaching the baits are to be frightened away from the site. Due to this provision and others specific to non-egg baits, risks to non-target species from use of this formulation of DRC-1339 are extremely low and the analysis in this section will focus on risks associated with use of egg baits.

DRC-1339 is unique because of its relatively high toxicity to most pest birds but low-to-moderate toxicity to most raptors and almost no toxicity to mammals (DeCino et al. 1966, Schafer 1984, Schafer 1991). The LD_{50} is a standard notation for pesticides used to assess the relative toxicity of products and risks to human and animal health. It stands for lethal dose 50% which means that in a controlled experiment, the dosage of toxicant that is required to kill 50% of the animals exposed. Starlings, a species highly sensitive to

DRC-1339, require a dose of only 0.3 mg/bird (3.8 mg/kg) to cause death (Royall et al. 1967). The LD_{50} value for ravens is 5.62 mg/kg (Schafer et al. 1983) and black-billed magpies is 5.6 to 17.7 mg/kg (DeCino et al. 1966). In contrast, Timm (1994) shows that the LD_{50} for bird species such as raptors (100 to over 500 mg/kg), sparrows (over 300 mg/kg), and eagles (over 100 mg/kg) classified as non-sensitive have much higher LD_{50}s. Timm (1994) further reports that the LD_{50} for American kestrel (*Falco sparverius*) and Cooper's hawk (*Accipiter cooperii*) are >320 mg/kg and 320-1,000 mg/kg, respectively. Eisemann et al. (2001) report that the LD_{50} for an African member of the Falconidae family (raptor) was >350 mg/kg and Schafer et al. (1983) report an LD_{50} for golden eagle at >100 mg/kg. Mouse and white rat LD_{50} values have been reported as 2,000 and 1,170-1,770 mg/kg, respectively (Hyngstrom et al 1994). Hyngstrom et al (1994) reports that the LD_{50} for domestic dogs, sheep and cows are >100 mg/kg, 400 mg/kg and >10 mg/kg, respectively. In order for a 30 pound (14 kg) dog, a 125 pound (68 kg) sheep, and 1,000 pound (454 kg) cow, to receive an LD_{50} dose of DRC-1339, they would need to consume the equivalent amount of DRC-1339 that would treat 700, 13,600, and 2,270 eggs (dosage of 2 mg/egg), respectively.

Prebaiting with untreated eggs is one technique used to reduce the exposure to non-target animals. Prebaiting is required by the DRC- 1339 pesticide label to 1) promote feeding by the target species (e.g., ravens and magpies), 2) facilitate monitoring target species' numbers, and 3) assess potential for exposure of non-target species. Non-treated, hard boiled chicken eggs are used for pre-baiting. To asses for terrestrial and nocturnal non-targets, such as coyotes, badgers, snakes, skunks, etc., the pre-baited site where untreated eggs are placed is thoroughly inspected for animal tracks or sign before and after the eggs are placed. If pre-baiting determines that non-target exposure is likely, then WS-Wyoming will abandon that application site for placement of treated egg baits. If non-targets are attracted to the pre-baited eggs and there is evidence that the eggs have been pecked-on, consumed or been carried off, then that potential application site also will not be used. Eggs that are still in place after seven days will be removed, disposed of and that baiting site will most likely not be used for the remainder of that year's project. This approach will help reduce the potential of ravens caching eggs.

Coats et al. (2007) reports that videography used in the last two years of a four-year field study, documented that 14 DRC-1339 treated eggs were totally consumed by Wyoming ground squirrels, Piute ground squirrels consumed three treated eggs, great basin pocket mice consumed one treated egg and American magpies consumed two treated eggs. Domestic cattle consumed two untreated eggs. A total of 5,280 treated eggs were placed during this two-year period, but not all treatment sites were video recorded. It is important to note that videography did not capture any non-target species that are known to be at risk of fatality from DRC-1339 effects consuming egg baits (Coates et al. 2007). However, ground squirrels, which are not known to be vulnerable to the dosage of DRC-1339 injected into the eggs, were commonly observed consuming eggs. Ground squirrel LD_{50} value has not been described, but reported values of other rodents are relatively high (having a high tolerance). For example, mouse and white rat LD_{50} value was reported as 2,000 and 1,170-1,770 mg/kg, respectively (Hyngstrom et al 1994). LD_{50} value for ravens is 5.62 mg/kg (Schafer et al. 1983) and black-billed magpies is 5.6 to 17.7 mg/kg (DeCino et al. 1966), which means that mice and white rats (rodents) have a significant higher tolerance to DRC-1339. In evaluating the threat of DRC-1339 treated eggs to ground squirrels, the LD_{50} value for white rats (1,170 mg/kg) will be used for the

comparison because they are similar in size and weight to a Wyoming ground squirrel (i.e., similar to that of the Idaho ground squirrels) as described in Coates et al. (2007) and because it is the lesser of the two rodent species and a more conservative value for this exercise. In order for an adult white rat, weighing 454 grams (1 pound), to receive an LD_{50} dosage, a single rat would have to eat 129 treated eggs. The average weight of a large, hard-boiled chicken egg is about 57 grams. A white rat would have to eat 7,353 grams or 16.2 pounds of eggs in order to receive an LD_{50} dosage of DRC-1339 and because DRC-1339 metabolizes very quickly, consuming this many eggs while still viable is biologically impossible. Besides, the number of treated eggs placed per square mile (640 acres) for the protection of sage-grouse and Columbian sharp-tailed grouse nests will most likely never exceed 14 at any one time. So in order for a one-pound white rat (or ground squirrel in this exercise) to receive an LD_{50} dose of DRC-1339, it would have to locate and eat all treated eggs placed in a nine square mile area which is impossible. In a Coates et al. (2007) study, the authors reported that the initial week of treatment following pre-baiting may have resulted in high raven take, but prolonged treatment did not appear to continue to remove ravens at high rates throughout the treatment period.

Birds in the corvid family, including the jays, crows, magpies and ravens are relatively sensitive to DRC-1339. Most birds in this family are known to prey on eggs of other birds although the extent to which they may use larger eggs such as the poultry eggs used to deliver DRC-1339 varies by species (Trost 1999, Balda 2002, Curry et al. 2002, Smith et al. 2013). Members of the corvid family which might occur in likely sage-grouse protection area include common raven, American crow, black-billed magpie, and Western scrub jay (*Aphelocoma californica*). Although crows, magpies and the jays listed above may occur in the project area, risks to these species from the use of DRC-1339 are anticipated to be low. Coates et al. (2007) reported that of the animals he video-recorded consuming treated and untreated egg baits (n=42), magpies were only recorded twice (4.8%) and videography did not capture any non-target species that are known to be at risk of fatality from DRC-1339 effects consuming egg baits. American crows are known to occasionally occur in the project areas, and black-billed magpies could be common in the project areas

There are no instances of crow, magpie or jay predation on sage-grouse nests recorded in video monitoring conducted in Elko County Nevada from 2002-2005 or in the Virginia mountains of northwest Nevada from 2009 - 2011 (Coates et al. 2008, 2013) even though magpies and crows were specifically mentioned as occurring in the project areas. Assuming that corvids will respond to treated eggs in the same manner they respond to sage-grouse eggs, we anticipate minimal incidental take of American crows or black-billed magpies with the proposed use of DRC-1339. Additionally, in studies using videography at sage-grouse nests in Idaho and Nevada, crows and magpies and jays were not documented as nest predators (Coates et al. 2008, Lockyer et al. 2013).

Some birds such as crows and magpies are known to raid food caches of other birds and the possibility exists that these birds could access eggs treated with DRC-1339 that have been cached by ravens. Howe and Coates (2015) reported sage-grouse egg caching by ravens. Observations of ravens at landfills indicate that, when offered multiple eggs, ravens commonly consume at least one egg (often 2 eggs with a portion of a third) before attempting to move or cache other eggs (Spencer 2002, J. Spencer, WS-Nevada, Reno,

NV, pers. comm.). In a study of greater sandhill crane (*Grus canadensis*) nest predation, common ravens consumed 67% of the eggs at the nest and cached the remaining 33% (Austin and Mitchell 2010). Sage-grouse commonly lay 5-8 eggs per clutch (Taylor et al. 2012). Based on observations above of the number of eggs eaten at landfill bait stations, a raven could eat sage-grouse eggs at the nest and still have eggs to cache. To help reduce risk of egg caching, WS-Wyoming would only set one to two treated egg baits at each flat ground bait station, every seven days, as necessary. If during prebaiting, there is evidence that ravens are generally eating only one egg and caching the second, the number of eggs placed at each "set" can be reduced from two eggs to one. Additionally, each egg contains a lethal dose for a raven, so a raven that eats at least one egg only has a limited amount of time in which to locate and cache additional eggs which also helps to reduce the number of cached eggs available to non-target birds. Ravens hide cache sites from other species and have been known to conceal their caches with leaves, grass and dirt (Howe and Coates 2015). Risks are further reduced by the fact that DRC-1339 is only likely to remain viable in the moist environment of an egg for approximately a week. At dump or other sites where ravens are concentrated, only one to four eggs will be placed at a maximum of every seven days. Again, the number of eggs per "set" will be reduced if needed to reduce caching based on observations made during prebaiting observations. WS-Wyoming will remain in close proximity of the dump site and observe using binoculars to determine if ravens are potentially caching eggs. If this is suspected, then only one to two treated eggs will be placed at each dump site to reduce the possibility of caching. This is the approach WS-Nevada has taken to minimize caching of eggs by ravens. (See also Section 4.2.5.2).

The use of elevated platforms may help reduce potential exposure to non-targets, such as snakes or small mammals. Heinrich (1988) reports that some ravens can be highly neophobic which could result in ravens rejecting egg baits on platforms. There is also some risk that platforms could serve as perching sites for species that prey on wildlife to be protected, and could exacerbate predation problems. It is not expected that elevated platforms will be used very often and if platforms are suspected as attracting other non-target species, such as raptors and non-target corvids, then the platform will be removed and use of it discontinued. The pesticide label also requires the applicator to observe the site for evidence of non-target activity before placement of treated egg baits. The observations will help determine flight patterns and paths and communal roost sites of ravens or magpies. Again, if non-target species are seen and the applicator determines that non-target exposure is likely, then that application site will not be used for placement of treated egg baits. Other procedures WS-Wyoming will implement to minimize and avoid exposure to non-targets is by collecting unconsumed treated egg baits within no later than seven days after placement and by placing no more than two eggs at any one application site at any one time. This technique is recommended in Bentz et al. (2007) because it limits bait exposure on bait sites, thus reducing exposure to non-targets. Collected egg baits will be disposed of by burning or burial. Treated egg baits will only be placed at sites that ravens or magpies are actively using or where those birds are actually observed in the area.

It is highly unlikely that use of DRC-1339 would result in death of scavengers because of the product's relatively low toxicity to species that might scavenge birds killed by DRC-1339 and the tendency for DRC-1339 to be rapidly and almost completely metabolized in the target birds (Cunningham et al. 1979, Schafer 1984, Knittle et al. 1990). The excreted

metabolites are non-toxic (Cunningham et al. 1979). Metabolism studies have shown that as much as 90% of a dose of DRC-1339 administered to birds is excreted in the form of parent compound or metabolite within 30 minutes (Apostolou 1969, Apostolou and Peoples 1971, Mull 1971, Giri et al. 1976). Goldade et al (2004) observed that when DRC-1339 was administered to dark-eyed junkos and red-winged blackbirds most of the radioactively marked DRC-1339 and metabolites had been excreted 4 hours after ingesting the bait (blackbirds - 85% excreted; junkos – 91% excreted). DeCino et al. (1966) fed a diet of starlings that had been killed with an estimated one to three lethal doses of DRC-1339 to a Cooper's hawk, a northern harrier and an American kestrel during a three- and four-month period. The Cooper's hawk consumed 222 starlings, the northern harrier consumed 191 starlings and the American kestrel consumed 60 starlings during the testing period. At the conclusion of the feeding trial, none of the raptors showed any ill effects and all gained weight. Cunningham et al. (1979) estimated that a sensitive species (i.e. cat, owl and magpies) could be at risk only if its diet consisted wholly of DRC-1339-poisoned starlings for more than 30 continuous days, which is highly improbable given the scope, duration, and density at which DRC-1339 baits would be used under this EA.

Nationwide, in the decades that WS has been using DRC-1339, there have been only two reports of secondary toxicity associated with this method. In one instance, a crow may have scavenged the gut contents of a recently treated pigeon (APHIS 2001). A second instance was reported in 1995 in which a peregrine falcon died from secondary poisoning after eating starlings near a DRC-1339-baited site (USFWS, BO 1995). Both applications involved the use of grain baits applied so that multiple starlings or pigeons could obtain a lethal dose of DRC-1339 bait at a single feeding station. The risks associated with these applications are not similar to the egg or meat bait formulation proposed for use under this EA. As applied for sage-grouse protection, the amount of bait available to a raven in a single feeding is limited because only two eggs would be available in any given bait site and bait sites would be widely dispersed to reduce likelihood that raven would be able to access multiple baits. The volume of material in an egg also reduces the likelihood that a raven would be able to consume the amount of DRC-1339 necessary to adversely affect a raptor or most scavengers in one feeding prior to succumbing to the toxicant. Based on the above information, risks to non-target species from DRC-1339 are low.

DRC-1339 also degrades rapidly when exposed to moisture, sunlight, heat or UV radiation (Tawara et al. 1996). The useful life of DRC-1339 can vary between a couple of hours when under high humidity and sunlight to more than a week under dark, dry conditions (Bentz et al. 2007). The half-life of DRC-1339 in biologically active soil is about 25 hours and identified metabolites have low toxicity (Cunningham et al. 1997). Because DRC-1339 degrades rapidly in soils, does not persist and binds tightly to soils, it is unlikely that DRC-1339 is translocated into plants (APHIS 2001). Given that DRC-1339 is rapidly metabolized and does not persist in the environment, risks of bioaccumulation are negligible.

In addition to secondary poisoning, some members of the public are concerned about tertiary poisoning from DRC-1339 (tertiary poisoning is defined as a scavenger/predator dying after eating a prey item that fed on the carcass of a bird that died from direct poisoning of DRC-1339). In addition to the explanations provided in the previous

concerns, it is extremely unlikely that any effects would occur to an animal that would kill and consume or scavenge on an animal that fed on another animal that fed on an animal that ingested DRC-1339 or had died from secondary poisoning, simply because of the unlikelihood of secondary poisoning ever occurring.

Effects on Threatened and Endangered Species
Federal agencies are required to consult with the USFWS when their actions may affect species listed under the ESA. WS-Wyoming consulted with the USFWS through the Section 7 process regarding program effects on the Canada lynx, the grizzly bear and other listed species, and received a BO or concurrence that WS-Wyoming was not likely to adversely affect those species (USFWS Sept 9, 2007, lynx; Feb 6, 2015, grizzly bear; Mar 10, 2015 for programmatic consultation).

INDIRECT IMPACTS

Effects on non-target animals from consumption of lead fragments. Agencies and members of the public have expressed concerns regarding the potential for adverse environmental impacts and risks to human health and safety from the materials used in ammunition. The majority of concerns expressed pertain to the use of lead ammunition and this section correspondingly focuses on risks associated with lead (e.g., Watson et al. 2009). However, it should be noted that some of the non-lead materials used in ammunition and lead-free ammunition (arsenic, nickel, copper, zinc, tungsten) are also known to pose environmental risks (EPA 2016, Clausen and Korte 2009, Beyer et al. 2004, Eisler 1998). Exposure and risk to non-target animals would be greatest for wild and domestic animals that consume carcasses containing lead ammunition from PDM actions including bald and golden eagles (Stauber et al. 2010, Bedrosian et al. 2012 and Haig et al. 2014). There is also the potential for lead exposure to non-target mammals and birds from consumption of lead bullet fragments in the soil. The potential for lead exposure and risk to these types of scavengers would be reduced in situations where carcasses are removed or otherwise rendered inaccessible to scavengers through burial or state, territory, or tribally-approved carcass disposal practices. Lead exposure and risk would also be further reduced in cases where the use of lead-free shot can be effectively, safely, and humanely used to remove feral swine.

For all programs, 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. WS does not use lead ammunition in areas where it is prohibited by law or where prohibited by the landowner/manager (e.g., National Park Service). WS uses lead-free shot to remove ravens, magpies and crows and for other MBTA permitted activities, including activities in waterfowl production and wintering areas.

The WS program has specific ammunition and firearm requirements to maximize performance, safety and humaneness similar to those for other wildlife damage management applications (Caudell et al. 2012). Precision performance of bullets is essential for project efficacy, safety, humaneness (shot placement to result in rapid death) (McPhearson 2005, Caudell et al. 2009), and shot placement to preserve tissues for animal health monitoring. Direction of ricochet/ pass-through is difficult to predict

(Burke and Rowe 1992) and is a safety concern especially at airports, in areas near residences, areas with rocky substrate, and for WS-Wyoming personnel in aerial shooting teams. Ammunition which conveys its full energy to the target animal and which results in low or no pass through is needed for reasons of humaneness (instant or near-instant incapacitation) and to reduce safety risks associated with wounded animals.

Current challenges associated with lead-free ammunition include that some types of lead-free ammunition are harder than lead ammunition and more likely to ricochet off hard surfaces, increasing the odds of hitting aircraft, personnel, or other unintended targets and presenting unacceptable risks to human safety (APHIS 2012). WS has also tested bismuth ammunition for aerial operations but found the product too frangible for safe and effective use. Increased wounding has been associated with lighter bullets (Aebischer et al. 2014). Lead-free alloys require longer bullets to obtain comparable bullet weights. Terminal performance (the performance of the bullet upon striking the target animal) is, in part, determined by bullet weight. Ballistically, a faster rate of twist is usually necessary to stabilize longer bullets, though individual firearm performance varies. In some calibers (i.e., .22 rimfire and centerfire), accuracy of non-lead ammunition is less than accuracy of lead ammunition in many of the firearms presently in use by WS-Wyoming. While non-lead ammunition is available in many calibers, their suitability and accuracy in all firearms is not universally equal to lead ammunition. Harder lead-free rifle ammunition is more likely to result in "non-frangible bullet pass-through," and failure of the bullet to convey its full energy to the target animal, although similar problems also exist with some types of lead rifle ammunition. In addition to the increased risk of hitting an unintended target, non-frangible bullet pass-through also increases the likelihood that the target animal may not be rapidly or instantly killed by the shot and may be considered less humane (APHIS 2012). WS-Wyoming evaluates new lead-free ammunition alternatives as they become available.

Lead-free ammunition is often more expensive than equivalent ammunition using lead. Although, the cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns, it is still an issue. Cooperators usually pay a substantial portion of operational program costs, and may be unwilling to pay the additional ammunition costs in areas where it is otherwise legal to use lead ammunition.

WS aims to use the fewest number of shots on targeted animals. Lead ammunition use by WS-Wyoming for wildlife damage management activities is minimal compared to lead use at firing ranges and use for hunting, fishing, and shooting sports. The national WS programs' FY08 - FY012 total estimated lead use in all program activities including feral swine damage management was approximately 5.87 tons (12,948 lbs.) with a yearly average of 1.174 tons (2,588 lbs.). The average yearly total amount of lead used in all states by WS (FY08-FY12) is small (0.0017%) compared to the U.S. use of lead from ammunition, shot, and bullets based on data from 2011 (USGS 2011) and is decreasing as WS works to incorporate use of lead free ammunition to the extent practicable.

At the current rate of use, lead ammunition by WS may have the potential to adversely impact individual non-target animals, particularly animals which scavenge carcasses and birds which may inadvertently pick up lead shot when seeking grit for their crop. However, WS total program use of lead ammunition, including ammunition used for feral

swine damage management is only a small fraction of lead ammunition used by other entities (e.g., hunting, target shooting). WS adheres to all applicable laws governing the use of lead ammunition in WS activities and landowner/manager desires for lead-free ammunition in their projects. Additionally, WS will shift to lead-free ammunition as new lead-free alternatives that meet WS standards for safety, performance, and humaneness are developed and become reliably available in adequate quantities for program use. Use of lead ammunition by WS is anticipated to decrease over time. Consequently, cumulative impacts of WS use of lead ammunition would be very low. Given that the majority of lead ammunition is used by non-WS entities, the decisions made by states, territories, tribes, federal regulatory agencies, and land management agencies regarding use of lead ammunition will be the greatest factor affecting the cumulative contribution of lead in the environment.

Deposit of lead into soil could occur if, during the use of a firearm, the projectile passes through a predator, if misses occur, or if the predator carcass was not retrieved. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil is generally retained within the top 20 cm (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could contaminate ground water or surface water from runoff. Stansley et al. (1992) studied lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "transport" readily in surface water when soils were neutral or slightly alkaline in pH (i.e., not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "fall zones" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around bullet impact areas were far below the "action level" of 15 parts per billion as defined by the EPA (i.e., requiring action to treat the water to remove lead). The study found that the dissolution (i.e., capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments (Craig et al. 1999). Therefore, the transport of lead from bullets or shot distributed across the landscape was reduced once the bullets and shot formed crusty lead oxide deposits on their surfaces, which served to reduce naturally the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead being deposited and the concentrations that would occur from activities conducted by WS-Wyoming to reduce predator damage using firearms, as well as most other forms of dry land small game hunting in general, lead contamination from such sources would be minimal to nonexistent.

When WS-Wyoming uses shot shells with lead in hazing or shooting, the typical amount of lead distributed by each shot would be 1.0 to 1.5 ounces. High-powered rifle bullets are about 0.3 ounces and about 0.1 ounces for small caliber firearms and pellets for air rifles. WS-Wyoming personnel primarily use shotguns during damage management activities, with over 85% of the shots fired occurring by shotgun (e.g., aerial and ground shooting). About 5% of the shots fired by WS-Wyoming personnel occur using high-powered rifles and over 10% of the shots fired are to euthanize animals in traps with small caliber pistols (.22) or to shoot birds with air rifles (~0.1 ounces each at most).

WS-Wyoming estimated the amount of lead in each of the spots on the ground where the soil is impacted by lead shot, and then evaluated the risk of a person encountering one of those spots and becoming exposed to toxic levels of lead. The amount of lead in the soil impact zones of each shot taken was calculated as each shot potentially distributes 1.2 to 1.5 ounces, or 34.0 to 42.5 grams of lead into an approximate 30 inch circle. Using the same estimate of weight per cubic foot of soil and depth of soil in which the lead shot would remain as discussed previously, the amount of lead per unit weight of soil in the 30 inch circle would be about 200 to 260 mg/kg (ppm). Therefore, even if a person were to encounter one of the impact spots on the ground, the amount of lead in the soil would average less than the EPA hazard standard for children's play areas. The chances of someone stumbling across one of the impact spots could be calculated if there were 15,000 30 inch impact spots (shots per year) distributed over 260,000 acres, or more than 11 billion square feet, of landscape – this means that the total area of impact spots for any one year are only three millionth of the area of the affected landscape. It would be highly unlikely for a person to stumble across one of the affected impact spots, but, even if someone did, there would be no health risk unless the person ingested some of the soil and the portion ingested contained some lead eroded from the spent shot. As discussed previously, solid lead exposed to the environment tends to form an oxidizing layer that slows down its ability to be dissolved in water (Craig et al. 1999), which means the lead from spent shot in the soil would tend to remain in place and not distribute throughout the soil. This would further lessen the chance that someone contacting an impact spot would become exposed to lead.

In a review of lead toxicity threats to the California condor, the Center for Biological Diversity et al. (2004) concluded that lead deposits in soils, including those caused by target shooting by the military at shooting ranges on military reservations used by condors, did not pose significant threats to the condor. The concern was that lead might bio-accumulate in herbivores that fed on plants that might uptake the lead from the soil where the target ranges were located. However, the Center for Biological Diversity et al. (2004) reported blood samples from condors that foraged at the military reservation where the target shooting occurred did not show elevated lead levels, and, in fact showed lower lead levels than samples from condors using other areas.

Indirect Benefits to Wildlife: As noted in Chapter 1, relationships among predators and prey are complex, and even PDM projects specifically intended to enhance prey populations, may not always have the intended consequences. Effective programs to benefit specific species of wildlife requested by state and federal wildlife management agencies are generally conducted in critical seasons and locations that are most likely to benefit the species to be protected (e.g., during periods and locations of birthing/nesting

and when vulnerable juveniles are present). PDM conducted for livestock protection is usually of lower intensity than projects for the protection of sensitive wildlife species. As noted in the Chapter 4 sections on effects on target predator populations for each alternative, cumulative impacts of Wyoming PDM activities are generally low relative to other known sources of mortality and total population sizes, and/or are within sustainable harvest thresholds identified for the target species and will not cause sustained predator population declines. Due to immigration and compensatory mortality and natality, local population declines resulting from PDM are localized, short-term and unlikely to last for the duration of a year. Consequently, although PDM for livestock protection has the potential for some indirect benefits to wildlife, any potential benefits are likely to be limited and highly localized or associated with intensity of removal for PDM atypical of that which is conducted by WS-Wyoming. However, see also discussion of Dinkins et al. (2016) below.

WS-Wyoming Impact on Biodiversity and Ecosystem Resilience. Biodiversity refers to the variety of species within an ecosystem. Ecosystem resilience refers to the ability of individual species and ecosystems to withstand unpredictable fluctuations in environmental conditions (e.g., drought) without jeopardy to species survival or changes in ecosystem structure. Predators, particularly apex predators, can have a pronounced impact on biodiversity and ecosystem resilience, (Estes et al. 2011). In diverse ecosystems, there is a degree of redundancy in the roles species play within the different ecological levels (e.g., apex predators, mesopredators, herbivores, plants, decomposers). In general, ecosystems that are less complex in terms of biodiversity and trophic levels, are more susceptible to adverse impacts and stressors such as climate change; disease outbreaks, introduction of invasive species, disease, etc. (e.g., reduced ecosystem resilience; Beschta et al. 2013, Crooks and Soulé 1999, Ritchie and Johnson 2009, Estes et al. 2011, Bergstrom et al. 2014).

Predators impact ecosystems directly through predation and exclusion/reduction in populations of other predators/mesopredators, and indirectly through alteration of prey behavior and habitat use, limiting the abundance of prey species and alteration of impacts these species have on other levels of the food web (see discussion of trophic cascades below; Miller et al. 2001, Prugh et al. 2009, Ritchie and Johnson 2009, Estes et al. 2011, Wallach et al 2010, Miller et al. 2012). The loss of apex predators from an ecosystem reduces biodiversity and shortens the food web length in the system which may alter the presence and abundance of mesopredators, increase the intensity of herbivory and ultimately impact the abundance and composition of plant communities, soil structure, nutrients and even physical characteristics of the environment (Diamond 1992, Berger et al. 2001, Beschta and Ripple 2006, Ripple and Beschta 2006, Beschta et al. 2008, Prugh et al. 2009, Estes et al. 2011). Some authors and members of the public have raised concerns that PDM actions by WS-Wyoming may result in unintentional adverse impacts on biodiversity and ecosystem resilience by eliminating or reducing predator populations (Bergstrom et al. 2014). Presence of native predators in a healthy ecosystem may also improve the ability of the system to resist adverse impacts of invasive species. Wallach et al. (2010) found that increases in dingo populations that occurred in the absence of exclusion fencing and poison baiting result in decreases in mesopredators and generalist herbivores and an increase in small and intermediate-weight mammals. Allowing predator populations to achieve a degree of social stability (the presence of packs and associated territoriality) was also identified as important because it established natural

population control at levels below the maximum that could potentially be sustained by the prey base. Similarly, a review of scientific literature by Ripple et al. (2010), also indicated that irruptions in cervid populations and associated damage to plant communities and biodiversity (e.g., tree regeneration, presence of shrubs, introduction of invasive species, and loss of species dependent upon vegetation damaged by deer) occurred in most instances where large predators were removed but only a few instances where large predators were present. Another review of studies of large predators on prey species abundance by Beschta and Ripple (2012) provided evidence that the presence of combinations of wolves and bears (*Usrus* spp.) was able to limit herbivore densities and associated impacts on ecosystems over that of systems with just bears. In systems with bears but without wolves or where wolves were rare, herbivore densities increased sharply with net primary productivity of the system indicating that cervid population fluctuations were highly linked to food supply. In systems with wolves, herbivore density increased with primary productivity, but at a much lower rate and magnitude than for systems without wolves indicating that large predators, or at least combinations of large predators, can put sufficient pressure on prey populations to mitigate population fluctuations driven by food availability.

WS-Wyoming damage management activities would occur in localized areas of Wyoming and would not be conducted throughout the year, but would occur for short periods after damage had occurred (i.e., reactive damage management). Activities conducted to reduce threats of damage (i.e., proactive damage management) would likely occur for short periods (90 to 180 days) during the time of year when addressing predators would be the most beneficial to reducing threats of damage (e.g., the period of time immediately preceding and during calving and lambing in the spring). WS-Wyoming generally only conducts activities on a small portion of the land acres allowed under an MOU, AWP, cooperative service agreement or other comparable document. For example, a landowner may allow WS-Wyoming to conduct activities on the 1,000 acres they own but WS-Wyoming personnel might only conduct activities on 5 acres of the property. In addition, the number of predators addressed annually by WS-Wyomng and other entities is likely a small percentage of the actual populations of those species in the State. Therefore, the effects on biodiversity would be of low magnitude.

Most evaluations of the impacts of predator removal or loss on biodiversity and ecosystem function involve systems wherein the predator species has been completely removed from the environment for years (e.g., Berger et al. 2001, Beschta and Ripple 2006, Beschta et al. 2008, Frank 2008, Beschta and Ripple 2009, Gill et al. 2009, Ripple et al. 2010, Beschta and Ripple 2012b). WS-Wyoming's actions will not result in long-term extirpation or eradication of any wildlife species, so findings of most of these studies are not directly relevant to the current analysis. WS-Wyoming operates in accordance with international, federal and State laws and regulations enacted to ensure species viability. WS-Wyoming operates on a relatively small percentage of the land area of Wyoming and take is only a small proportion of the total population of any species as analyzed in Chapter 4. Analysis of impacts on target species in Section 4.2.1.1 and elsewhere in this section indicates the current WS-Wyoming PDM program will not result in the direct or indirect loss of any wildlife species population or sustained reduction in local predator population densities. Any reduction of a local population or groups would be temporary because natural immigration from adjacent areas or reproduction from remaining animals would replace the animals removed unless actions

are taken by the landowner/manager to make the site unattractive to the target species. The limited nature of WS-Wyoming take of most predator species listed in this EA is so low that substantive shifts in population age structure are not anticipated (Section 4.2.1.1) and further discussions of this issue will focus on removal of coyotes, which are the species most commonly taken by WS-Wyoming.

Henke (1992, 1999) documented a decline 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. Cottontail rabbit density and raptor richness, species diversity and density did not differ between control and treatment areas. However, the year-round level of coyote removals, which occurred in Henke (1992, 1999) does not occur during normal WS-Wyoming PDM operations which would occur in Wyoming under Alternative 1. Similarly, the degree of predator control (exclusion or sustained year-round intensive population reduction efforts via the use of toxicants), was far greater in the study by Wallach et al. (2010) than occurs as a result of PDM that would be conducted by WS-Wyoming. Based on findings of Gese (2005), both the number of coyotes and the number of packs in areas with PDM patterns similar to that of WS-Wyoming had returned to pre-control levels within 8 months. Although there was evidence of a reduction in the average age of the population, there was no evidence that this resulted in an increase in coyote densities above pre-control levels. Based on this information, we conclude that the impacts of the current WS-Wyoming operations (Alternative 1) are not of sufficient magnitude or scope at the local or state level to adversely impact biodiversity or ecosystem resilience.

Impact on Trophic Cascades Including Potential for Mesopredator Release and Increases in Prey Populations. The term trophic cascade refers to the relationships among predators and prey in ecological systems that affect the abundance, biomass, or productivity of a population, community or trophic level (Beschta and Ripple 2009). In a simple example, predators, their herbivore prey and plants that provide food for the herbivores are three trophic levels that interact in a food chain. The presence of the predator causes reductions in the size of the prey populations or causes the prey population to alter its use of habitat (e.g., landscape of fear; Laundré et al. 2010) which, in turn, impacts plant community composition and health. Relationships are not restricted to top-down influence of predators on prey but also include the "bottom up" impacts of prey and primary producers (e.g., plants) on other levels of the system. Depending on the nature of the impact and the prey species, changes in vegetation and prey behavior can have impacts on abiotic factors such as soil compaction, soil nutrients and river morphology (Beschta and Ripple 2012a, Beschta et al. 2008, Beschta and Ripple 2006, Naiman and Rogers 1997). Relationships in trophic cascades are not limited to simple linear progressions, from predators to prey to vegetation, and can branch through the system. For example, reintroduction of wolves in the Yellowstone ecosystem has been associated with changes in elk density and behavior and reductions in browsing on palatable woody plants such as aspen. Understory shrub species richness and height, including berry-producing plants, were positively correlated with increased height of understory aspen. Increases in berry producing plants have the potential to benefit a wide range of animal species, and eventually food availability for other species of predators including grizzly bear (Ripple et al. 2013a, Beschta and Ripple 2012b). In the Midwest, changes in coyote activity were documented to impact white-tailed deer

activity and associated impacts on plant community composition (Waser et al. 2014). However, as with most ecosystems, the nature and magnitude of these types of relationships varies. For example, Maron and Pearson (2011) did not detect evidence that the presence of vertebrate predators fundamentally affected primary production or seed survival in a grassland ecosystem.

The issue of trophic cascades also refers to the impact the presence or absence of a larger apex predator (e.g., wolves or coyotes) has on another predator (fox, raccoons, feral cats) that may have different impacts on prey populations (aka. mesopredator release; Crooks and Soule´ (1999), Berger et al. 2008; Prugh et al. 2009, Brashares et al. 2010, Miller et al. 2012, Newsome and Ripple 2014). For example, Berger and Conner (2008) compared causes and rates of pronghorn antelope mortality in sections of Wyoming with and without wolves. Coyote predation was the primary cause of mortality in all sites, but coyote predation was 34% lower in sites with wolves. The decrease in pronghorn mortality rates was estimated to be sufficient to change the trend for the population from decreasing to increasing. In some cases, mesopredators may have similar or greater impacts on prey species of interest than the apex predator of initial concern. The presence of coyotes in an area has been shown to limit the density of smaller predators, which may prey more heavily on songbirds, ground nesting birds such as ducks and game birds, and some rodents (Crooks and Soulé 1999, Levi and Wilmers 2012, Miller et al. 2012). Carnivores such as badgers, bobcats, feral cats and fox may increase in number when coyote populations are reduced (Robinson 1961, Nunley 1977; Crooks and Soulé 1999). Recovery of wolf populations and associated long-term declines in coyote populations has been documented to result in an increase in survivorship of pronghorn deer fawns (Berger and Conner 2008).

Data on the impacts of coyotes and coyote removal on prey populations are mixed. In two studies conducted in south Texas (Beasom 1974b, Guthery and Beasom 1977), intensive short-term predator removal was employed to test the response of game species to reduced coyote abundance. At the same time, rodent and lagomorph species were monitored. A marked reduction in coyote numbers apparently had no notable effect on the populations of rabbits or rodents in either study. Similarly, Neff et al. (1985) noted that reducing coyote populations on their study area in Arizona to protect pronghorn antelope fawns had no apparent effect on the rodent or rabbit population.

Wagner (1988) reviewed literature on predator impacts on prey populations and concluded that such impacts vary with the locale. In some ecosystems, prey species, such as snowshoe hares, increased to the point that vegetative food sources were depleted, despite predation. In others, coyotes may limit jackrabbit density and evidence indicated food shortages do not occur to limit jackrabbit abundance (Wagner 1988, Stoddart et al. 2001). Wagner and Stoddart (1972) reported that coyote predation was a major source of jackrabbit mortality in the Curlew Valley of Utah, which may have caused a decline in the local jackrabbit population in the Valley. Their study makes no connections between PDM and jackrabbit mortality or coyote populations. In fact, the coyote population in Wagner and Stoddart (1972) was subject to more sustained and intensive control than is expected to occur under the current WS-Wyoming PDM program with coyotes taken through use of aerial shooting, trapping for bounties and pelts and the use of 1,080 poison bait stations that were placed in the fall and recovered in the spring (Wagner and Stoddart 1972). Any moderating effects of coyotes on jackrabbit populations occurred even

though the population was subject to intensive removals. Wagner and Stoddart (1972) and Clark (1972) independently studied the relationship between coyote populations and jackrabbit populations in northern Utah and southern Idaho. Both Wagner and Stoddart (1972) and Clark (1972) concluded that coyote populations seemed to respond to an abundance of jackrabbits. Complexity of the system and the range of available prey species may also impact the relationships between predators and prey. When a broad range of prey species are available, coyotes will generally feed on all species available; therefore, coyote populations may not vary with changes in the availability of a single prey species (Knowlton 1964, Clark 1972).

Intensive studies of the snowshoe rabbit population cycles by Krebs et al. (2001) reflect the complexity of predator and prey relationships. The authors determined that 10-year cycle in snowshoe hares is the result of an interaction between predation and food supplies, with predation playing the principle role in driving the cycle in the hare population. Mammalian predator (primarily coyotes and Canada lynx) abundance was strongly linked to abundance of hares, lagging the hare cycle by 1-2 years. Although Canada lynx and coyotes were key predators impacting hare survival, many species of predators were involved in the cycle, and the authors were unable to pinpoint the specific role of any one predator species. The importance of a range of predators in the system is illustrated by the 10-year cycle on Anticosti Island on the St. Lawrence River in eastern Canada. Canada lynx have been extirpated from the island, but the hare cycle persists, likely due to compensatory predation by other species (Stenseth et al. 1998). Impacts of food in the studies reported by Krebs et al (2001) appeared to be indirect and were associated with declines in body condition which may impact chronic stress, the ability of hares to avoid predators and reproductive output. Interestingly, the study implicated long-range movement of predators as the potential mechanism behind the synchronisity of the snowshoe hare population cycles over large geographic regions. As indicated above, the role of predators and food supplies appears to vary. Stevens (2010) provided an example of a system in Sweden in which red foxes prey on voles, grouse and hares. Like the snowshoe hare and lynx example, the fox and prey species appear to have linked population cycles with changes in predator populations following changes in prey populations. However, unlike the snowshoe hare example, forage availability appeared to have a more direct impact on prey populations. Based on forage switching from preferred to less preferred forage, in this system, the availability of forage also acts as a limiting factor on prey populations. When preferred food was scarce, individuals grew more slowly and reproduced less.

Henke (1995) reviewed literature concerning coyote-prey interactions and concluded that short- term coyote removal efforts (<6 months per year) typically did not result in increases of small mammal prey species populations. This finding is supported by Gese (2005) in which local coyote populations in a 131 mi^2 study area of up to 60 to 70% of the local coyote population in two consecutive years did not appear to have an impact on local lagomorph abundance. Some of the reason for the lack of impact noted by Gese (2005) may have been attributable to the fact that coyote pack size and density in the project area returned to pre-removal levels within 8 months of removal. Henke (1995) also concluded that long-term intensive coyote removal (nine months or longer per year) could, in some circumstances, result in changes to the rodent and rabbit species composition in the area where removals occurred, which could lead to changes in plant species composition and forage abundance. Henke (1995) based the conclusion that

long-term intensive coyote removal could result in change to prey populations on a previous study (Henke 1992) that was conducted in the rolling plains area of Texas that involved one year of pretreatment and two years of treatment. Removals occurred year round and resulted in a sustained reduction in the coyote population of approximately 48%. After the initiation of coyote removal, species richness and rodent diversity declined in treatment areas and relative abundance of badgers, bobcats and gray foxes increased. Cottontail rabbit density and raptor richness, species diversity and density did not differ between control and treatment areas. However, the sustained reduction in coyote populations (and presumably other mesopredators that might be released by the reduction in coyotes) resulting from restoration of wolf populations resulted in increases in the number of voles within 3 km of wolf dens (Miller et al. 2012).

One recent study (Dinkins et al. 2016) looked at the indirect effects of raven and coyote removal by WS for livestock protection in Wyoming on sage grouse nest success. This study concluded that even when raven removals were not conducted specifically for sage-grouse protection, decreases in raven density associated with livestock protection were associated with increases in sage-grouse nest success. However, Dinkins et al. (2016) also observed that sage-grouse nest success decreased with intensity of coyote removal (coyotes per unit area) in areas with greater precipitation the week before the nest failed. The authors state that the decrease in nest success might be due to mesopredator release, a change in mesopredator behavior such as an expansion of home ranges, a change in mesopredator foraging success under wet weather conditions or a combination of the above. However, there were no direct estimates of coyote or mesopredator abundance in this study before or after treatment and the causes of nest failures were not determined, which complicates conclusions regarding the role of mesopredator release and understanding the effects of varying levels of coyote removal. In the absence of this information, conclusive determinations regarding the role of mesopredators is not warranted at this time. However, even if the observed trend was the result of mesopredator impacts, the potential for this type of impact is limited. As noted elsewhere in the EA, WS-Wyoming PDM is only conducted in a small portion of the state. Furthermore, intensity of PDM effort in any given area varies from year to year. The conditions Dinkins et al. (2016) associated with lower nest success would require a specific combination of weather and predation intensity, which are not likely to commonly co-occur.

Some individuals have expressed concerns that activities such as WS-Wyoming's PDM would cause disruptions to trophic cascades or irruptions in prey populations by eliminating or substantially reducing top predators (e.g., Prugh et al. 2009, Ritchie and Johnson 2009, Estes et al. 2011, Bergstrom et al. 2014). WS-Wyoming has reviewed these studies but many are not applicable to the types of PDM proposed for Wyoming because they involve reviews of the complete absence of apex consumers from the system (e.g., Berger et al. 2001, Bechta and Ripple 2006, Beschta et al. 2008, Frank 2008, Gill et al. 2009, Ripple et al. 2010, Estes 2011, Ripple et al. 2013b;). In some instances, impacts have also been observed in cases where the predators were substantially reduced over an extended period of time (e.g., Henke et al. 1992, 1995, Henke and Bryant 1999 and Wallach et al. 2010 discussed above). Ripple and Beschta (2006, 2008) documented herbivore impacts on a site in Zion National Park largely avoided by cougar because of high human activity, an impact sustained over a period of decades. Reduction in cougar resulted in increases in mule deer and associated increases

in herbivory on riparian cottonwoods. Ultimately, this resulted in decreased cottonwood regeneration in the riparian area, increases in bank erosion and reduction in both terrestrial and aquatic species abundance (Ripple and Beschta 2006). They also documented diminished black oak (*Quercus keloggii*) recruitment in areas accessible to deer concurrent with reductions in mountain lion populations, but continuous recruitment in refugia where there were physical barriers deer access (Ripple and Beschta 2008). As discussed in detail in Sections 4.2.1.1 and 4.2.5.1, the current program would not result in the elimination of any predator population and impacts on apex predators are only temporary and in relatively small or isolated geographic areas, compared with population levels of target species. Consequently, this alternative is not anticipated to result in ecosystem impacts noted in the studies with complete removal or sustained extreme reductions in predator populations.

We did identify one instance wherein short term removals or absence of predators or removal of predators from an area appeared to have the potential for impacts on mesopredator populations. Crooks and Soule´ (1999) conducted an evaluation of the impacts of habitat fragmentation and mesopredator release on scrub-breeding birds in coastal southern California. In their study, coyotes were the apex predator and striped skunks, raccoons, grey fox, domestic cats and opossum were mesopredators. Coyote presence and abundance was primarily correlated with the size of the habitat fragment. Coyote abundance was negatively correlated with total mesopredator abundance. There was a consistent negative correlation between total mesopredator abundance and the number of scrub specialist bird species persisting in habitat fragments, although total fragment area and fragment age were the strongest determinants of bird diversity. Scrub bird diversity was higher in fragments where coyotes were either present or more abundant. Coyote presence and absence and coyote abundance remained a strong predictor of bird species diversity even after accounting for impacts of fragment area and fragment size. Even in areas that were only occasionally visited by coyotes, total abundance of mesopredators was lower in areas that temporarily had coyotes than areas without coyotes, with foxes, cats and skunks most responsive to the presence of coyotes. There was also short-term variance in mesopredator presence concurrent with the temporary presence and absence of coyotes with the majority of avoidance between coyotes and mesopredators driven by coyote-cat interactions. In general interactions among coyotes, cats and birds likely had the strongest impact on the decline and local extinction of scrub-based breeding birds. Approximately 25% of radio-collared cats were killed by coyotes, with an additional indirect impact of residents keeping cats indoors when they believed coyotes were nearby. Cat populations in and around the habitat fragments were maintained at levels far above carrying capacity and predation on birds by cats was identified as being at levels that appeared to be unsustainable. Existing population sizes of some bird species did not exceed 10 individuals in small to moderately sized fragments. In these fragments, even modest increases in predation pressure in combination with other factors could lead to localized extinctions. The extent of habitat fragmentation and high density of mesopredators supported by human-generated food and habitat subsidies were critical factors for the study, and may have contributed to conditions in which relatively small sections of habitat were surrounded by a superabundance of mesopredators. Conditions of habitat fragmentation and high densities of introduced predators such as the ones observed by Crooks and Soule´ (1999) are not typical of conditions where WS-Wyoming conducts PDM activities, particularly activities involving coyotes. Unlike the study of Crooks and Soule (1999) most WS-

Wyoming PDM actions and the majority of coyote take are conducted in large open agricultural areas with relatively little habitat fragmentation for human development.

WS-Wyoming only conducts PDM when and where it is needed. When direct management of a depredating animal(s) is needed and requested, efforts focus on management of the specific depredating animal or local group of animals. WS-Wyoming does not strive to eliminate or remove predators from any area on a long term basis, no predators or prey would be extirpated and none would be introduced into an ecosystem. As discussed in detail in Section 4.2.1.1 and 4.2.5.1, impacts are generally only on a temporary basis and in relatively small or isolated geographic areas, compared with population levels of target species. Therefore, we conclude that the impacts of WS-Wyoming's actions are not of sufficient magnitude or scope to result in ecosystem-level shifts in trophic cascades. Most removal of predators for PDM by WS-Wyoming involves removal of one to five individuals from relatively isolated locations. This level of removal is not of sufficient magnitude to result in substantive reductions in predator species abundance. The three primary species taken by WS-Wyoming in sufficient numbers to result in substantive short-term local population reductions are coyotes, common ravens and crows. Given the patchy and limited scope of WS-Wyoming damage management actions, repopulation of areas where PDM is conducted occurs relatively quickly, often within a year of the removals. As noted above in the section on biodiversity and ecosystem resilience, removals are not expected to result in long-term reductions in pack density or the number of coyotes present despite reductions in the age structure of the population (Gese 2005). Similarly, ravens and crows are highly mobile and PDM actions are patchy in nature. Unlike coyotes, there is strong evidence to believe that common raven populations may sustained at levels above that normal for the native ecosystem (Section 4.2.1.1). Temporary localized reductions in raven density may help to restore populations more typical of that for the system. Given the above factors, we believe it is unlikely that PDM actions by WS-Wyoming would result in unintended adverse impacts on ecosystems through perturbation of trophic cascades.

4.2.1.3 Alternative 1: Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans

Before an alternative can be considered for implementation on USFS or BLM-administered lands, it must be consistent with Land and Resource Management Plans (LRMPs) or more commonly "Forest Plans" and BLM Resource Management Plans(RMPs). If the Alternative is consistent with the LRMP or RMP, no additional action would be necessary by the USFS or BLM.

If an alternative(s) that is inconsistent with the LRMP or RMP is selected, the USFS or BLM could amend their LRMP or RMP to be consistent with the findings of this EA. The decision would not be implemented on the Forest System or BLM-administered lands until the inconsistency is resolved, either through amendment of the LRMP or RMP, or modification of the alternative(s). Any inconsistencies would be identified and resolved before damage management is initiated. A work plan is developed by WS with each National Forest and BLM District before any conflict management can be conducted, or in rare instances, under emergency control only. Damage management activities on Forest System and BLM lands in Wyoming would only be considered after consultation between the USFS, BLM, WGFD, and WS.

U. S. Forest Service Land and Resource Management Plans
The USFS has LRMPs, or "Forest Plans," for its National Forests. WS, under a national MOU, has authority to conduct wildlife damage management activities for the protection of private resources on these lands and is responsible for NEPA compliance. WS, USFS, and WGFD have annual work plan meetings to discuss management actions that are anticipated on each USFS National Forest. During these meetings, the USFS identifies anticipated activities that are inconsistent with their respective LRMPs. If an Alternative in this NEPA process is selected that is inconsistent with the LRMP, the USFS could amend the LRMP to be consistent with the EA, or elements of that Alternative could be modified when operating on that Forest. The decision would not be implemented on USFS lands until the inconsistency was resolved, either through amendment of the LRMP or modification of the Alternative. Any inconsistencies would be identified and resolved before wildlife damage management activities are conducted on a National Forest, unless an action is regarded as *emergency management* to resolve an immediate threat to HHS, such as an outbreak of a zoonotic disease.

BLM Resource Management Plans
The BLM currently uses RMPs to guide land use decisions and management actions on lands it administers. Any decision made as a result of this EA process will be consistent with guidance in these RMPs regarding WS activities. In Wyoming, WS prepares annual Work Plans for each of the three BLM Districts (High Desert District, Wind River/Bighorn Basin (NW) District, and High Plains District). During the preparation of these plans, the BLM districts check the proposed action and provide information needed to ensure that WS actions are consistent with the RMPs for their respective districts.

4.2.1.4 Alternative 1: Effects on the socioeconomic environment

Humaneness of Methods Used by WS
Some individuals are concerned with the humane treatment of animals. Humaneness, in part, is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important and very complex concept that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate pest damage management for societal benefits could be compatible with animal welfare concerns, if " . . . the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process."

Pain obviously occurs in animals, but assessing pain experienced by animals can be challenging (AVMA 2007). The American Veterinary Medical Association (AVMA) defines pain as being, "that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways" (AVMA 2007). The key component of this definition is the perception of pain. The AVMA (2007) notes that "pain" should not be used for stimuli, receptors, reflexes, or pathways because these factors may be active without pain perception. For pain to be experienced, the cerebral cortex and subcortical structures must be functional. If the cerebral cortex is nonfunctional because of hypoxia, depression by drugs, electric shock, or concussion, pain is not experienced. The AVMA recognizes that many manifestations of pain are shared by numerous animal species (AVMA 2007). The intensity of pain perceived by

animals could be judged by the same criteria that apply to human beings. If a condition causes pain in a human being, it probably causes pain in other animals.

Suffering is a much abused and colloquial term that is not defined in most medical dictionaries. Neither medical nor veterinary curricula explicitly address suffering or its relief. Therefore, many problems arise when attempting to define this term. Nevertheless, suffering may be defined as a highly unpleasant emotional response usually associated with pain and distress. Suffering is not a modality, such as pain or temperature. Thus, suffering can occur without pain, and although it might seem counter-intuitive, pain can occur without suffering (AVMA 2007). The degree of pain experienced by animals that are shot probably ranges from little to no pain to significant pain, depending on the nature of the shot and time until death. Since the concept of suffering carries with it the connotation of time, it would seem that there is little or no suffering where death occurs immediately. WS-Wyoming personnel are trained professionals experienced in the placement of shots that result in quick death and therefore, minimal pain and suffering.

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

The AVMA 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" (AVMA 2013). Additionally, euthanasia methods should minimize any stress and anxiety experienced by the animal prior to unconsciousness." Although use of euthanasia methods to end an animal's life is desirable, as noted by the AVMA, "For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible." AVMA (2013) recognizes that there is "an inherent lack of control over free-ranging wildlife, accepting that firearms may be the most appropriate approach to their euthanasia, and acknowledging that the quickest and most humane means of terminating the life of free-ranging wildlife in a given situation may not always meet all criteria established for euthanasia. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible" (AVMA 2001). Because of the variety of situations that may be encountered, it is difficult to strictly classify methods for termination of free-ranging wildlife as acceptable, acceptable with conditions, or unacceptable. Furthermore, classification of a given method as a means of euthanasia or humane killing may vary by circumstances. These acknowledgments are not intended to condone a lower standard for the humane termination of wildlife. The best methods possible under the circumstances must be applied, and new technology and methods demonstrated to be superior to previously used methods must be embraced.

AVMA (2013) notes, "While recommendations are made, it is important for those utilizing these recommendations to understand that, in some instances, agents and methods of euthanasia identified as appropriate for a particular species may not be available or may become less than an ideal choice due to differences in circumstances. Conversely, when settings are atypical, methods normally not considered appropriate may become the method of choice. Under such conditions, the humaneness (or perceived lack thereof) of the method used to bring about the death of an animal may be distinguished from the intent or outcome associated with an act of killing." Following this reasoning, it may still be an act of euthanasia to kill an animal in a manner that is not perfectly humane or that would not be considered appropriate in other contexts. For example, due to lack of control over free-ranging wildlife and the stress associated with close human contact, use of a firearm may be the most appropriate means of euthanasia. Also, shooting a suffering animal that is in extremis, instead of catching and transporting it to a clinic to euthanize it using a method normally considered to be appropriate (e.g., barbiturates), is consistent with one interpretation of a good death. The former method promotes the animal's overall interests by ending its misery quickly, even though the latter technique may be considered to be more acceptable under normal conditions (Yeates 2010). Neither of these examples, however, absolves the individual from her or his responsibility to ensure that recommended methods and agents of euthanasia are preferentially used."

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

Analysis of this issue must consider not only the welfare of the animals captured, but also the welfare of humans, livestock and some T&E species if damage management methods are not used. For example, some individuals may perceive techniques used to remove a predator that is killing or injuring pets or livestock as inhumane, while others may believe it is equally or more inhumane to permit pets and livestock that depend upon humans for protection to be injured or killed by predators.

WS-Wyoming personnel are experienced and professional in use of management methods to increase humaneness as much as possible under the constraints of current technology, workforce, and funding. SOPs used to maximize humaneness are listed in Chapter 3 and humaneness and other sociological issues are discussed in Chapter 4. When implementing management actions, WS-Wyoming evaluates all potential tools for their humaneness, effectiveness, ability to target select species or specific individuals, and potential impacts on HHS. AVMA (2007) also recognizes that "for wild and feral

animals, many recommended means of euthanasia for captive animals are not feasible. The panel recognized that there are situations involving free-ranging wildlife when euthanasia is not possible from the animal or HHS standpoint, and killing may be necessary." The AVMA states that in these cases, the only practical means of animal collection may be gunshot or lethal trapping, and personnel should not only select the proper caliber of firearm and ammunition, but be proficient in their use. WS policy and operating procedures are in compliance with these guidelines, and the WS program recognizes the importance of careful decision-making regarding the use of lethal methods (WS Directive 2.101, 2.201).

Animal welfare organizations and members of the public have expressed concern that some methods used to reduce wildlife damage expose animals to unnecessary pain and suffering. Research suggests that with methods such as restraint in foot-hold traps, changes in the blood chemistry of trapped animals indicate a stress response. The situation is likely to be similar for animals caught in snares or chased by dogs.

Selectivity of wildlife damage methods is related to the issue of humaneness in that greater selectivity results in less potential suffering of non-target animals. Methods vary in their selectivity for non-target animals. The selectivity of each method is augmented by the skill and discretion of the WS Specialist applying the technique, and on specific measures and equipment modifications designed to reduce or minimize non-target captures. All WS Specialists are trained in techniques to minimize the risk of capturing non-target wildlife. Section 4.3.1.2 discusses the proposed program's potential for affecting non-target species.

The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology. WS personnel are concerned about animal welfare. WS is aware that techniques like snares and traps are controversial, but also believes that these activities are being conducted as humanely and responsibly as practical. WS and the National Wildlife Research Center (NWRC) are striving to bring additional non-lethal damage management alternatives into practical use and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when non-lethal damage management methods are not practical or effective. WS supports the most humane, selective, and effective damage management techniques, and would continue to incorporate advances into program activities. WS supports the most humane, selective, and effective damage management techniques, and will continue to incorporate methodological advances into program activities. WS Specialists conducting damage management are highly experienced professionals, skilled in the use of management methods and committed to minimizing pain and suffering (WS Directive 2.101). Effects on individual animals may include: anxiety, fear, stress, and injury. This includes not only target species, but also dogs used to pursue mountain lions or bears.

Wildlife Values and Ethical Perceptions of Damage Management

Ethics can be defined as the branch of philosophy dealing with values relating to human conduct, with respect to the rightness or wrongness of actions and the goodness and badness of motives and ends (Costello 1992). Individual perceptions of the ethics of wildlife damage management and the appropriateness of specific management techniques

depend on the value system of the individual. These values are highly variable (Schmidt 1992, Teel et al. 2002), but can be divided into general categories (Kellert 1994, Kellert and Smith 2000, Table 4-7). An individual's values on wildlife may include components of various categories and are not restricted to one viewpoint. The tendency to hold a particular value system varies among demographic groups. For example, one major factor influencing value systems is the degree of dependence on land and natural resources as indicated by rural residency, property ownership and agriculture or resource dependent occupations (Kellert 1994). People in these groups tend to have a higher tendency for utilitarian and dominionistic values. Socioeconomic status also influences wildlife values, with a higher occurrence of naturalistic and ecologistic value systems characterizing college educated and higher income North Americans (Kellert 1994). Age and gender also influence value systems, with a higher occurrence of moralistic and humanistic values expressed by younger and female test respondents (Kellert 1980, 1994).

Table 4-7. Basic wildlife values (from Kellert 1994, Kellert and Smith 2000).

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

A recent study by (George et al. 2016) replicated the research of (Kellert 1985) evaluating human uses and values toward animals. The study found that favorable ratings for predators (coyotes and wolves) had increased since the study by Kellert with positive attitudes towards these species increasing 47% and 42%, respectively, and that overall attitudes towards wildlife appeared to be shifting from more dominionistic and utilitarian values to more mutualistic values in which the wildlife are viewed as part of an extended family deserving of caring and compassion and wherein the value of predators in ecosystems is valued. This shift is consistent with success of recent ballot measures intended to improve animal welfare through regulation of domestic animal housing standards and legislation banning or placing severe restrictions on use of devices such as foothold traps.

Individual relationships with the species in question still appear to have a substantial influence on attitudes towards wildlife. For example, Treves (2013) found that public attitudes towards wolves may be increasingly negative among residents of areas occupied by wolves, especially those negatively impacted by wolves. Increasing urban residence has been associated with a rise in positive attitudes towards wildlife, and positive attitudes of this portion of the U.S. population likely outnumber opinions from more rural areas. However, like livestock producers in areas with wolves, attitudes of urban/suburban residents may be influenced by experiences in their area. George et al.

(2016) noticed a decrease in positive attitudes towards raccoons and hypothesized that one of the potential reasons could be increased conflicts with raccoons (property damage, health and safety concerns) that are experienced in urban/suburban areas.

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

One philosophy regarding the relationship between animals and people, Animal Rights, asserts that all animals, humans and nonhumans, are morally equal. Under this philosophy, no use of animals, (*e.g*., for research, food and fiber production, recreational uses such as hunting and trapping, zoological displays, animal damage management, etc.) should be conducted or considered acceptable unless that same action is morally acceptable when applied to humans (Schmidt 1989). A second philosophy, Animal Welfare, does not promote equal rights for humans and nonhumans, but focuses on reducing pain and suffering in animals. Advocates of this philosophy are not necessarily opposed to utilitarian uses of wildlife but they are concerned with avoiding all unnecessary forms of animal suffering. However, the definition of what constitutes *unnecessary* is highly subjective (Schmidt 1989). In general, only a small portion of the U.S. population adheres to the Animals Rights philosophy, but most individuals are concerned about Animal Welfare. A third philosophy takes the view that overpopulation of an animal species (whether natural, man-induced or artificial) leads to increased animal suffering when the population suffers malnutrition, disease outbreaks of epidemic proportion or populations crashes due to exceeding the environmental carrying capacity. Advocates for this approach suggest that it is man's obligation to manage animal populations in a manner that reduces potential suffering to a minimal level (Beauchamp and Frey 2011). Similarly, some individuals may feel that humans have a moral obligation to correct environmental impacts that result from the human introduction of invasive species such as feral swine.

When evaluating issues relating to the ethics of conserving or controlling nature, another approach is to consider the reason for the action as the determination of whether the action is ethical or not. One model using this approach involves assessing actions from the point of view of humans only (anthropocentric) or from a more general view of all living organisms (biocentric) that considers any harm to living creatures that can be avoided as immoral (Haider and Jax 2007). These approaches have been considered for conservation decisions, but could also be applied to PDM decisions such as those discussed in this EA.

A simple model for determining the ethics of a potential action proposes assessing whether the action is necessary and whether it is justified. In this model, if "yes" is the answer to both questions, the action is ethical (Littin and Mellor 2005). Although the considerations relating to each of these questions may involve several factors, only the two basic questions need to ultimately be answered using this model.

Yet another approach developed a set of six major criteria that can be used to design a pest control program that is ethically sound (Littin et al. 2004). The six major criteria are:

1. The goals, benefits and impacts of action must be clear.
2. The action should only be taken if goals can be achieved.
3. The most effective methods must be used to achieve goals.
4. The methods must be used in the best ways possible.
5. The goals must be assessed.
6. Once goals are achieved, processes should be in place to maintain results.

Using this model, an ideal project is one that follows all six criteria above (a "gold standard" project). If not all six criteria can be followed, an ethically sound pest control program can still be conducted if the project is conducted in a way that moves toward the "gold standard." With unlimited funding and time available, achieving a "gold standard" project may be possible. The challenge in coping with this type of model is how to achieve the best project (as close to the "gold standard" as possible) with the least amount of animal suffering within the constraints imposed by current technology and funding.

Models assigning numerical values to criteria have been proposed to assist in decision-making for alternatives when faced with animal disease outbreaks. One such model attempts to incorporate social ethics as one of the major criteria to be ranked, assigning numerical ranking to issues such as animal welfare (Mourits et al. 2010). Although the primary application of this model is for disease outbreaks, it could also potentially be applied to PDM.

The issue of ethics is evolving over time (Perry and Perry 2008), but no one commonly-accepted standard for the evaluation of ethics relating to control of animal pests exists. Any of the above models, alone or in combination, may provide additional consideration of the ethics of a proposed action. WS has numerous policies, directives and SOPs that provide direction to staff involved in wildlife control reinforcing the achievement of the most appropriate and effective wildlife damage management program possible. Many of these guidance documents incorporate aspects of the ethics consideration issues discussed above. Directives pertaining to WS' activities may be located using the WS home page at https://www.aphis.usda.gov/.../wildlifedamage.

Alternative 1 would be unacceptable to Animal Rights advocates, individuals with strong Humanistic and Moralistic values, and to others with strong emotional or spiritual bonds with certain wildlife species. Some individuals assert that killing the offending animal is not the response of a moral or enlightened society. Response of other individuals and groups would vary, depending on individual assessments of the need for damage management, risk to the target animal population, risk to non-target species and individuals, the degree to which efforts are made to avoid or minimize the pain and suffering associated with the various management techniques, and the perceived humaneness of individual methods.

Effects on Recreation (Hunting and Non-consumptive Uses)
Some members of the public may be concerned that WS-Wyoming activities could conflict with recreation. Further, the human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public is no exception and today a large percentage of households have pets. Some people may also consider individual wild animals and birds as "pets" or exhibit affection toward these animals, especially people who enjoy coming in contact

with wildlife. Conversely, others may see the same species as a detriment to aesthetic values (i.e., predators killing or attacking pets or livestock). Therefore, the public reaction to PDM is variable and mixed because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the aesthetic values of wildlife and the best ways to reduce conflicts/problems between humans and wildlife.

There may be some concern that the proposed action or alternatives would result in the loss of aesthetic benefits to the public or effect recreational opportunities. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is a philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature and is dependent on what an observer regards as beautiful.

Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). These include direct benefits related to consumptive and non-consumptive use (e.g., wildlife-related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (e.g., reading, television viewing), and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (e.g., ecological, existence, bequest values) (Bishop 1987). Direct benefits are derived from a user's personal relationship to animals and may take the form of direct consumptive use (using up the animal or intending to) or non-consumptive use (viewing the animal in nature or in a zoo, photography) (Decker and Goff 1987). Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Many people, directly affected by problems and threats to HHS caused by predators, insist upon their removal from the property or public location when they cause damage. Other people directly impacted by the problem may want to exhaust all non-lethal alternatives before attempts are made to remove the animals. Others may decide they can learn to live with the problem. Similarly, individuals not directly affected by the harm or damage caused by wildlife may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Those totally opposed to PDM want WS to teach tolerance for damage and threats to HHS, and that wildlife should never be killed, and would strongly oppose removal of predators regardless of the amount of damage. Other members of the public oppose removal of wildlife because of human-affectionate bonds with individual animals. Other members of the public believe that all wildlife should be captured and relocated to another area to alleviate damage or threats to HHS.

The WS-Wyoming program only conducts wildlife damage management at the request of the affected property owner or resource manager. If WS received requests from an individual or official for PDM, WS would advise the landowner/manager of the sociological issues/concerns and consideration would be made to explain these issues relative to the proposed individual damage management methods. Management actions would be carried out in a caring, humane, and professional manner.

Recreation encompasses a wide variety of outdoor activities in the form of consumptive and non-consumptive uses. Consumptive uses of public lands include hunting, fishing, and rock-hounding. Non-consumptive uses include activities such as bird watching, photography, camping, hiking, biking, rock climbing, winter sports, and water sports. Recreationists are the general public and their pets, includes hunting dogs. WS-Wyoming is aware that most concerns expressed by recreationists about wildlife damage management focus on its perceived impacts on hunting, photography, wildlife viewing, and pet safety.

Public opinion about the best ways to reduce conflicts between humans and wildlife is highly variable, making the implementation of damage management programs challenging and often complex. Ideas about how these programs are implemented and conducted are as unique as the combinations of philosophies, psyches, aesthetic values, personal attitudes, and opinions of humans. These differences in opinion result in concerns that the proposed action or the alternatives would result in the loss of aesthetic benefits to the general public and resource owners. The mere knowledge that wildlife exists is a positive benefit to many people (Decker and Goff 1987).

Wildlife populations also provide a range of direct and indirect social and economic benefits. Direct benefits are derived from a user's personal relationship or direct contact with wildlife and may include both consumptive (*e.g.*, hunting), or non-consumptive (*e.g.*, observing or photographing wildlife) uses. Indirect benefits or indirect values arise without a human being in direct contact with an animal and are derived from experiences such as watching wildlife, looking at pictures or videos of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). According to Decker and Goff (1987), two forms of indirect benefits exist: bequest and pure existence. Bequest benefits arise from the belief that wildlife should exist for future generations to enjoy, while pure existence benefits accrue from the knowledge that wild animals exist in the human environment (Decker and Goff 1987), or that they contribute to the stability of natural ecosystems (*e.g.*, ecological values) (Bishop 1987).

Under the proposed alternative, some predators would be lethally removed (Table 4-1 and Table 4-3). WS programs for reducing predation damage focus on individual problem predators or localized populations of predators. The proposed action has a low magnitude of impact on target predator populations in Wyoming. Dispersal from adjacent areas typically contributes to repopulation of a site, depending upon the level of removal and the status of predator populations in surrounding areas. Problem wildlife species which cause the most damage are typically abundant (Conover 2002). While the likelihood of seeing certain predator species in some localized areas could be temporarily reduced as a result of WS-Wyoming activities, those that are more commonly observed would continue to be observed, while those that are less commonly or rarely, if ever, observed (*e.g.*, mountain lions), would continue to be present in the environment. In the latter case, there would be little visual impact due to the very low likelihood of observing such species in the first place. In this case, the aesthetic and visual impact would probably not be noticeable.

Game and non-game wildlife populations are not significantly impacted by WS-

Wyoming activities on public lands, allowing hunters ample opportunity to pursue these species. Recreationists interested in pursuing wildlife viewing and photographic opportunities have access to large areas of land in Wyoming that are suitable for observing abundant wildlife, including some areas that WS-Wyoming has historically worked. Because WS-Wyoming activities do not remove a significant number of any one species, populations of such species are not impacted to any large degree. In fact, in some cases, WS-Wyoming activities could bolster populations of certain game species or T&E species impacted by predators under requests for predator removal by WGFD or USFWS.

Procedures and policies designed to minimize potential negative effects on recreationists are in place that help minimize the potential for effects of WS-Wyoming activities on public recreational activities. WS-Wyoming personnel post signs in prominent places to alert the public that M-44s are being utilized in an area (WS Directive 2.415, 2.450). On private lands, the cooperators or landowners are aware that damage management tools are being used and can alert guests using the property of their presence. Landowners determine the areas and timing of equipment placement, thereby avoiding conflicts with recreationists.

On federal lands, WS-Wyoming coordinates with the land management agency through work plans and designates different work zones on maps to reduce potential problems. For example, high-use recreational areas are designated on maps associated with the work plan and WS-Wyoming does not set equipment within a ¼ mile of these areas. Furthermore, high-use hunting areas are delineated by WGFD, USFS, or BLM, and if WS-Wyoming works on them, damage management equipment is removed a week or more prior to the hunting season. WS-Wyoming does not conduct damage management in high use recreational areas except for the protection of HHS. High use recreation and other sensitive areas are identified at the site-specific level in WS-Wyoming work plans, or as new damage situations arise. HHS zones, planned damage management areas, and restricted or coordinated management areas are identified through interagency coordination.

Table 4-8. Number of Predators taken on BLM land by WS-Wyoming from FY2010-FY2014 (MIS 2014).

Species	FY10	FY11	FY12	FY13	FY14
Black Bear	1	6	4	5	52
Bobcat	0	2	0	0	0
Coyote	804	622	703	905	613
Feral dog	1	0	1	0	5
Mountain Lion	5	7	13	0	0
Raven	50	62	41	12	8
Red Fox	13	1	0	1	19
Total Take	874	700	762	923	697

Some individuals may believe that their recreational experiences on public lands are impaired by merely knowing that any damage management actions are occurring on these lands. Others feel that they are being deprived of the aesthetic experience of viewing or hearing coyotes or other predators because of WS-Wyoming damage management actions. On the other hand, some believe that damage management is wholly acceptable since it can help bolster populations of certain game species (*e.g.*, mule deer, bighorn sheep, pronghorn antelope, sage-grouse) or sensitive/threatened/ endangered species.

The WS-Wyoming take of predators on BLM and USFS lands for damage management purposes is minimal, averaging about 791.2 target animals per year on BLM lands across the state and 145.6 target animals per year on USFS lands in Wyoming (Table 4-8 and Table 4-9). This has little impact on recreational pursuits of any kind. Although the primary impetus for take under these situations is PDM, corollary benefits occasionally accrue, such as education of the public on results of wildlife disease surveillance activities for certain zoonotic diseases, such as plague and tularemia.

Table 4-9. Number of Predators taken by WS-Wyoming on USFS Lands from FY2010-FY2014 (MIS 2014).

Species	FY10	FY11	FY12	FY13	FY14
Bear	72	62	35	45	17
Coyote	60	87	155	94	99
Mountain Lion	0	0	2	0	0
Total	132	149	192	139	116

Some groups or individuals have expressed concerns regarding the effects of WS-Wyoming low-level aerial shooting activities on non-target wildlife and on public land recreational users. WS-Wyoming has agreements for conducting wildlife damage management on 49.4% of the public lands in Wyoming. Aerial shooting takes place under 95% of these agreements. Because WS-Wyoming typically conducts damage management on a fraction of the land under agreement, the acreage potentially affected by WS-Wyoming damage management activities is actually much less than the agreement figure. On average, from FY 2010-FY 2014, aerial shooting was conducted on 95% of lands under BLM management, 44% under USFS management, 56% private, and 90% other lands[16]. WS-Wyoming concentrates flying efforts on specific areas, such as lambing grounds, at certain times of the year, so the amount of time spent flying properties under agreement on an annual basis is relatively small. Acreage flown or operational management performed by WS-Wyoming is tracked by MIS at the individual agreement level. Therefore, even if an aerial crew, or a WS Specialist, performed work on only 100 acres of an individual agreement listed at 5,000 acres, MIS will summarize the activities under the total acreage listed under the agreement (*e.g.*, 5,000 acres). Thus, the average amount of time during any year that WS-Wyoming spends working a given agreement is minimal. This analysis shows that the potential for impacts on recreation is low. Additionally, as the majority of low level flying in Wyoming is typically conducted in remote spring lambing and calving grounds, encounters with recreationists would occur infrequently at best.

Conflicts with recreationists by WS-Wyoming activities are further reduced as a result of inherent operational characteristics and locations of damage management. Damage management activities on public lands are conducted almost entirely on sheep and cattle grazing allotments. Such remote and rugged areas where livestock and natural resource protection activities typically occur (*e.g.*, bighorn sheep range) are rarely used by recreationists. Because of the nature and magnitude of recreational use, some of these areas are primarily dedicated to that specific purpose and grazing is not allowed. The highest frequency of seasonal damage management activities for the protection of livestock coincides with lambing and calving, which occurs in the spring. During this time, aerial shooting is the method of choice because many of these grazing areas have poor access and driving conditions are usually limited

[16] The area comprising "other lands" is extremely small compared to the vast acreage of BLM property in Wyoming.

by wet ground. This impacts access for recreationists as well as WS-Wyoming Specialists.

Cost Effectiveness of PDM

Many factors can impact the effectiveness of a PDM. Some of the variables that would change the cost-to-benefit ratio of a PDM program include: local market values for livestock, age, class and type of livestock preyed upon, management practices, geographic and demographic features of the area, local laws and regulations and WS policies, the skill and experience of the individual WS Specialist responding to the damage request, and others.

Predators negatively affect livestock profitability both directly (via death), and indirectly (by reducing weaning weights caused by stress from the presence or harassment of predators, and increasing labor and management costs). Direct livestock mortality alone can significantly reduce the viability of the ranching business. A reduction in weaning weights can affect the whole herd, and in extreme cases may also threaten the economic viability of the ranch business. Increases in labor and management costs associated with predation can include additional veterinary services and herders. Rashford et al. (2010) found that the effect of predators in western Wyoming cow-calf operations was most costly from the standpoint of reducing herd weaning weights, followed by calf death loss to predation and lastly, increased management costs. While the collective impacts on the ranch economy from these three variables were not examined, they could significantly reduce the profitability of a ranch business. This study suggested that PDM would need only to reduce death or weaning weight losses a small amount to be economically efficient. Rashford et al. (2010) also point out the value of protecting the long-term viability of private western ranch lands, as they contribute to beneficial public and ecosystem services such as open space and wildlife habitat.

A common concern about government-funded wildlife damage management programs is that the value of livestock losses reported to, or verified by, WS is often less than the cost of providing wildlife damage management services. However, this opinion is shortsighted because it conveys a misconception regarding the purpose of wildlife damage management for livestock protection, which is to be proactive (*i.e.*, to prevent or stop losses in order to minimize them, not to wait until the value of losses is high). PDM would be most effective if it prevented all losses. However, it is not reasonable to expect zero loss. The concern should be whether the cost of providing PDM services is equal to or greater than the value of livestock losses avoided.

The NWRC conducted an economic assessment of select benefits and costs of WS in California. The assessment focused primarily on damage in agricultural areas because urban wildlife damage figures were not readily available. Funding for the study was provided by the California Department of Food and Agriculture Vertebrate Pest Control Research Advisory Committee. Results of the study indicate that for every $1.00 California counties invest in WS, they save between $6.50 and $10.00 in wildlife damage and replacement costs (Shwiff et al. 2005).

Other studies have also documented positive benefit-to-cost ratios for PDM. An economic assessment of the California Cooperative Animal Damage Control program for the 10-year period between 1980 and 1990 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. Bodenchuk et al. (2002) reported predation management benefit-to-cost ratios of 3:1 up to 27:1 for agricultural resource protection, and 2:1 to 22:1 benefit-to-cost ratios for predation management for wildlife. 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 ahead of summer sheep grazing.

Although cost effectiveness is one of many factors considered in selecting PDM methods and strategies, in some instances, cost effectiveness should not be the primary concern driving selection of a PDM method, IWDM strategy or alternative. Connolly (1981) examined the issue of cost effectiveness of federal PDM programs and concluded that public policy decisions have been made to steer the program away from being as cost effective as possible. This is because of the elimination of damage management methods believed to be effective but less environmentally acceptable, such as the use of toxic baits. Thus, implementation of the remaining available methods increases costs, but also achieves other public benefits besides livestock protection and therefore, could be viewed as mitigation for the loss of effectiveness in reducing damage. Additional constraints, such as environmental protection and land management goals, are considered whenever a request for assistance is received. These constraints increase the cost of the program while not necessarily increasing its effectiveness, yet are a vital part of the WS program.

4.2.1.5 Alternative 1: Effects on HHS

Impacts on Human Safety and the Environment (*e.g.*, effects of pesticides and hazardous materials)

Effects on HHS: Some members of the public may be concerned that management methods employed by WS-Wyoming could threaten HHS, and that the use of pesticides could negatively affect the environment; these issues are discussed in Chapter 4.

Safety of Proposed Chemical Methods

Safety concerns pertaining to the use of chemical PDM methods include the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed (e.g., animals used for food). Under the alternatives identified, the use of chemical methods would include carbon dioxide for euthanasia, sodium cyanide in the M-44, gas cartridges used or burrow fumigation, immobilization chemicals and the avicide DRC-1339 (Appendix C). Chemicals proposed for use under the relevant alternatives are regulated by the EPA through FIFRA, by WDA through Chapter 28 Applicator Rules and Regulations, and by WS Directives.

Safety of Proposed Non-Chemical Methods

Non-chemical methods employed to reduce damage and threats to safety caused by predators, could potentially be hazardous to HHS through misuse or accident. Non-chemical methods may include but are not limited to firearms, foot-hold traps and snares, neck snares, exclusion, pyrotechnics, and other scaring devices (Appendix C). Some people may be concerned that WS' use of firearms, traps, and pyrotechnics could cause injuries to people. There are also concerns regarding potential fire hazard to agricultural sites and private property from pyrotechnic use.

Firearm use is a very sensitive issue and a concern because of public fears regarding the risks associated with unsafe firearm use and the potential for misuse of firearms. WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program prior to using firearms and annual refresher training thereafter (WS Directive 2.615). WS employees who carry firearms as a condition of employment, are also required to sign a form certifying that they meet the criteria as stated in the Lautenberg Amendment which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence. WS works with cooperators to develop management strategies suited to the specific needs of each site. WS communicates the potential risks from the proposed methods to the cooperator during the development of the management strategy. The cooperator also has opportunities to communicate their concerns to WS to ensure that WS can then create a management strategy in which both parties are in agreement. The methods to be used are listed in a MOU, cooperative service agreement, or a similar document approved by the cooperator, property owner or managed by the cooperator.

Impacts on HHS from predators

The concern addressed here is that the absence of adequate PDM would result in adverse effects on HHS, because predator damage would not be curtailed or reduced to the minimum levels possible and practical. The potential impacts of not conducting such work could lead to increased incidence of injuries, illness, or loss of human lives.

SOPs to reduce risks to HHS and the environment are built into the WS-Wyoming program and are listed in Chapter 3 under SOPs. Such tools (*i.e.*, traps, snares, firearms, aerial shooting, immobilization drugs, and pesticides) used by WS are regulated under these SOPs and by other guidelines. The use of immobilizing agents and pesticides by WS-Wyoming is regulated by EPA under FIFRA, and/or WS Policies and Directives (2.210, 2.401, 2.405, 2.415, 2.430). Under the current program alternative in this EA, WS-Wyoming would use sodium cyanide in the M-44 device and carbon dioxide (produced by the gas cartridge) for fumigating coyote and fox dens. When WS-Wyoming chemical methods, including those referenced above, are used in accordance with label directions, they are highly selective to target individuals or populations, and such uses have negligible impacts on the environment and do not represent a risk to the public.

WS-Wyoming management methods do not pose a significant hazard to employees or the public because all methods and materials are consistently used in a manner known to be safe to the user and the public. This includes potential risks to WS employees, the public, and non-target animals. While some of the materials and methods used by WS-Wyoming have the potential to represent a threat to HHS if used improperly, problems associated with their misuse rarely occur. This favorable record is due to training and certification in the use of damage management methods such as the M-44, with an emphasis on proper use and safety, and mandatory compliance with agency policies and pesticide labels. The risk to the public is further reduced because most WS-Wyoming damage management methods are used in areas where public access is limited and warning signs are prominently posted to alert the public to the presence of equipment in such areas. WS-Wyoming coordinates with cooperators or landowners regarding the timing and

placement of management tools, thereby reducing the likelihood of conflicts with the public.

WS-Wyoming damage management activities are also not likely to negatively affect the public in terms of "Environmental Justice" and "Executive Order 12898" (see section 1.5.2). "Environmental Justice" and "Executive Order 12898" relate to the fair treatment of people of all races, income and culture with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Environmental justice is a priority within USDA, APHIS, and WS. Also, all WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice.

Under the current program alternative, damage management methods could be used to resolve complaints involving predators that represent a risk to HHS.

Risks associated with the use of lead ammunition: WS has determined that the use of lead from ground shooting is not significant in terms of effects from accumulation in the soil (USDA 2005). A very small amount of lead (in the form of ammunition) is sparsely and widely dispersed in the environment, rather than concentrated in small areas. Lead artifacts and lead from spent ammunition are relatively stable, and are not readily released into aquatic or terrestrial systems (Rattner et al. 2008). Additional discussion on the effects of lead is contained under discussions of effects on non-target species (Section 4.3.1.2).

4.2.1.6 Alternative 1: Effects from Aerial Shooting

Impacts on the environment from the use of aircraft (*i.e.*, wildlife, recreation, other issues)

Impacts on wildlife species populations caused by low-level flight during aerial shooting aircraft play an important role in the management of various wildlife species. Resource management agencies rely on low-flying aircraft to monitor populations of a variety of wildlife species, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1976), and colonial waterbirds (Speich 1986). Low-level flights are also commonly used to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1994).

Aerial shooting is an important tool for reducing coyote damage in Wyoming, especially during the lambing and calving seasons. Fixed-wing aircraft are the primary aircraft used by WS-Wyoming for aerial shooting in Wyoming, but a limited use of helicopters is employed in locations where the terrain is rough, heavily wooded, or mountainous. WGFD routinely employs fixed-wing aircraft and helicopters to census big game populations (S. Smith, WGFD, pers. comm.). Some individuals express concern that aerial shooting disturbs non-target wildlife species and wild horses and burros to the detriment of their survival and reproduction; such species commonly encountered during aerial shooting activities include deer, elk, wild horses, and pronghorn antelope. WS-Wyoming avoids wild horses and other wildlife species encountered during aerial operations and presents little disturbance to them.

Fixed-wing aerial time by WS-Wyoming totaled 3,147.1 hours in FY 2010, 3,097.5 hours in FY 2011, 3,197.8 hours in FY 2012, 3,064.8 hours in FY 2013 and 2,874.5 hours in FY 2014 (MIS 2014). WS-Wyoming conducts aerial damage management activities only on areas under agreement. Much of this activity is concentrated on specific areas, such as lambing grounds, during critical time periods. The average amount of time WS-Wyoming spends during any year on a given property is not substantial. Cooperative service agreements between WS-Wyoming and cooperators specify a total acreage on which WS-Wyoming is authorized to work. Because aerial and other operational management activities conducted by WS-Wyoming are tracked by the MIS database only to the agreement level, if only a small portion of the acreage on any agreement is worked by WS-Wyoming, as is commonly the case, MIS will overestimate the area worked under a given agreement. For example, the acreage of "other lands" agreements is extremely small compared to the vast acreages of public lands under agreement, and consequently, a small amount of time spent flying on "other lands" is disproportionately reflected in the MIS database.

The National Park Service (1995) reviewed studies on the effects of aircraft overflights on wildlife. This report revealed that a number of studies have documented responses by certain wildlife species that suggest adverse impacts could occur. Few, if any studies, have proven that aircraft overflights cause significant adverse impacts on populations, although the report stated that it is possible to draw the conclusion that impacts to wildlife populations are occurring. Some species will frequently or occasionally show adverse responses to even minor overflight occurrences. Generally, the more serious potential impacts occur when overflights are frequent (hourly) and over long periods of time (chronic exposure). Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. WS-Wyoming aerial shooting operations occur in relatively remote areas where tree cover is scattered at best, a necessity for maintaining visibility of target animals from the air. By their very nature, aerial activities conducted by WS devote relatively little time to any one area.

Several examples of wildlife species that have been studied with regard to low-level flights are available in the literature. Grubb et al. (2010) evaluated golden eagle response to civilian and military (Apache AH-64) helicopter flights in northern Utah. Study results indicated that golden eagles were not adversely affected when exposed to flights ranging from 100 to 800 meters along, towards and from behind occupied cliff nests. Eagle courtship, nesting and fledging were not adversely affected, indicating that no special management restrictions were required in the study location.

Kushlan (1979) reported that low level (390 feet followed by a second flight at 200 feet) overflights of 2-3 minutes in duration by a fixed-wing airplane and a helicopter produced no "drastic" disturbance to tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level flying military aircraft in North Carolina and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the time-activity budgets of the species. Krausman et al. (1986) reported that only 3 of 70 observed responses of mule deer to small fixed-wing aircraft overflights at 150 to 500

feet above ground level resulted in the deer changing habitats. These authors felt that the deer may have been accustomed to overflights because the study area was near an interstate highway which was followed frequently by aircraft. WS-Wyoming aircraft are unlikely to be flown over waterfowl or shorebirds in Wyoming because aerial shooting occurs in upland areas, primarily away from any riparian bird habitat. Even if an overflight of a nesting colony occurred, due to the infrequency of the overflight, little or no disturbance would result.

Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. They observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy deficit. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse impacts. Snow geese occur in Wyoming only as migrants, and typically aren't encountered in numbers or locations which would be of concern to WS-Wyoming aerial operations. Thus, disturbance of migrating snow geese should be essentially nonexistent.

When Krausman et al. (1983, 1998) evaluated the effects of simulated low-altitude jet aircraft noise on desert mule deer (*Odocoileus hemionus crooki*) and mountain sheep (*Ovis canadensis mexicana*), they found that heart rates of the ungulates increased according to the decibel levels, with lower noise levels resulting in less dramatic increases. Elevated heart rates rapidly returned to pre-disturbance levels, suggesting that the animals did not perceive the noise as a threat. Responses to the simulated noise levels were found to decrease with increased frequency of exposure. Fancy (1982) reported that only 2 of 59 bison (*Bison bison*) groups showed any visible reaction to small fixed-wing aircraft flying at 200-500 feet above ground level. This study indicated that bison are relatively tolerant of aircraft overflights. Andersen et al. (1989) conducted low-level helicopter overflights directed at 35 red-tailed hawk (*Buteo jamaicensis*) nests; their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period. Their results showed similar nesting success between hawks subjected to such overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but showed that ferruginous hawks (*Buteo regalis*) are sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, and neither were they alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that 5 species of hawks, 2 species of falcons, and golden eagles were "incredibly tolerant" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and never limited productivity. Analyses by the Air National Guard (1997a, 1997b) show that, despite considerable research on numerous wildlife species, no scientific evidence exists that indicates any substantive adverse effects on wildlife populations as a result of any type of low-level or other overflight.

Accident Risks Associated with Aerial shooting: Concerns are occasionally raised regarding the potential for aircraft accidents during WS aerial shooting operations to cause catastrophic ground fires or pollution as a result of spilled fuel and oil. As a result of these issues, the following information was obtained from Mr. Norm Wiemeyer, Chief, Denver Field Office of the National Transportation Safety Board (the agency that investigates aviation accidents).

Regarding major ground or forest fires, Mr. Wiemeyer stated he had no recollection of any major fires caused by government aircraft since he has been in his position beginning in 1987. Also, an informal poll of APHIS-WS State Directors in the Western Region affirms that no major ground fires have resulted from any APHIS-WS aviation accidents (USDA 2005).

Regarding fuel spills and the potential for environmental hazard from aviation accidents, Mr. Wiemeyer stated that aviation fuel is extremely volatile and will evaporate within a few hours, by which time its odor cannot even be detected. Thus, there should be no environmental hazard from unignited fuel spills. The quantities of fuel carried in APHIS-WS aircraft are small (10-30 gallons). In some cases, not all of the fuel is spilled.

Regarding oil and other fluid spills, the aircraft owner or his/her insurance company is responsible for cleanup of spilled oils and other fluids if required by the owner or manager of the property on which the accident occurred. In the case of BLM, USFS, and National Park Service lands, the land managing agency generally requires that contaminated soil be removed and disposed of. In most accidents involving private property, the property owner is generally not concerned about the quantities of spilled oil and to date has not requested or required clean-up. Given the size of aircraft used by WS-Wyoming, the quantities of oil which could potentially be spilled in any accident are small and insignificant with respect to the potential for environmental damage (*e.g.*, 6-8 quarts maximum for reciprocating (piston) engines and 3-5 quarts for turbine engines). Aircraft used by WS-Wyoming are single engine models, so the greatest potential amount of oil that could be spilled in one accident would be 8 quarts.

Petroleum products biodegrade through volatilization and bacterial action, particularly when exposed to oxygen (EPA 2000): Small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities which would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, EPA guidelines provide for "natural attenuation" or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents are not cleaned up, the oil does not persist in the environment. Also, WS-Wyoming accidents would occur in remote areas, far removed from human habitation and drinking water supplies. Thus, the risk of contamination to drinking water appears to be exceedingly low or nonexistent.

For these reasons, the risk of ground fires or fuel/oil pollution from aviation accidents is considered to be low. Given the history of the program relative to aircraft accidents, the risk of significant environmental damage from such accidents is exceedingly low.

4.2.1.7 Alternative 1: Indirect and Cumulative Impacts

Indirect impacts are impacts that occur as an unintended consequence of another action. In the case of PDM, the primary concerns regarding indirect impacts are the potential for PDM to result in irruptions of prey species and the potential for PDM to impact other levels of the ecosystem through trophic cascades. These issues are addressed in detail in Section 4.2.1.2.

Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes such other actions. Section 4.2.1.1 addresses the cumulative impacts of all known and anticipated impacts on target species populations. Cumulative impacts of unquantified factors such as climate change, habitat fragmentation, and increasing human activity are assessed primarily through review of population trends for wildlife species affected by PDM.

WS-Wyoming's take of non-target species is very low and not of sufficient magnitude to contribute substantively to cumulative adverse impacts on non-target species populations. T/E species populations may be particularly sensitive to loss of individual animals, but WS-Wyoming works with the USFWS to assess risks and cumulative impacts to T/E species from the proposed action and has developed appropriate mitigating procedures to minimize potential impacts to these species.

The impact of climate change on wildlife and their habitats is of increasing concern to land management agencies, biologists and members of the public. Most of the species that could be involved in conflicts that are addressed by WS-Wyoming under this alternative are abundant through a wide range of climate conditions (e.g., fox, coyote, raccoon, and mountain lion) and may be relatively resilient to change. Other species such as grizzly bear may be less tolerant. Climate change may also alter the frequency and severity of habitat-altering events such as wildfires, weather extremes such as drought, presence of invasive species, and wildlife diseases. Habitat fragmentation associated with development can also adversely affect wildlife species through a range of factors, including but not limited to, alterations in predator and prey abundance and relationships due to habitat change and human-generated food and habitat sources, and reductions in animal movement and genetic exchange among habitat fragments. State, federal and tribal land and wildlife management agencies are working collaboratively to address these issues and preserve wildlife populations for current and future generations. WS-Wyoming works with these entities and complies with all applicable state, federal and tribal regulations and policies for the protection of wildlife and their habitats. As noted in Chapter 1, WS-Wyoming may provide technical or operational assistance in situations where interactions among species have been perturbed to the extent that short-term localized PDM may be of assistance and is requested by the applicable management agency.

Wildlife populations and their habitats are not static, but are in a state of continuing change as ecosystems and the species within them adjust to the cumulative impacts of human activity and changing environmental conditions. State, federal and tribal land and wildlife management agencies address these ongoing changes though monitoring and use of adaptive management practices in which populations and ecosystems are monitored

and management actions are adjusted as needed (e.g., adjustments to hunting seasons or license sales, altering grazing timelines and patterns, closing or opening certain areas to public use). All WS-Wyoming take of wildlife is reported to and coordinated with applicable State, federal and tribal land and natural resource management agencies to facilitate understanding of cumulative impacts on wildlife populations. WS-Wyoming monitors its activities to ensure that WS-Wyoming's actions remain consistent with provisions of this EA and maximum take limits analyzed. WS-Wyoming also conducts ongoing monitoring to ensure that compliance with regulations for the protection of the environment, such as the ESA, is current. WS-Wyoming participates in scientific conferences and monitors the applicable scientific literature for new information relevant to the analysis. This EA will be updated as warranted to address substantive changes if any such changes are identified and needed. Given ongoing WS-Wyoming collaboration with state, federal and tribal land and natural resource management agencies, internal monitoring, and the WS-Wyoming's commitment to updating the NEPA review as appropriate, risks of adverse indirect or cumulative environmental impacts are low.

4.2.2 Alternative 2: No Federal PDM Program

This alternative would prohibit WS-Wyoming from providing PDM assistance in Wyoming. The primary concern of not having a federal program is that the need for action would remain and individuals and agencies would continue to seek to address conflicts in the absence of assistance from WS-Wyoming. Depending on the methods selected and the skills of the individuals implementing the method risks of negative impacts could increase. WGFD may conduct PDM; however, it is unlikely that WGFD would conduct PDM at the same level as the WS-Wyoming program. In most areas, counties are likely to establish alternative PDM services through the use of contracted trappers as is already the case in some counties (Section 3.1.2). There would also likely be increased PDM actions by private individuals. Many of these individuals may be untrained in safe, humane and effective use certain PDM methods, so there will be increased potential for negative impacts. Because private persons conducting PDM would not be associated with a federal program, standards of accountability, records maintenance, regulatory and policy compliance and coordination with other agencies would likely be lower than with the WS-Wyoming program, impacts would have the potential to be much higher than under the current program alternative. Finally, it is hypothetically possible that the inability of some private individuals to resolve damage problems would lead to an increase in the illegal use of toxicants, which could have great potential for significant negative impacts on the environment.

4.2.2.1 Alternative 2: Effects on Target Predator Species Populations

Under this alternative, WS-Wyoming would have no impact on target predator populations in Wyoming. However, PDM by WGFD, county trappers, private organizations and individuals would most likely increase in proportion to the reduction of services, less the contribution of WGFD support. Initially, there would likely be an decrease in total PDM take until such time as alternative mechanisms for PDM services are identified and implemented by the state, counties and private individuals. With the exception of impacts associated with DRC-1339, efforts to reduce or prevent depredations by non-WS entities would probably result in effects similar to those of the proposed action. Take of common ravens and crows under this alternative would likely be substantially lower than for Alternative 1 because of the lack of access to DRC-1339 and because alternative methods for lethal removal of these species are not likely to be as

effective in removing the same number of birds. For the same reasons shown in the population impacts analysis, (see Section 4.3.1.1), it is highly unlikely that predator populations would be affected significantly by implementation of this alternative. However, the possible use of illegal toxicants, as described in Section 4.3.2, could lead to unknown impacts on carnivore and other wildlife populations.

Non-WS entities are not required to provide the same information on take of target and non-target species to WGFD and the public as the WS-Wyoming program, especially in regards to species classified as predatory animals. Consequently, agency, tribal and public access to and ability to use this information to guide management decisions and will be reduced under this alternative.

4.2.2.2 Alternative 2: Effects on Non-target Species Populations, Including T&E Species

Under this alternative, WS-Wyoming would not be able to provide assistance with PDM, including the administration of programs to protect T&E species. The amount of professional oversight in PDM would probably diminish, but would still be available to some extent through programs conducted by WGFD. This alternative could result in less aerial shooting and increased ground work (use of traps, snares, M-44s and shooting) for PDM by non-governmental entities. The increase in ground work would result in increases in potential risks to non-target animals from an increased use of traps and snares (Wagner and Conover 1999).

Private efforts to reduce or prevent depredations would likely increase, which may result in less experienced persons implementing PDM methods that lead to a greater take of non-target wildlife than under the current program. Similar to the current WS-Wyoming PDM program, private individuals could trap coyotes and other unprotected predators year-round. However, private individuals would not be required to comply with regulations designed to limit non-target take, such as restrictions for setting traps in the vicinity of livestock carcasses to avoid capturing scavenging birds or using pan-tension devices to exclude animals smaller than target species. Therefore, hazards to raptors, including bald eagles, and other non-target animals could be greater under this alternative. As described in Section 4.3.2, the potential use of toxicants could impact non-target species populations, including T&E species. Therefore, it is likely that greater impacts would occur under this alternative than under the current program, as discussed in section 4.3.1.2. Aerial shooting would probably not be used as much under this alternative either, and the effects of low-level flights on wildlife would likely be similar to those discussed in section 4.3.1.2, barring illegal activities.

4.2.2.3 Alternative 2: Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans

Non-WS entities would be subject to the same requirements to comply with land management agency policies and regulations as the WS program. However, in the absence of annual work plan meetings and associated consultation and coordination between WS-Wyoming and managers of SMAs, there is increased risk that some actions may be conducted that, while legal, may not take compatibility with the full range of land

use concerns and activities into consideration. Consequently there is potential for slightly greater risks to SMAs than with the current program.

4.2.2.4 Alternative 2: Effects on the socioeconomic environment

Humaneness of damage management techniques
Under this alternative, the WS-Wyoming program would not employ methods viewed by some persons as inhumane and thus, have no program effect on humaneness. WGFD would probably still provide some level of professional operational assistance with PDM, but without federal supervision, and could use some PDM methods considered inhumane by some individuals. However, private individuals who experience resource losses could conduct lethal control practices on their own. This could have the potential for increased and unnecessary pain and suffering to target and non-target species. Use of foot-hold traps, snares, and shooting by private individuals would probably increase. This could result in less experienced persons implementing PDM methods such as trapping without using modifications like pan tension devices to exclude smaller non-target animals. Consequently, increased take and suffering of non-target wildlife could result. It is hypothetically possible that frustration caused by the inability of resource owners to reduce losses could lead to illegal use of toxicants as well. The illegal use of toxicants often results in loss of both target and non-target wildlife (White et al. 1989, Allen et al. 1996, USFWS 2001, FDA 2003) and result in increased animal suffering.

PDM actions taken by individuals would probably be less humane than under the auspices of a federal program for other reasons as well. WS-Wyoming is accountable to the public, and humane interest groups often focus their attention and opposition on PDM activities employed by WS-Wyoming. PDM methods employed by private individuals would be less visible to the public. Consequently, the people that perceive some PDM methods as inhumane would be less aware of PDM activities being conducted by private individuals because such individuals would not be required to comply with policies or regulations that WS-Wyoming is subject to. Thus, the *perception* of inhumane activities would probably be reduced, although the actual *occurrence* of such activities may increase.

Livestock producers and other stakeholders who receive services from WS-Wyoming are likely to perceive this as an unethical restriction of their access to legally available damage management techniques from professional, accountable WS-Wyoming Specialists, and as an imposition of additional costs to livestock production resulting from unacceptable levels of loss. People concerned about the use of public resources to reduce damage (e.g., enhance profit) on private and public lands may find this alternative preferable to Alternative 1. However, some degree of state level (WGFD) involvement would still be likely.

Effects on Recreation (*i.e.*, hunting and non-consumptive uses)
Under this alternative, there would be no WS-Wyoming involvement in PDM and, consequentially, no impact on recreation. However, WGFD could provide some level of PDM. Private efforts to reduce or prevent depredations on livestock would likely increase, which could result in less experienced persons implementing PDM methods and a greater impact on recreation than Alternative 1. Aerial shooting would probably be greatly reduced under this alternative because it requires pilots with experience at low

level flying. Even if WDA increased the number of permits to private individuals, impacts are not likely to be greater than analyzed for Alternative 1. A reduction in aerial shooting would result in an increase in the amount of ground traffic and hours of PDM required for an equivalent level of PDM (Wagner and Conover 1999). This increase in PDM activity on the ground would increase the risk of damage to the environment from vehicular traffic and increase the likelihood of a conflict between PDM and recreational activities.

The federal portion of WS-Wyoming would not impact hunting and non-consumptive uses with the no federal program alternative. WGFD would probably provide some level of operational assistance with PDM. WGFD would have similar effects on recreation as described under the current program alternative, except that with no federal portion, effects would be decreased proportionately. Private efforts to reduce or prevent depredations would likely increase, which could result in less experienced persons implementing PDM methods and leading to a greater effect on recreation than described under the current program alternative. As discussed with other issues, it is hypothetically possible that the frustration caused by the inability of novice PDM persons to reduce losses could lead to the illegal use of toxicants, which could impact recreationists and their pets. Aerial shooting would probably not be used as much under this alternative because it requires pilots with experience at low level flying and a permit from WDA, and therefore, recreationists would be affected minimally with this PDM method. PDM activities would probably cause damage to the environment from off-road vehicle use where WS-Wyoming would normally aerially gun. This is because much of the arid environment is sensitive by nature and vehicles can leave long-lasting scars, especially when vehicles are used during the wet season because ruts are made. These scars can be an eyesore to recreationists. Therefore, it is likely that some negative impacts could occur under this alternative, which are more than the current program, as discussed in section 4.3.1.4.

Cost Effectiveness of PDM

Federal funds would not be expended by WS-Wyoming for PDM activities in the state. WS-Wyoming currently provides slightly over a third of the funding for PDM and supervision of the activities under Alternative 1. To compensate, WGFD or WDA or the counties would have to increase its expenditures in this capacity using state funds. Alternative mechanisms for compensating for the absence of PDM could include increased use of permits and other authorizations to facilitate private entities conducting PDM, establishment of a system of certified PDM providers similar to that implemented for wolf damage management in Minnesota in which the state determines the need for action and then services are provided by the certified controller with payment to the controllers based on animals removed, or through increases in taxes as used in South Dakota when federal funds for PDM were eliminated.

For most types of damage management, damage control costs could be variable relative to the current program depending on the skill level of the individuals conducting PDM and the strategies implemented to make up for loss of federal funds. Lack of access to DRC-1339 will result in a shift to more labor intensive methods for lethal removal of ravens, crows and magpies for damage management. Similar prohibitions on the use of aircraft by non-WS entities on USFS lands may also result in a shift to more labor

intensive and expensive corrective control methods (Wagner and Conover 1999). Although the state is anticipated to identify alternative means to provide PDM services, the loss of federal funds would necessitate acquisition of funding from other sources, shifting more of the costs of PDM to producers, or seeking alternative systems, such as private contractors or certified volunteers. Increases in taxes and management alternatives which shift more of the financial burden to producers have the potential for greater impact on low-income individuals than the population as a whole. It was estimated that in a statewide "no program" option, monetary losses to producers would be expected to increase and response time implementing PDM to address predation would increase, resulting in additional predation and increased monetary losses. Indirect consumer and producer impacts could be expected to be substantially higher. The cost effectiveness under this alternative is estimated to be lower than under the current program alternative because there would be less resources directed at applying IWDM principals to effectively resolve the conflicts and loses.

4.2.2.5 Alternative 2: Effects on HHS

Impacts on Human Safety and the Environment (*e.g.*, effects of pesticides and hazardous materials)
Under this alternative, there would be no WS-Wyoming involvement in PDM and, consequently, no risks to HHS from WS-Wyoming use of pesticides or aircraft. Conversely, WS-Wyoming would not be available to provide assistance with wildlife threats to HHS. However, WGFD could provide some level of assistance with these issues. Private efforts to reduce or prevent depredations on livestock allotments would likely increase, which could result in less experienced persons implementing PDM methods and greater HHS risks associated with improper use of PDM tools. Aerial shooting would be reduced under this alternative because it requires pilots with experience at low-level flying. The reduction in aerial shooting activities would result in further increases in ground-based PDM techniques (Wagner and Conover 1999). As stated above, increased ground-based private efforts to reduce or prevent depredations on livestock could result in less experienced persons implementing PDM methods and greater safety risks associated with improper use of PDM tools.

WS-Wyoming would have no effect on public safety, the environment, or Environmental Justice (Executive Order 12898) issues under this alternative. Under this alternative, WGFD could still provide some level of PDM without federal supervision. Compared to the current program alternative, private individuals would likely have more significant negative effects on the environment and HHS. This would result from untrained and unlicensed individuals using PDM methods and toxicants, legal and illegal. It is possible that individuals frustrated by their inability to reduce losses could resort to illegal use of toxicants; such unregulated use could lead to unknown impacts on public safety. In addition, private individuals are not accountable and can conduct PDM of unprotected species year-round and without the restrictions implicit in the policies and regulations WS-Wyoming personnel must follow. Of all the alternatives considered, this one would have the greatest potential for negative impacts on public safety and the environment.

4.2.2.6 Alternative 2: Effects from aerial shooting

Impacts on the environment from the use of aircraft (*i.e.*, wildlife, recreation, other issues)
Under this alternative, there would be no WS-Wyoming involvement in PDM and, consequently, no risks aerial shooting or WS aircraft use. In addition there would no WS-Wyoming use of pesticides. Conversely, WS-Wyoming would not be available to provide assistance with wildlife threats to livestock or HHS. However, WGFD could provide some level of assistance with these issues. Private efforts to reduce or prevent depredations on livestock allotments would likely increase, which could result in less experienced persons implementing PDM methods and greater risks to wildlife or recreationists associated with improper use of PDM tools. Aerial shooting would be reduced under this alternative because it requires pilots with experience at low-level flying. The reduction in aerial shooting activities would result in further increases in ground-based PDM techniques (Wagner and Conover 1999). As stated above, increased ground-based private efforts to reduce or prevent depredations on livestock could result in less experienced persons implementing PDM methods and greater safety risks associated with improper use of PDM tools. As discussed in Section 4.3.2.5, it is possible that individuals frustrated by their inability to reduce losses could resort to illegal use of toxicants; such unregulated use could lead to unknown impacts. In addition, private individuals are not accountable and can conduct PDM of unprotected species year-round and without the restrictions implicit in the policies and regulations WS-Wyoming personnel must follow. Of all the alternatives considered, this one would have the greatest potential for negative impacts on the environment.

4.2.2.7 Alternative 2: Indirect and Cumulative Impacts

WS-Wyoming would have no direct or indirect impacts on wildlife or ecosystems under the no federal program alternative. Indirect and cumulative impacts of all other entities under this alternative would initially be less than described for Alternative 1 because of lower levels of overall PDM, but are anticipated to reach levels similar to Alternative 1 as non-WS sources for current PDM services are identified and become established.

Non-federal entities are not required to report target or non-target take or coordinate with tribes and federal land management agencies in the same way as WS-Wyoming. For these management agencies, the administrative burden associated with tracking activities of multiple private entities will exceed current levels. Consequently, reporting, consultation with land and wildlife management agencies, and program monitoring that would occur under Alternative 1 would not occur under this alternative. The lack of reporting will impair the ability of state, federal and tribal agencies to monitor and address cumulative effects on wildlife populations and ecosystems, including impacts from factors such as climate change and habitat fragmentation. Cumulative impacts would be expected to be higher under this alternative than under the current program alternative as a result of uncoordinated control actions or misapplication and unaccountability of control methods by individuals. These impacts could result in greater impacts on target and non-target wildlife and public safety, thereby affecting wildlife populations and the environment.

4.2.3 Alternative 3: Technical Assistance

4.2.3.1 Alternative 3: Effects on Target Predator Species Populations

Under this alternative, WS would have no direct impact on target mammal populations in the State because the program would not provide any operational damage management. The program would be limited to providing advice only and making recommendations. It is likely that most landowners/resource managers would continue to attempt to do something about their predator damage as permitted under Wyoming state law. Cumulative impacts on target species populations would be variable depending upon actions taken by affected landowners/resource managers and the level of training and experience of the individuals conducting the management activities. Some individuals experiencing damage may take illegal or unsafe actions against the problem species either unintentionally due to lack of training, or deliberately out of frustration of continued damage. In these instances, more target species may be taken than by professional WS personnel (Alternatives 1). Use of WS' technical assistance may decrease the risks associated with uninformed use of lethal management techniques and may increase the use of non-lethal alternatives over that expected in the absence of any WS involvement (Alternative 2). Overall impacts on target species populations would be similar to or slightly higher than Alternative 1 and 4 depending upon the extent to which resource managers use the technical assistance provided by WS. However, for the reasons presented in the population effects analysis in Section 4.3.1.1, it is unlikely that target populations would be adversely impacted by implementation of this alternative.

4.2.3.2 Alternative 3: Effects on Non-target Species Populations, Including T&E Species

Alternative 3 would not allow any WS-Wyoming operational assistance in Wyoming; therefore WS would not take any non-target species under this alternative. The WGFD or WDA may have to allocate staff time and resources to protect T&E and rare species because WS could no longer assist. Only technical assistance or self-help information would be provided. Although technical assistance might lead to more selective use of methods than that which might occur under Alternative 2, efforts to reduce or prevent damage could still result in less experienced persons implementing methods, leading to greater risks to non-target wildlife than under the proposed action. It is hypothetically possible that, similar to Alternative 2 and 4, frustration caused by the inability to reduce damage and associated losses could lead to illegal use of toxicants which could lead to unknown risks to non-target species populations. Hazards to wildlife could therefore be greater under this alternative if toxicants that are less selective or that cause secondary poisoning are used by frustrated entities.

WS-Wyoming would not have any direct impact on T&E species. Risks to T&E species from increased private efforts will vary depending upon the training and level of experience of the individual(s) conducting the PDM. As stated above, frustrated individuals may resort to use of unsafe or illegal methods like poisons which may increase risks to listed species. Risks to T&E species may be lower with this Alternative than with Alternative 2 because WS could advise individuals as to the potential presence of state and federally listed species and could facilitate consultation with the appropriate agency.

4.2.3.3 Alternative 3: Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans

The current program has been determined to have no significant effect on the SMAs, so a technical assistance program without the federal operational component would similarly not affect SMAs. Without a federal operational program, individuals affected by predator damage could conceivably have a negative effect on SMAs. Therefore, this alternative could have more negative effects on SMAs than the current program alternative.

4.2.3.4 Alternative 3: Effects on the Socioeconomic Environment

Humaneness of damage management techniques
Under this alternative, WS-Wyoming would provide self-help advice only. Lethal methods viewed as inhumane by some persons would not be used by WS. Resource owners could use the information provided by WS or implement their own damage reduction program without WS' technical assistance. Many of the methods considered inhumane by some individuals and groups might still be used by resource owners. Overall impacts should be less than Alternative 2 when WS technical advice is requested and followed.

Effects on Recreation (*i.e.*, hunting and non-consumptive uses)
Under this alternative, WS-Wyoming would not conduct any operational PDM, but would provide technical assistance or self-help advice to entities requesting assistance. However, WGFD could provide some level of PDM. Analysis of this issue would be similar to the "No Program" alternative.

Cost Effectiveness of PDM

In some instances, nonlethal methods can provide cost-effective solutions for depredation problems, although they may require a substantial initial investment to implement (e.g., fencing). WS-Wyoming already recommends and provides technical assistance on nonlethal methods where practical and effective. Consequently the extent to which this alternative would result in increased adoption of nonlethal methods is unclear and may ultimately be related to the funding available to implement nonlethal methods. As noted above, WS funding available for operational PDM would likely decrease under this alternative as federal funds for aircraft and pilots are transferred to other states. Cooperator willingness to fund a program that does not provide assistance with the full range of legally available PDM methods is unclear.

Although nonlethal methods can be effective in some situations, for other producers, livestock losses would most likely be greater than in the current program. Nonlethal 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 nonlethal methods. If this alternative were implemented, WS-Wyoming would be unable to provide operational or technical assistance for producers with conflicts that could not be addressed through the nonlethal methods. As noted under Alternatives 2 and 3, lethal PDM by non-WS entities may be less cost effective than services provided by trained WS-Wyoming personnel. In some instances of threats

to human health and safety, prompt removal of the individual animal involved in the incident may be the most appropriate response, but, under this alternative, that assistance would have to be provided by an entity other than WS. Ultimately, this alternative may be more cost-effective than Alternative 2, similar to Alternative 3, but is likely to be less cost effective than Alternatives 1 and 5.

4.2.3.5 Alternative 3: Effects on HHS

Impacts on Human Safety and the Environment (*e.g.*, effects of pesticides and hazardous materials)
Alternative 3 would not allow any operational PDM assistance by WS-Wyoming. Concerns about human health risks from WS' use of PDM methods would be alleviated because no such use would occur. Private efforts to reduce or prevent damage would be expected to increase, resulting in less experienced persons implementing management methods and leading to a greater risk than Alternative 1. However, because some of these private parties would be receiving advice and instruction from WS, concerns about HHS risks from PDM methods use should be less than under Alternative 2.

Hazards to humans and pets could be greater under this alternative if toxicants that are less selective or that cause secondary poisoning are used. It is possible that frustration caused by the inability to alleviate damage could lead to illegal use of certain toxicants that could pose secondary poisoning hazards. Some chemicals that could be used illegally could present greater risks of adverse effects on humans than those potentially used under the Proposed Action.

4.2.3.6 Alternative 3: Effects from aerial shooting

Impacts on the environment from the use of aircraft (*i.e.*, wildlife, recreation, other issues)
Under this alternative, WS-Wyoming would only provide PDM technical assistance and consequently there would be no WS-Wyoming aerial shooting risks or aircraft use. In addition there would no WS-Wyoming use of pesticides. Private efforts to reduce or prevent depredations on livestock allotments would likely increase, which could result in less experienced persons implementing PDM methods and greater risks to wildlife or recreationists associated with improper use of PDM tools. Aerial shooting would likely be reduced under this alternative because it requires pilots with experience at low-level flying. Analysis of this issue would be similar to the "No Program" alternative.

4.2.3.7 Alternative 3: Indirect and Cumulative Impacts

Indirect impacts under the technical assistance program alternative would be low and would correlate with program effectiveness. Positive contributions to the local economy would be expected to be low under the technical assistance program alternative because resource losses are expected to be higher if alternative sources of PDM are less effective than the WS-Wyoming program.

Cumulative impacts would be expected to be higher under this alternative than under the current program alternative as a result of no WS operational PDM or misapplication of control methods by individuals. This could result in higher impacts on target and non-

target wildlife and public safety, thereby impacting wildlife populations and the environment. Overall impacts would be lower than for Alternative 2 because of guidance and assistance provided by WS-Wyoming but generally greater than all other alternatives.

As with Alternatives 2 and 3, non-federal entities are not required to report target or non-target take or coordinate with tribes and federal land management agencies in the same way as WS-Wyoming. For these management agencies, the administrative burden associated with tracking activities of multiple private entities will exceed current levels. Consequently, most reporting, consultation with land and wildlife management agencies, and program monitoring that would occur under Alternative 1 would not occur under this alternative. The lack of reporting will impair the ability of state, federal and tribal agencies to monitor and address cumulative effects on wildlife populations and ecosystems, including impacts from factors such as climate change and habitat fragmentation. Cumulative impacts would be expected to be higher under this alternative than under the current program alternative as a result of uncoordinated control actions or misapplication and unaccountability of control methods by individuals. These impacts could result in greater impacts on target and non-target wildlife and public safety, thereby affecting wildlife populations and the environment.

4.2.4 Alternative 4: Nonlethal Management Only

This alternative was discussed in Section 3.2.4. The nonlethal management only alternative is a modification of the current program alternative wherein no lethal technical or operational assistance would be provided or used by WS-Wyoming. Both technical and operational assistance would be provided in the context of a modified IWDM strategy that administratively constrains WS-Wyoming personnel to use and recommendation of nonlethal strategies to resolve wildlife damage problems (Table 3-1). All nonlethal methods discussed for the current program would be available under this alternative. With the exception of the use of aircraft and M-44s on USFS lands and all use of DRC-1339 as noted for Alternative 2, most lethal methods would also be available to non-WS entities. The experience level of individuals conducting lethal PDM would vary. Lethal PDM methods and control devices could be applied by persons with little or no training or experience.

As with Alternative 2, we would expect a temporary decline in lethal PDM services in the absence of those no longer being provided by WS-Wyoming until alternative systems become established to provide lethal PDM services no longer available through WS-Wyoming. Individuals experiencing predator damage would still have access to nonlethal and lethal PDM methods as allowed under applicable state, federal and tribal laws. Under this alternative, WS-Wyoming aircraft and associated federal funding and staff would be transferred to other WS state offices that use aircraft in their activities. The federal funding for the aerial component of the current WS-Wyoming operations would not be “freed” for other WS-Wyoming operational activities. Remaining federal funding for implementation of an operational program would remain the same as Alternative 1. It is unclear whether the non-WS entities that currently provide approximately 65% of the funding for PDM would continue to support WS-Wyoming. Given that many livestock producers in Wyoming feel that an integrated program that includes lethal methods is important for effective resolution of their conflicts, these entities may choose to allocate all funds to a different entity(ies) that could provide an fully integrated program or just assist with lethal methods not available from WS-Wyoming.

4.2.4.1 Alternative 4: Effects on Target Predator Species Populations

Under this alternative, WS-Wyoming would be limited to using nonlethal methods, so WS-Wyoming would have no direct impact on target predator species populations under this alternative. Other agencies, organizations, or individuals would be free to carry out necessary lethal control work to resolve wildlife damage. Nonlethal control methods alone do not always prevent or reduce wildlife damage to acceptable levels, so other government agencies, private organizations, and individuals would likely implement lethal control to resolve their problems with the restrictions noted under Alternative 2.

As under Alternative 2, depending on the skill and supervision of individuals using lethal PDM methods, efforts to reduce or prevent depredations could result in higher levels of take for some actions by non-WS individuals. Anticipated declines in federal and cooperator funding discussed in Section 3.2.3 would limit the extent to which WS-Idaho could provide nonlethal assistance. WS-Wyoming anticipates the program would be able to provide technical assistance, but, based on costs of the Marin County California program that provided subsidies for nonlethal methods (livestock guarding animals and fencing) to address coyote predation cost an average of approximately $20,000 per year and provided assistance for only a limited number of nonlethal methods and predator species, WS-Wyoming capacity to provide operational assistance would not be sufficient to meet statewide need. Increased WS-Idaho efforts to promote use of nonlethal methods could result in decreases in use of lethal methods for some cooperators. Lethal removal of predators by non-WS entities would initially decline and then is expected increase to levels somewhat below or near those of the current PDM program. As with Alternative 2, because of the lack of access to DRC-1339, lethal removal of ravens and crows for the protection of livestock, agricultural and natural resources would likely be lower under this alternative. For the same reasons shown in the population impacts analysis in Section 4.3.1.1, it is highly unlikely that predator populations would be impacted significantly by implementation of this alternative. Impacts and possible risks of illegal toxicant use under this alternative would probably be about the same as those under Alternatives 2 and 3.

4.2.4.2 Alternative 4: Effects on Non-target Species Populations, Including T&E Species

Alternative 4 would not allow WS-Wyoming to conduct operational PDM assistance. Therefore, WS-Wyoming would not have any direct impact on non-target or T&E species. Although technical support might lead to more selective use of control methods by private parties than that which could occur under Alternative 2, private efforts to reduce or prevent depredations could result in less experienced persons implementing control methods, leading to greater take of non-target wildlife and T&E species as discussed in section 4.3.2.2. This alternative would have the potential for increased adverse impacts resulting from WS-Wyoming not providing quality PDM and the resultant compensatory actions of private individuals. Presumably, many recipients would become frustrated with the failure of WS-Wyoming to resolve their wildlife damage problems, and would consequently seek assistance elsewhere. Higher variability in the level and scope of wildlife damage control activities could occur without a full IWDM program, and this could have a greater negative impact on some local wildlife species, including T&E species. Aerial shooting activities would not be used by WS-

Wyoming, but could be implemented by the private sector. Even if aerial shooting activities by the private sector increased, the effects of low-level flights on wildlife would likely be similar to those discussed in section 4.3.1.2, barring illegal activities.

4.2.4.3 Alternative 4: Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans

The current program has been determined to have no significant effect on the SMAs, so a non-lethal only program would similarly not affect SMAs. Without a federal non-lethal only program, individuals affected by predator damage could conceivably conduct their own control and have a negative effect on SMAs. Therefore, this alternative could have more negative effects on SMAs than the current program alternative. The effects would probably be much closer to the no federal program alternative for the same reasons identified in Section 4.3.2.

4.2.4.4 Alternative 4: Effects on the socioeconomic environment

Humaneness of damage management techniques
Under this alternative, WS-Wyoming would provide non-lethal management only. Non-lethal management techniques are generally considered more humane by animal welfare groups. However, non-lethal techniques involving the use of cage traps and netting must be utilized in a proper fashion. For example, cage traps can be potentially inhumane if the trap is not checked on a regular basis; furthermore, captured animals can break teeth or suffer from exposure to the elements (heat and cold). The effects of this alternative related to humaneness would be most similar to those under Alternative 1. However, the effects would not be as great under this alternative because in some cases, problems could be successfully resolved using non-lethal techniques, while in other situations, predator damage would merely be tolerated. Some individuals not satisfied with service provided by WS-Wyoming would conduct lethal control on their own, resulting in similar effects as described in Section 4.3.2.5.

The federal portion of this Alternative would be more acceptable to Animal Rights activists and to a wider range of animal welfare advocates because WS-Wyoming would not be involved in the lethal removal of predators. Livestock producers and other beneficiaries of WS-Wyoming services are likely to perceive this as an unethical restriction of their access to legally available damage management techniques from professional, accountable WS-Wyoming Specialists, and may perceive this Alternative as an imposition of additional costs to livestock production as a result of unacceptable levels of loss. People concerned about the use of public resources to reduce damage on private and public lands may find this alternative preferable to Alternative 1. However WS-Wyoming would still use federal funds for supervision, reporting, and compliance with state and federal regulations.

Effects on Recreation (*i.e.*, hunting and non-consumptive uses)
WS-Wyoming would not impact hunting and non-consumptive uses under the nonlethal alternative. However, individuals implementing lethal control could have adverse impacts on both hunting and non-consumptive user groups, as discussed under Alternative 1, section 4.3.1.4. However, the negative effects on recreation would

probably be slightly greater under this alternative than under Alternative 1, but less than under the current program alternative.

Cost Effectiveness of PDM
Federal funds for a non-lethal only program would be less than the current program because the WS-Wyoming program currently provides much of the supplies for PDM and supervision of the cooperative program. WGFD or WDA would have to increase their expenditures in this area with state funds. Analysis of this issue would be similar to the technical assistance alternative.

4.2.4.5 Alternative 4: Effects on HHS

Impacts on Human Safety and the Environment (e.g., effects of pesticides and hazardous materials)
Since lethal management would no longer be used, WS-Wyoming activities would not negatively affect HHS, although WGFD would still probably provide lethal PDM services at some reduced level. Additionally, private individuals would increase their use of lethal PDM methods. As discussed in Alternative 1, many of these individuals would use registered toxicants incorrectly or illegally and these could adversely impact the environment and public safety. In addition, traps, snares, and firearms used by novices could have adverse effects on public safety and the environment. WS-Wyoming non-lethal PDM activities would not likely have a negative effect on the public in reference to "environmental justice and executive order 12898" issues. WS-Wyoming would be able to respond to predator complaints with lethal PDM for incidents involving HHS and, therefore, in such cases, such actions would have the same effect as under the current program alternative. As with Alternative 1, aerial shooting would probably be greatly reduced under this alternative because it requires pilots with experience in low-level flight. The reduction in aerial shooting would result in an increase in the amount of ground work and hours of PDM required for an equivalent level of predation management (Wagner and Conover 1999). This increase in PDM activity on the ground would increase the risk of damage to the environment from vehicular traffic and increase the likelihood of conflicts between PDM efforts and recreational activities.

4.2.4.6 Alternative 4: Effects from aerial shooting

Impacts on the environment from the use of aircraft (*i.e.*, wildlife, recreation, other issues)
Under this alternative, WS-Wyoming would only provide PDM non-lethal assistance and consequently there would be no WS-Wyoming aerial shooting risks or aircraft use. In addition there would no WS-Wyoming use of pesticides. Private efforts to reduce or prevent depredations on livestock allotments would likely increase, which could result in less experienced persons implementing PDM methods and greater risks to wildlife or recreationists associated with improper use of PDM tools. Aerial shooting would likely be reduced under this alternative because it requires pilots with experience at low-level flying. Analysis of this issue would be similar to the "No Program" alternative.

4.2.4.7 Alternative 4: Indirect and Cumulative Impacts

Indirect impacts under the non-lethal only alternative would be low for WS activities but would correlate with program effectiveness. Positive contributions to the local economy would be expected to be lower under the non-lethal only program alternative because resource losses are expected to be higher.

Cumulative impacts would be expected to be higher under this alternative than under the current program alternative as a result of uncoordinated lethal control by non-WS personnel or misapplication of control methods by individuals. These impacts could result in higher impacts on target and non-target wildlife and HHS, thereby impacting wildlife populations and the environment.

Under Alternative 4, the effects on prey populations from predator removal would be somewhat less than those of the proposed action if the non-lethal methods resolved the damage problem. However, the difference is not likely to be substantial because: 1) private efforts to reduce predator populations could still occur and lethal efforts would probably increase without WS-Wyoming operational activities; 2) WGFD PDM actions would still occur without federal involvement, but would likely be to a lesser extent than under the current program; 3) restricting WS involvement would probably only reduce the percentage of land area worked, which is not a major change in terms of potential impacts on prey populations; and 4) anticipated effects on predator populations and other carnivore populations are variable, depending on the actions of non-WS personnel, as identified by the analysis in Section 4.3.1.

4.2.4 Alternative 5: Nonlethal Required before Lethal Control

This alternative would require that: 1) livestock grazing permittees, landowners or resource managers show evidence of sustained and ongoing use of nonlethal or husbandry techniques aimed at preventing or reducing predation prior to receiving operational services from WS-Wyoming; 2) employees of WS-Wyoming use or recommend appropriate nonlethal techniques in response to a confirmed damage situation prior to using lethal methods; and, 3) lethal techniques be used only when the use of husbandry or nonlethal techniques has failed to keep livestock losses below an acceptable level as indicated by the party experiencing the predation. No lethal preventive predation management would occur under this alternative. Producers and the general public would still have the option of implementing lethal control measures on their own and WS-Wyoming would continue to recommend nonlethal and lethal control when and where appropriate.

4.2.5.1 Alternative 5. Effects on Target Predator Populations

Under this alternative, WS-Wyoming removal of target predator species would probably be somewhat less than that of the proposed alternative (Alternative 5) because lethal actions would be restricted to situations where the requester or WS-Wyoming attempted nonlethal control methods with no success. WS-Wyoming would not conduct proactive lethal removal of coyotes, so take of coyotes for PDM would likely be substantially lower in the first years of this program. However, given that there are currently several non-WS entities with licenses to hunt from aircraft, and that shooting from aircraft is the

primary method used for lethal preventive predation management of coyotes, take for preventive predation management by non-WS entities would likely reach levels similar to those of WS-Wyoming under Alternative 1.

For most of the remaining species and individual damage situations, this alternative would be similar to the current program (Alternative 1) because many producers, prior to contacting WS-Wyoming, have attempted one or more nonlethal methods such as herders and/or guarding dogs with sheep, and carcass retrieval, selective use of range, timing of season and location of calving with cattle to minimize the risk of predation, as described in Appendix C, without success, or have considered them and found them to be impractical in their particular situations. For the same reasons shown in the population impacts analysis in Section 4.2.1.1, it is highly unlikely that coyote or other predator populations would be significantly affected by implementation of this alternative. Impacts and potential risks from illegal chemical toxicant use under this alternative would probably be similar to Alternative 1.

4.2.5.2 Alternative 5. Effects on Non-target Species Populations, Including T/E Species

In the absence of lethal preventive predation management of coyotes by WS, the amount of corrective predation management is likely to increase. Aerial shooting is the primary method used for preventive coyote predation management and is highly selective to target species. Under this alternative, in areas where shooting from aircraft would normally be used for preventive predation management, subsequent risks to non-target species may increase, because corrective predation management tends to make greater use of traps and snares (Wagner and Conover 1999). If, as predicted, other entities pick up preventive coyote predation management activities no longer conducted by WS, then eventual risks to non-target species from PDM methods would likely be similar to Alternative 1 after a period of initial increase. WS-Wyoming SOPs to avoid T/E impacts (described in Chapter 3) would ensure that adverse impacts from expected greater use of traps and snares by WS-Wyoming are not likely to occur to T/E species under implementation of Alternative 4.

The nonlethal before lethal control alternative would not consistently allow WS-Wyoming to respond to wildlife threats quickly or adequately. If cooperators become frustrated by the nonlethal initial response of WS-Wyoming to depredations, they may seek private services to reduce or prevent further depredations; as described in Alternatives 2 and 3. Impacts of non-WS entities implementing PDM would be similar to those described in Alternatives 2 and 3. Overall impacts on non-target species, biodiversity and trophic cascades would be intermediate to Alternatives 1 and 3, but closer to Alternative 1 because WS-Wyoming would be implementing the lethal PDM methods.

4.2.5.3 Alternative 5. Effects on SMAs and Compliance with U. S. Forest Service Land and Resource Management Plans and BLM Resource Management Plans Impacts on SMAs

Impacts on SMAs under this alternative would be similar to the current program (Alternative 1) except there would be no use of preventive coyote predation management

or other preventative predation management. The decline could reduce impacts of aircraft on SMAs, but may result in increased use of traps and snares as discussed under Section 4.3.2.20. Preventive predation management could still be conducted in most areas by private entities in the absence of WS-Wyoming. Certain nonlethal methods may be unsuitable for use in some SMAs, particularly wilderness areas (e.g., frightening devices that produce noise and lights, temporary night pens). Although the effectiveness of stopping or reducing predation may not be as high as under the current program (Alternative 1), this alternative would gradually allow the use of all methods. Producers would be less inclined to impact SMAs since coordinated assistance would still be available.

4.2.5.4 Alternative 5. Alternative 4: Effects on the socioeconomic environment

Humaneness and Ethical Perspectives

The amount of suffering by target and non-target wildlife under this alternative would initially be less than under the proposed alternative because fewer animals would be taken if proactive preventive control activity by WS-Wyoming is disallowed. However, given the number of private permits for aerial shooting, use of aircraft for preventive predation management is eventually anticipated to reach levels similar to that of WS-Wyoming. Private individuals would also increase their use of foothold traps, snares and shooting for preventive control activities where producers feel WS-Wyoming could not resolve a damage problem in a timely manner because nonlethal control measures needed to be implemented first. Lack of preventive predation management via aerial shooting may also result in increased use of traps and snares by WS-Wyoming for corrective PDM and associated risks to non-target species. Suffering of livestock because of injuries caused by predation would likely increase under this alternative because PDM actions by WS-Wyoming could not be implemented until depredation is confirmed and after nonlethal methods fail to solve the problem.

Alternative 5 would still be unacceptable to animal rights advocates and other individuals because it permits lethal removal of predators and because of the likely initial increases in the use of traps and snares if preventive predation management using aerial shooting is not available from WS-Wyoming . However, a larger number of animal welfare advocates would find this alternative more acceptable than the current program (Alternative 1) because it provides an assurance that predators would not be killed unless at least one nonlethal alternative has been attempted first. Livestock producers may perceive this alternative as an unjustified imposition due to the additional costs of production that may be incurred; furthermore, additional losses to resource owners may accrue because most livestock producers already implement some form of nonlethal protection and need assistance when such measures have failed. Individuals concerned about the use of public resources to enhance private profit are unlikely to perceive this alternative as an improvement over Alternative 1 because it may still involve the use of lethal strategies to resolve conflicts.

Effects on Recreation

WS-Wyoming would minimally affect recreationists under the nonlethal before lethal PDM alternative. In areas where nonlethal control had already been implemented and found to be unsatisfactory, the full array of PDM methods could be used; these effects were considered minimal, as discussed in Section 4.3.1.4. However, some private

individuals would implement lethal control on their own because WS-Wyoming might seem unresponsive. This could have significant adverse effects on recreationists as discussed for Alternatives 2 and 3. However, the effects on recreationists as a result of implementation of Alternative 4 would probably be less than Alternatives 2 and 3 because of the greater likelihood that livestock producers would rely on private sector services to resolve their depredation conflicts under these alternatives, but more than the effects discussed for Alternatives 1 and 5 because of less dependence on these private sector services to resolve depredation conflicts under these alternatives.

Opportunities for consultation and coordination with the tribes and resultant reductions in risks to tribal spiritual, cultural and economic resources would be similar to Alternative 1. This alternative may be preferable to tribal members because it offers added assurance that nonlethal methods will be attempted prior to use of lethal methods and because no proactive PDM would be conducted. Some private individuals may seek to conduct lethal PDM on their own instead of working under the restrictions inherent in WS-Wyoming programs. Impacts to tribes from these actions and tribal access to recourse for adverse impacts resulting from actions of non-WS entities would be as described under Alternative 2. However, because most private individuals that cooperate with WS-Wyoming already use nonlethal methods, instances of this type of impact are likely to be limited.

4.2.5.5 Alternative 5: Effects on HHS

WS-Wyoming would not have an adverse effect on public safety, the environment or the public concerning "environmental justice and Executive Order 12898." Risks to pets would initially be slightly higher than Alternative 1 because of initial increases in the use of traps and snares, but still low for the reasons noted under. Because WS-Wyoming could not necessarily resolve problems in a timely manner, some cooperators would resort to tactics described in Section 4.2.2.5. If private individuals conduct lethal PDM without federal oversight, effects on public safety and the environment under this alternative would be greater than under the current program alternative (Alternative 1) because of the greater likelihood that livestock producers would utilize private sector services to resolve their depredation conflicts, but less than under the nonlethal control only alternative (Alternative 2).

The cost effectiveness of requiring the use of nonlethal methods before implementation of lethal methods would be low in situations where they are not effective and resource losses are allowed to continue. The full array of management tools would be available, but nonlethal methods must be used first, regardless of whether or not they were determined to be the most effective or appropriate choice using the WS Decision Model (Slate et al. 1992, WS Directive 2.201). Thus, the use of nonlethal methods first may delay effective wildlife damage management and the protection of livestock, property and human health and safety. The current program (Alternative 1) uses or recommends nonlethal methods in instances in which they are considered likely to be effective. Mandating nonlethal methods as a first option when they are unlikely to resolve a damage situation would reduce the effectiveness of PDM. Under the IWDM approach, WS-Wyoming always considers the efficacy of nonlethal methods before contemplating the use of lethal methods. Therefore, this alternative would be more costly than the current program (Alternative 1) because it does not consider cost effectiveness in its initial

response to resolve damage, but more effective than the no federal program alternative (Alternative 2) and nonlethal only alternative (Alternative 3) because these latter two alternatives do not consider the entire IWDM philosophy for resolving conflicts.

4.2.5.7 Alternative 5: Effects from Aerial Shooting

Aerial shooting is the primary method for conducting preventive coyote predation management. Under this alternative WS would not conduct preventive predation management. The absence of conflict resolution/prevention with preventive aerial shooting is likely to result in an increase in corrective predation management actions including sue of aircraft. However, increase in use of corrective predation management is not likely to occur to the same extent as it currently is for preventive predation management. Consequently, overall WS-Wyoming use of aircraft and associated environmental impacts would be less than described for Alternative 1. As noted in the description of this alternative, sources other than WS-Wyoming are able to conduct shooting from aircraft. After a period of initial decline while alternative sources of preventive predation management assistance with aerial shooting are identified, overall rates of aircraft use are expected to reach levels similar to the current WS program.

Non-WS entities generally do not have access to the training in aerial shooting provided to WS-Wyoming personnel through the WS Aviation Training and Operations Center. They are also not required to adhere to the more exacting standards for safety and aircraft maintenance that WS has developed. Consequently risks of an adverse safety indicent would be slightly higher than the current program.

4.2.5.8 Alternative 4. Indirect and Cumulative Impacts

In areas where non-WS entities conduct lethal PDM because of objections to WS-Wyoming actions and where non-WS entities will be able to conduct preventive lethal PDM that would otherwise be conducted by WS-Wyoming under Alternative 1, risks of adverse indirect impacts on non-target species would be similar to or slightly greater than Alternative 1. To elaborate, this alternative does not fully utilize the IWDM philosophy in its initial response to resolving damage. Therefore, it would inherently be less effective than the current program (Alternative 1) in resolving conflicts. This would likely result in greater reliance on private sector services by livestock producers to respond to identified threats and damage in a more timely manner, which is likely to cause this alternative to have greater indirect and cumulative impacts.

Cumulative impacts on target and non-target species would be expected to be greater than under the current program (Alternative 1), because individuals who find Alternative 4 unacceptable would be more likely to implement their own lethal control actions without waiting for nonlethal methods to be attempted first. However, risks of this type of behavior would be lower than for Alternatives 2 and 3 because these two alternatives do not contain any provisions for lethal PDM to resolve identified conflicts; therefore, WS-Wyoming services are far less likely to be considered in lieu of private sector services that are far less regulated. Therefore, the cumulative impacts of this alternative are anticipated to be less than those for Alternatives 2 and 3. Impacts of implementing Alternative 4 on prey species populations would not likely differ much from those of the proposed action for the same reasons identified in Section 4.3.1.7.

4.3 SUMMARY AND CONCLUSION

The current and proposed program, Alternative 1, provides the lowest overall negative environmental consequences and the highest positive benefits (cost effectiveness, humaneness, HHS). Impacts associated with PDM activities under consideration here are not expected to be significant. The addition of those impacts to other impacts associated with past, present, and reasonably foreseeable future actions would not result in significant cumulative environmental impacts. Monitoring the impacts of the program on the populations of both target and non-target species will continue. All PDM activities that take place will comply with relevant laws, regulations, policies, orders, and procedures, including the ESA, Migratory Bird Treaty Act, and Federal Insecticide, Fungicide, and Rodenticide Act. The environmental consequences of each alternative as discussed in this document are summarized and compared in Table 4-7.

The Current Program Alternative is likely to have the lowest cumulative effect on target species since a professional program with federal coordination and oversight supported by credible research programs would be expected to remove only those individuals or groups of depredating animals after nonlethal options have been determined to be ineffective or impractical. Alternatives that inhibit WS-Wyoming operations would default to other public agencies, such as WGFD, or private individuals; some of these individuals would have fewer skills or experience conducting PDM and would be less likely to be as selective for target animals. For similar reasons, effects on non-target species would be expected to be the lowest under the Current Program. Concerns regarding humane treatment of animals are likely to be most adequately addressed under the Current Program, according to perspectives of wildlife professionals, but perhaps not viewed as such by members of animal rights groups opposed to PDM. The Current Program is likely to be effective in resolving damage problems.

Under the No Federal Program Alternative, WS-Wyoming would have no impact on the issues evaluated. This alternative would likely result in the greatest negative environmental impact when professional and accountable assistance is not available.

The Technical Assistance and Nonlethal Methods Only Alternative could impact the ability of WS to efficiently address wildlife damage problems by limiting the PDM methods that could be used. Continued or increased threats to agricultural producers, property owners, and HHS would be likely to occur due to the restrictions placed on this management program. The No Federal Program, Technical Assistance and Nonlethal Methods only alternatives would, to varying degrees, not allow WS-Wyoming to respond to wildlife threats quickly or adequately. These alternatives do not fully support WS Directive 2.101, which addresses WS policy for applying IWDM principles. The Nonlethal Before Lethal Methods Alternative would enable WS personnel to respond effectively, though not efficiently because lethal methods are considered only when nonlethal methods have been determined by the wildlife professional to be ineffective, inhumane, not biologically sound, or not economically feasible.

Table 4-7. Summary of Environmental Consequences of Each Program Alternative Relative to Each Issue.					
Issues	Alternative 1 Current Program	Alternative 2 No Federal Program	Alternative 3 Tech. Assistance	Alternative 4 Nonlethal Only	Alternative 5 Nonlethal Before Lethal
Impacts on Target Species Populations	Well below sustainable harvest levels, including cumulative effects.	WS-Wyoming would have no effect on target species. WGFD may increase efforts but would not replace WS-Wyoming. Impact of private actions to resolve damage is likely to have greater negative consequences.	WS-Wyoming would have no direct effect on target species. WGFD may increase operational efforts but would not replace WS-Wyoming. Impact of private actions to resolve damage is likely to have greater negative consequences.	Effects likely to be similar to Alternative 1 since non-lethal methods that are not effective would likely result in lethal PDM being implemented by others.	Similar to Alternative 1 since PDM activities to protect wildlife would increase slightly. Overall program effort and effects on target species would be similar.
Impacts on Non-target Species	Low negative impact on non-target species	WS-Wyoming would have no negative effects on non-target species. Depending upon who implements PDM, the actions of others in the absence of a federal program could have a higher negative effect on non-target species.	Low negative impact on non-target species, by WS but variable depending on the actions of others.	Low negative impact on non-target species, by WS but variable depending on the actions of others.	Similar to Alternative 1 with indirect benefits to wildlife from predation control.
Impacts on T&E Species	Not likely to adversely affect T&E species; ongoing consultation and coordination	WS-Wyoming would have no effect. WGFD may increase PDM efforts, but would not replace	Low negative impact on T&E species, by WS but variable depending on the actions of others.	Low negative impact on T&E species, by WS but variable depending on the actions of others.	Not likely to adversely affect T&E species; ongoing consultation and coordination with USFWS and WGFD

	with USFWS and WGFD will ensure WS-Wyoming would not adversely impact any T&E species.	WS-Wyoming. The uncoordinated actions of others in the absence of a government program are likely to have a higher negative effect on T&E species.			will ensure WS-Wyoming would not adversely impact any T&E species.
Special Management Areas	WS-Wyoming actions are coordinated with land management agencies, minimal disturbance effects and minimal work performed in SMAs ensures no notable effects on SMAs.	No WS-Wyoming effect; potential for negative effects where individuals implement actions to protect livestock grazing on SMAs.	No notable effects, similar to Alternative 1 if WS recommendations are followed.	No notable effects, similar to Alternative 1.	No notable effects, similar to Alternative 1
Humaneness/ Ethical Perspectives	Perceptions vary by method. Familiarity with the tools and an individual's relationship to the natural world and to resources protected govern attitudes. WS-Wyoming uses selective PDM techniques that reduce unnecessary pain.	WS-Wyoming would have no effect. WGFD may increase efforts, but would not replace WS-Wyoming. This is the least humane of the alternatives due to actions of untrained individuals who would likely implement PDM in absence of professional assistance.	Similar to Alternative 2; preferred by some groups and individuals opposed to WS operational PDM, but rejected by resource and pet owners experiencing predation. Impacts would be variable depending on implementation of methods.	Similar to Alternative 2; preferred by some groups and individuals opposed to lethal PDM, but rejected by resource and pet owners experiencing predation. Impacts would be variable depending on implementation of methods.	Similar to Alternative 1. This alternative may be more acceptable to some because it provides greater assurance that nonlethal will be applied before WS uses lethal. However, lethal methods may still be used by other entities, with less imput or accountability to public. Some individuals may oppose PDM to protect sage-grouse and other wildlife.
Cost Effectiveness	Positive benefit-to-cost ratios repeatedly	Not applicable; resource losses likely to be higher.	Lower than Alternative 1 and where	Low where nonlethal methods are ineffective.	Positive benefits expected, similar to Alternative 1. Some

	demonstrated.	Domestic animals (livestock and pets) would be likely to experience increased levels of predation because of a lack of coordinated effort.	recommendations are not followed.		long-term benefits from potential increase in use of nonlethal methods, but also some increases in costs because of potential delays in implementing nonlethal methods that may be needed to resolve problem.
Public safety (HHS)	Low risk to public safety due to WS-Wyoming procedures that minimize the potential for public exposure to PDM tools.	WS-Wyoming would have no effect. WGFD may increase efforts, but would not replace WS-Wyoming. Potential for higher negative impact from individuals that may improperly use toxicants or other tools to resolve wildlife damage.	Effects variable depending on implementation of recommendation by others but probably lower than Alternative 1.	Similar to Alternative 3, but probably lower than Alternative 1.	Similar to Alternative 1. Some increases associated with increase in aerial shooting by non-WS entities and potential delays in effectively resolving conflicts.
Aerial shooting	Not considered to be significant on target or non-target animals, the public, or the environment.	Greater than Alternative 1 because of increase in aerial shooting by entities without same safety standards or training as WS.	Effects variable depending on use of recommendations by WS.	Greater than Alternative 1 because of increase in aerial shooting by entities without same safety standards or training as WS.	Slightly greater than Alternative 1 because of increase in aerial shooting by entities without same safety standards or training as WS.
Recreation	No notable effects; coordination with land management agencies and WGFD ensures minimum effects on recreational users	WS-Wyoming would have no effect; individuals addressing damage problems in the absence of WS-Wyoming oversight may have negative effects to recreationists and pets.	Similar to Alternative 2, since resource owners would implement their own PDM in the absence of professional assistance.	Similar to Alternative 2, since resource owners would implement their own operational PDM in the absence of professional assistance.	Similar to Alternative 1

Cumulative Impacts	Species populations would not be negatively affected. No significant adverse impacts on biodiversity, ecosystem resilience or trophic cascades.	No effect by WS-Wyoming; WGFD may increase efforts, but would not replace WS-Wyoming. The uncoordinated actions of individual resource owners/managers have the highest potential for negative environmental consequences.	Increased potential for negative effects over that of the current program due to the actions of others if recommendations are not followed.	Increased potential for negative effects over that of the current program due to the actions of others in the absence of effective professional assistance (where non-lethal methods are not effective).	Species populations would not be negatively affected. No significant adverse impacts on biodiversity, ecosystem resilience or trophic cascades.
Indirect Impacts	No notable negative effects; potential benefits to T&E and game species.	Potential negative effects to game and T&E species.	Potential negative effects to game and T&E species.	Potential negative effects to game and T&E species.	No notable negative effects; potential benefits to T&E and game species.

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5.2 List of Agencies Consulted

State of Wyoming:
Animal Damage Management Board
Wyoming Game and Fish Department
Wyoming Department of Agriculture
Wyoming Livestock Board

U.S. Department of Interior:
Bureau of Land Management

U. S. Department of Agriculture:
Forest Service

APPENDIX A
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APPENDIX B
AUTHORITY AND COMPLIANCE WITH STATE AND FEDERAL LAWS AND REGULATIONS

Authority of Federal and State Agencies for Wildlife Damage Management in Wyoming

WS Legislative Authority
The primary statutory authority for the WS program is the Act of March 2, 1931, as amended (7 U.S.C. 426-426c; 46 Stat. 1468), which provides that: The Secretary of Agriculture is authorized and directed to conduct such investigations, experiments, and tests as he may deem necessary in order to determine, demonstrate, and promulgate the best methods of eradication, suppression, or bringing under control on national forests and other areas of the public domain as well as on State, Territory or privately owned lands of mountain lions, wolves, coyotes, bobcats, prairie dogs, gophers, ground squirrels, jackrabbits, brown tree snakes and other animals injurious to agriculture, horticulture, forestry, animal husbandry, wild game animals, furbearing animals, and birds, and for the protection of stock and other domestic animals through the suppression of rabies and tularemia in predatory or other wild animals; and to conduct campaigns for the destruction or control of such animals. Provided that in carrying out the provisions of this Section, the Secretary of Agriculture may cooperate with States, individuals, and public and private agencies, organizations, and institutions."

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

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

U.S. Forest Service and Bureau of Land Management
USFS and BLM have the responsibility to manage the resources on NFS and BLM-administered lands for multiple uses, respectively, including livestock grazing, timber production, recreation and development/maintenance of wildlife habitat, while recognizing the state's authority to manage wildlife populations. Both USFS and BLM recognize the importance of reducing wildlife damage on lands and resources under their jurisdictions, as integrated with their multiple use responsibilities. For these reasons, both agencies have entered into MOUs with WS at the national level to facilitate a cooperative relationship (USFS 2011, BLM 2012). Both agencies recognize the expertise of WS-Wyoming in wildlife damage management and rely on WS-Wyoming to diagnose livestock and other resource losses and implement the appropriate methodologies for alleviating the damage and related compliance with NEPA on BLM and USFS lands.

Wyoming Game and Fish Department (WGFD)

The WGFD has the responsibility to manage all protected and classified wildlife in Wyoming, except federally listed T&E species, regardless of the land class on which the animals are found (WYSA §23-1-103). WGFD is also authorized to cooperate with WS-Wyoming and the WDA for controlling predatory animals (WYSA §11-6-101 through WYSA §11-6-108). Wyoming State law allows a landowner or lawful occupant to take any black bear, mountain lion, or bobcat that is causing damage without first obtaining a permit from WGFD (WYSA §23-3-115). The law, however, does require the landowner to notify WGFD of the methods used, and species and number of animals taken.

In Wyoming, black bear and mountain lion management is the responsibility of the WGFD. However, the current MOU and Cooperative Agreement between the WGFD and WS-Wyoming authorize WS-Wyoming to independently respond to livestock damage caused by black bear and mountain lion. The WGFD is then notified within 24 hours of any action taken to resolve the problem. Generally, either the WGFD or WS-Wyoming receives requests to handle wildlife damage to livestock. The WGFD may choose to ask WS-Wyoming to respond to the request or may respond itself. Under existing agreements, WS-Wyoming is authorized to respond independently to livestock damage caused by black bears and mountain lions.

Wyoming Department of Agriculture (WDA)
Coyotes are classified as predatory animals in Wyoming under WYSA §23-1-101(viii) (A), administered by the WDA. The WDA is authorized to enter into Cooperative Agreements with WS-Wyoming and local entities for reducing coyote damage (WYSA §610.010, 015, 020, 025, 030, 032). The WDA is responsible for the issuance of permits for aerial shooting per the Fish and Wildlife Act of 1956, as amended, and for administering a program to reduce damage caused by predatory animals (ORS §610.002, 003, 005, 035). The WDA currently has a MOU, Cooperative Agreement, and Work Plan with WS-Wyoming. These documents establish a cooperative relationship between WS-Wyoming and WDA, outline responsibilities, and set forth objectives and goals of each agency for resolving wildlife damage conflicts in Wyoming.

Wyoming Statutes - Animal Control Laws
Under Wyoming state law (WSA 11-31-301(d)), any dog injuring or killing livestock may be killed by the owner of the livestock or his agent or any peace officer. In Wyoming, dog control is generally the responsibility of local governmental agencies (the county sheriff or animal control officer). APHIS-WS and WS-Wyoming policy allows WS-Wyoming personnel to assist in feral dog control at the request of local authorities in municipal areas, the appropriate landowner on deeded lands, or the designated tribal official on tribal lands, upon approval by the WS-Wyoming State Director.

Compliance with Federal Laws
Several federal laws authorize, regulate, or otherwise affect WS PDM activities. WS-Wyoming complies with all such laws, and consults and cooperates with other agencies as appropriate.

National Environmental Policy Act: All federal actions are subject to NEPA (Public Law 91-190, 42 U.S.C. 4321 et seq.). WS follows the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500 et seq.), USDA (7 CFR 1b), and the APHIS Implementing Guidelines (7 CFR 372) as a part of the decision-making process. These laws, regulations, and guidelines generally outline five broad types of activities to be accomplished as part of any project: public involvement, analysis, documentation, implementation, and monitoring. NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential significant impact on the quality of the human environment for the purpose of avoiding or, where possible, mitigating

and minimizing adverse impacts. Federal activities affecting the physical and biological environment are regulated, in part, by CEQ through regulations in Title 40, Code of Federal Regulations, Parts 1500-1508. In accordance with CEQ and USDA regulations, APHIS Guidelines Concerning Implementation of NEPA Procedures, as published in the Federal Register (44 CFR 50381-50384) provide guidance to APHIS regarding the NEPA process.

Pursuant to NEPA and CEQ regulations, this EA analyzes the potential impacts of a proposed federal action, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of NEPA are infused into federal agency actions. An EA is prepared by integrating as many of the natural and social sciences as may be warranted, based on the potential effects of the proposed action. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Endangered Species Act (ESA): It is WS and federal policy, under the ESA, that all federal agencies shall seek to conserve T&E species and shall utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts consultations with the USFWS, as required by Section 7 of the ESA, 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 species or threatened species. . ." (Sec.7(a)(2)). WS-Wyoming has obtained Biological Opinions from USFWS for the lynx describing potential effects on T&E species and prescribing reasonable and prudent measures for avoiding jeopardy, submitted a biological assessment for the grizzly bear to the USFWS for opinion on November 21, 2014, and a biological assessment for the other listed species in Wyoming to the USFWS for concurrence on December 17, 2014. Additionally, WS-Wyoming has conducted informal consultations with USFWS and WGFD for the proposed damage management program specifically concerning the T&E species in Wyoming. Both agencies concurred with the finding of WS-Wyoming that the proposed action would not likely effect T&E species.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. All pesticides used or recommended by WS-Wyoming are registered with and regulated by the Environmental Protection Agency (EPA) and WDA. WS-Wyoming uses all registered pesticides according to label procedures and requirements as regulated by EPA and WDA.

Fish and Wildlife Act of 1956 (section 742j-1) - Airborne Hunting: This Act, approved in 1971, was added to the Fish and Wildlife Act of 1956 and is commonly referred to as the Airborne Hunting Act or Shooting from Aircraft Act. The Act authorizes the shooting of certain species of animals from aircraft for certain reasons, including protection of wildlife, livestock and human life as permitted by a federal or state-issued license. USFWS regulates the Airborne Hunting Act but has delegated implementation to the States. In Wyoming, WDA issues permits to private pilots and gunners for aerial shooting. WS-Wyoming is exempt from this licensing provision.

National Historical Preservation Act (NHPA) of 1966 as amended: requires: 1) federal agencies to evaluate the effects of any federal undertaking on cultural resources, 2) consult with the SHPO regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian tribes to determine whether they have concerns for traditional cultural resources in areas of these federal undertakings. WS actions on tribal lands are only conducted at the tribe's request and under signed agreement; thus, the tribes have control over

any potential conflict with cultural resources on tribal properties. All Native American tribes in Wyoming were invited to be cooperating agencies in the production of this EA.

Each of the PDM methods described in the EA and in Appendix C that might be used operationally by WS-Wyoming do not cause major ground disturbance, do not cause any physical destruction or damage to property, do not cause any alterations of property, wildlife habitat, or landscapes, and do 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 under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, then site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

There is potential for audible effects on the use and enjoyment of a historic property when methods such as propane exploders, pyrotechnics, firearms, or other noise-making methods are used at or in close proximity to such sites for purposes of hazing or removing nuisance birds or other wildlife. However, such methods would only be used at a historic site at the request of the owner or manager of the site to resolve a damage or nuisance problem, which means such use would be to benefit the historic property. A built-in mitigating factor for this issue is that virtually all of the methods involved would only have temporary effects on the audible nature of a site and can be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary in those types of situations.

Native American Graves Protection and Repatriation Act: The Native American Graves Protection and Repatriation Act 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 projects would discontinue work until a reasonable effort has been made to protect the items and the proper authority has been notified.

The Wilderness Act (Public Law 88-577(USC 1131-1136)): The Wilderness Act established a national preservation system for the United States to protect areas "where the earth and its community life are untrammeled by man." 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 as an integral part of livestock grazing programs. The Act did leave management authority for fish and wildlife with the state for those species under its jurisdiction. Some portions of wilderness areas (WAs) in Wyoming have historic grazing allotments and WS-Wyoming conducts limited damage management in a few per Wyoming laws for protecting livestock and other resources.

Occupational Safety and Health Act of 1970: The Occupational Safety and Health Act of 1970 and its implementing regulations (29CFR1910) 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 birds that may cause safety and health concerns at workplaces.

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

WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS personnel use damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by WS are regulated by the EPA through FIFRA, WDA, by MOUs with federal land management agencies, and by WS Directives. Based on a Risk Assessment, APHIS concluded that when 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 operational program properly disposes of any excess solid or hazardous waste. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations.

Executive Order 13045 - Protection of Children from Environmental Health and Safety Risks: Children may suffer disproportionately from environmental health and safety risks, including their developmental physical and mental conditions, for many reasons. Because WS makes it a high priority to identify and assess environmental health and safety risks, WS has considered the impacts that alternatives analyzed in this EA might have on children. All WS PDM is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected.

Executive Order 13112 – Invasive Species: EO 13112 directs agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The EO, in part, states that each 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, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, 4) provide for environmentally sound control, and 5) promote public education on invasive species.

Global Climate Change/Greenhouse Gas Emissions: WS program activities likely to result from the proposed action would have a negligible effect on atmospheric conditions, including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur as a result of the proposed action. The proposed action would meet requirements of applicable federal laws, regulations, and Executive Orders, including the Clean Air Act and Executive Order 13514.

Bald and Golden Eagle Protection Act (16 USC 668-668c), as amended: Populations of Bald Eagles showed periods of steep declines in the lower US during the early 1900s attributed to the loss

of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail declining trends in Bald Eagles, Congress passed the Bald Eagle Protection Act (16 USC 668) in 1940 prohibiting the take or possession of Bald Eagles or their parts. The Bald Eagle Protection Act was amended in 1962 to include the Golden Eagle and is now referred to as the Bald and Golden Eagle Protection Act. Certain populations of Bald Eagles were listed as *"endangered"* under the Endangered Species Preservation Act of 1966, which was extended when the modern Endangered Species Act was passed in 1973. The *"endangered"* status was extended to all populations of Bald Eagles in the lower 48 States, except populations of Bald Eagles in Minnesota, Wisconsin, Michigan, Washington, and Oregon, which were listed as *"threatened"* in 1978. As recovery goals for Bald Eagle populations began to be reached in 1995, all populations of eagles in the lower 48 States were reclassified as *"threatened"*. In 1999, the recovery goals for populations of eagles had been reached or exceeded and the eagle was proposed for removal from the ESA. The Bald Eagle was officially de-listed from the ESA on June 28, 2007 with the exception of the Sonora Desert Bald Eagle population. Although officially removed from the protection of the ESA across most of its range, the Bald Eagle is still afforded protection under the Bald and Golden Eagle Protection Act.

Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of Bald or Golden Eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "*take*" includes actions that "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb*" eagles. The regulations authorize the USFWS to issue permits for the take of Bald Eagles and Golden Eagles on a limited basis (see 74 FR 46836-46837, 50 CFR 22.26, 50 CFR 22.27). As necessary, WS-Wyoming would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; P.L. 92-583, October 27, 1972; 86 Stat. 1280): This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, to identify uses of the area to be regulated by the state, the mechanism (criteria, standards or regulations) for controlling such uses, and broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varies, depending on whether the federal action involves a permit, license, financial assistance, or a federally authorized activity. WS is consulting with the Wisconsin Department of State regarding the consistency of the proposed BDM program with the state coastal management plan.

Controlled Substances Act of 1970 (21 U.S.C. 821 et seq.): This law requires an individual or agency to have a special registration number from the federal Drug Enforcement Administration (DEA) to possess controlled substances, including those that are used in wildlife capture and handling.

Federal Food, Drug, and Cosmetic Act (21 U.S.C. 360): This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the Food and Drug Administration.

APPENDIX C
WILDLIFE SERVICES WILDLIFE DAMAGE MANAGEMENT METHODS

Description of Methods

A variety of methods are used by U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) to address wildlife damage management problems. Management strategies are based on applied IWDM principles. WS-Wyoming employs three general strategies for reducing of wildlife damage: resource management, physical exclusion, and wildlife management. Each of these strategies provides guidelines for addressing wildlife damage situations using a variety of specific methods or procedures. Selection of the appropriate approach and method is the result of the WS decision making process, or Decision Model (Slate et al. 1992, WS Directive 2.201). Mechanical methods generally are used and recommended in preference to chemical pesticides. No pesticide is used or recommended if it is likely to adversely affect fish, wildlife, food safety, or other components of the natural environment.

Various Federal, State, and local statutes and regulations as well as WS Directives govern the use of management tools and pesticides. The following basic wildlife damage management methods and materials are used or recommended by WS-Wyoming in direct operational or technical assistance efforts.

- Resource Management
  - Animal Husbandry
  - Habitat Management
  - Modification of Human Behavior

- Physical Exclusion
  - Fencing/Netting
  - Perching Deterrents

- Wildlife Management
  - Habitat Management
  - Frightening Devices
  - Chemical Repellents
  - Capture Methods
  - Chemical Pesticides

The methods listed above all have limitations which are defined by the circumstances associated with individual wildlife damage problems. When WS-Wyoming Specialists receive a request for assistance, they consider the range of limitations as they apply the WS decision making process described in Slate et al. (1992) and WS Directive 2.201 to determine what method(s) to use to resolve a wildlife damage problem.

Resource Management

Resource management includes a variety of practices that may be used by agricultural producers to reduce their exposure to potential wildlife depredation losses. Implementation of these practices is appropriate when the potential for depredation can be reduced without significantly increasing the cost of production

or diminishing the resource owner's ability to achieve land management and production goals. Changes in resource management are recommended through technical assistance advice to producers when such changes offer the potential to avert or minimize losses.

Animal Husbandry: This general category includes 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 the use of human custodians or guarding animals to protect livestock.

The level of care or attention given to livestock may change daily or seasonally. Generally, as the frequency and intensity of livestock handling increases, so does the degree of protection. In operations where livestock are left unattended for extended periods, the risk of depredation is greatest. The risk of depredation, which is usually greatest with calves and lambs, can be reduced when operations permit nightly gathering so livestock are not vulnerable during hours when predators are most active. This risk diminishes as age and size of the individual increase and can be minimized by holding expectant females in pens or sheds to protect newborns and by holding them in pens for the first 2 weeks of life. Shifts in breeding schedules can also 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 such as golden eagles.

The use of human custodians and guarding animals can also provide significant protection in some instances. The presence of herders to accompany bands of sheep on open range may help ward off predators. Guard animals have also proven successful in many sheep and goat operations.

Altering animal husbandry to reduce wildlife damage has many limitations. Nightly gathering may not be possible where livestock are located in large pastures and where grazing conditions require livestock to disperse. Hiring extra herders, building secure holding pens, and adjusting the timing of births is usually expensive. The economics of calving/lambing may be related to weather or seasonal marketing advantages related to age of livestock. The expense associated with a change or changes in husbandry practices may exceed the savings from reductions in predation losses.

Because trained livestock guard dogs are typically not available for sale, most people purchase, rear and train a pup. This requires a 4-8 month time frame to produce an effective guard dog. Since 25% to 30% of dogs do not become effective livestock guardians, there is a reasonable chance that the first dog trained will not be useful in this capacity. The effectiveness of guard dogs may be inadequate in areas where there is a high density of predators, where livestock widely scatter to forage, or where dog-to-livestock ratios are less than recommended. Also, guard dogs often harass and kill non-target wildlife.

Habitat Management: Change in the architectural design of a building or a public space can often help to avoid potential wildlife damage. For example, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential wildlife damage to parks, public spaces, or residential areas. Similarly, incorporating open space into landscape designs that expose wildlife can significantly reduce potential problems. Modifying public spaces to remove the potential for wildlife conflicts is often impractical because of economics or the presence of other nearby habitat features that attract wildlife.

Predators are more likely to become a problem if habitat conditions in the area are conducive to ambush. Removal or thinning of brush can discourage predator activity. The resultant increased visibility simplifies monitoring for the presence of predators and provides an avenue for shooting.

Modification of Human Behavior: Alteration of human behavior can sometimes resolve potential conflicts between humans and wildlife. For example, the elimination of wildlife feeding programs that occur in parks, forests, or residential areas will disperse otherwise congregated animals, and reduce the likelihood of conflicts with humans. This includes inadvertent feeding by improper disposal of garbage. Many wildlife species adapt well to the presence of humans and their associated activities, but their proximity to people may result in damage to structures or threats to HHS. Eliminating wildlife feeding and handling can reduce potential problems, but many people who are not directly affected by problems caused by wildlife enjoy wild animals and engage in activities that encourage their presence. It is difficult to consistently enforce wildlife feeding bans and to effectively educate all people concerning the potential liabilities of feeding wildlife.

Physical Exclusion

Physical exclusion methods restrict access of wildlife to resources. These methods, (including fencing, sheathing, netting, porcupine wire, and wire grids) provide a means to effectively prevent wildlife damage problems in many situations. Some of these methods are described in the following section.

Fencing: Fences are widely used to prevent damage. Predator exclusion fences constructed of woven wire or multiple strands of electrified wire are effective in some situations, but fencing does have its limitations. Even an electrified fence is not predator proof and the expense exceeds the benefit in most cases. If large areas are fenced, the predators have to be removed from the enclosed area to make the effort worthwhile. Some fences inadvertently trap, catch or affect the movement of non-target wildlife. It is not uncommon for coyotes to use fences to trap deer or antelope. More importantly, fencing is not practical or legal in some areas (*e.g.*, restricting access to public land).

Sheathing: Sheathing consists of using hardware cloth, solid metal flashing, or other materials to - protect trees from predators or to block entrances to gardens, fish ponds, dwellings, or other areas. Tree protectors are most often used as a deterrent to bears, beavers, or porcupines. Entrance barricades of various kinds are used to exclude bobcats, coyotes, foxes, opossums, raccoons, skunks, or starlings from dwellings, storage areas, gardens, or other areas. Metal flashing may be used to prevent entry of small rodents to buildings. Sheathing may be impractical where there are numerous plants to protect.

Tree Protectors, Barriers, Netting, Wire Grids, and Other Methods: Netting is a technique involving the installation of plastic or wire nets around livestock pens, fish ponds, or agricultural areas. Netting is used to exclude a variety of birds and mammals from poultry operations and other areas requiring exclusion of animals.

Wildlife Management

Reducing wildlife damage through application of wildlife management principles involves a myriad of techniques. The objective of this approach is to alter the behavior of the target animal to eliminate or reduce the potential for loss or damage to property.

Habitat Management: Just as habitat management is an integral part of other wildlife management programs; it also plays an important role in wildlife damage management. The type, quality, and quantity of habitat are directly related to the wildlife that occurs within the habitat. Therefore, habitat can be managed to be unattractive to certain wildlife species. Generally, many predator problems on airports can be minimized through management of vegetation (*i.e.*, grass height, removal of shrubs and trees) and removal of water from runway areas, because the presence of an attractive prey species is reduced or eliminated.

Limitations of habitat management as a method of reducing wildlife damage are determined by the characteristics of the species involved, the nature of the damage, economic feasibility, and other factors. Also, legal constraints may exist which preclude altering particular habitats.

Frightening Devices and Harassment: Scaring and harassment techniques to frighten animals are probably the oldest methods of combating wildlife damage. A number of sophisticated techniques have been developed to scare or harass wildlife from undesirable sites. Noise-making devices are the most popular and commonly used method; however, other methods, including aerial hazing and visual stimuli have potential. Harassment techniques employing vehicles, people, falcons or dogs can be effective methods for frightening predators or birds from areas where they are not wanted. Boats, planes, automobiles, and all-terrain vehicles can be used as harassment devices. As with other wildlife damage management methods, these techniques tend to be more effective when used collectively in a varied regime rather than individually. However, the continued success of these methods frequently requires reinforcement by limited shooting (see Shooting).

The success of frightening methods depends on an animal's fear of, and subsequent aversion to, offensive stimuli. Once animals become habituated to a stimulus, they often resume their normal (damage-causing) activities. Persistent effort is usually required to prolong the effectiveness of frightening techniques by varying their placement and frequency of deployment. Over time, some animals learn to ignore commonly used scare tactics. In many cases, animals frightened from one location become problems at other sites. The effects of frightening devices on non-target wildlife need to be considered as well. For example, sensitive birds may be disturbed or frightened from nesting sites.

Electronic Distress Sounds: Distress and alarm calls of various animals have been used singly and in conjunction with other scaring devices to successfully scare or harass animals. Many of these sounds are available in portable electronic format. Calls should be played back to the animals from either fixed or mobile equipment in the immediate or surrounding area of the problem. Animals react differently to distress calls; consequently, their application depends on the species and the problem. Calls may be played for short (few second) bursts, for longer periods, or even continually, depending on the severity of damage and relative effectiveness of different call scenarios. Some artificially produced sounds repel birds in the same manner as recorded natural distress calls.

> **Propane Exploders:** Propane exploders operate on propane gas and are designed to produce loud explosions at preset intervals. They are strategically located (elevated above vegetation, if necessary) in areas of high wildlife use to frighten wildlife from a problem site. Because animals are known to habituate to sounds, exploders must be moved frequently and used in conjunction with other scare devices. Exploders can be left in an area after a dispersal program is complete to discourage animals from returning.

Pyrotechnics: Double shotgun shells, known as shell crackers or scare cartridges, are 12-gauge shotgun shells containing a firecracker that is projected up to 75 yards in the air before exploding. Noise bombs, whistle bombs, racket bombs, and rocket bombs are fired from 15 millimeter flare pistols. They are used in the same way as shell-crackers but are projected for shorter distances. Noise bombs (also called bird bombs) are firecrackers that travel about 75 feet before exploding. Whistle bombs are similar to noise bombs, but whistle in flight and do not explode. They produce a noticeable response because of the trail of smoke and fire, as well as the whistling sound. Racket bombs make a screaming noise in flight and do not explode. Rocket bombs are similar to noise bombs but may travel up to 150 yards before exploding. A variety of other pyrotechnic devices, including firecrackers, rockets, and Roman candles, are used for dispersing animals. Firecrackers can be inserted in slow-burning fuse ropes to control the timing of each explosion. The interval between explosions is determined by the rate at which the rope burns and the spacing between firecrackers. All of these pyrotechnics can be effectively used to frighten birds or mammals.

Lights: A variety of lights, including strobe, barricade, and revolving units, have been used with mixed results to frighten predators. Brilliant lights, similar to those used on aircraft, are most - effective at frightening night-feeding birds and mammals. These extremely bright flashing lights have a blinding effect, causing confusion that reduces an animal's ability to see or locate prey.

Flashing amber barricade lights, like those used at construction sites, and revolving or moving lights may also frighten predators when these units are placed on raceway walls, fish pond banks, or ingress corridors. However, most predators rapidly become accustomed to such lights and their long-term effectiveness is questionable. In general, the type of light, the number of units, and their location are determined by the size of the area to be protected and by the power source available.

Other Scaring Devices: The Electronic Guard, a portable unit that houses a strobe light and siren, has been developed by the Denver Wildlife Research Center and is produced by the Pocatello Supply Depot. In certain situations, this device has been used successfully to reduce coyote depredation on sheep. The device activates automatically at dusk and is programmed to discharge periodically throughout the night. This technique has proven most successful when used at "bedding grounds" where sheep gather to sleep for the night.

Chemical Repellents

Chemical repellents are compounds that prevent consumption of food items or use of an area. They operate by producing an undesirable taste, odor, feel, or behavior pattern. Effective and practical chemical repellents should be nonhazardous to wildlife, nontoxic to plants, seeds, and humans, resistant to weathering, easily applied, reasonably priced, and capable of repellent undesirable animals or birds. The reaction of different animals to a single chemical formulation varies, and for any species there may be variations in repellency between different locales. Lithium chloride and capsicum derivatives are two potential repellents which have been extensively studied for their mammalian predator repellent capabilities, but no successful applications have yet been found. Development of chemical repellents is expensive and cost prohibitive in many situations. Chemical repellents are strictly regulated, and suitable repellents are not available for many wildlife species or wildlife damage situations.

Capture Methods

Foothold Traps: Foothold traps are used to capture animals such as the coyote and bobcat. These traps are the most versatile and widely used tool for capturing these species. The foothold trap can be set under a wide variety of conditions but can be difficult to keep in operation during rain, snow, or freezing weather. Traps placed without baits in the travel lanes of target animals are known as "trail sets." More frequently, traps are placed as "baited sets," meaning that they are used with bait consisting of the animal's preferred food or some other lure, such as fetid meat, urine, or musk, to attract the animal. In some situations a "draw station," such as a carcass or large piece of meat, is used to attract target animals. In this approach, one to several traps are placed in the vicinity of the draw station. WS program policy prohibits placement of traps closer than 30 feet from a draw station. This provides protection to scavenging birds.

Before foothold traps are utilized, their limitations must be considered. Injury to target and non-target animals, including livestock, may occur. Weather and the skill of the user will often determine the success or failure of the foothold trap in preventing or stopping wildlife damage. Various pan tension devices can be used to prevent animals smaller than target animals from springing the trap. Effective trap placement also contributes to trap selectivity; however, livestock and non-target animals may still be captured. These traps usually permit the release of non-target animals.

Cage Traps: A variety of cage traps are used in different wildlife damage control scenarios. The most commonly used cage traps used in the current program are box traps. Box traps are usually rectangular, and made from sheet metal or heavy gauge mesh wire. These traps are used to capture animals alive and can often be used where many lethal or more dangerous tools would be too hazardous. Box traps are well suited for use in residential areas.

Cage traps usually work best when baited with foods attractive to the target animal. They are used to capture animals ranging in size from mice to deer, but their effectiveness decreases with most large animals. They are virtually ineffective for coyotes; however, large cage traps work well to capture bears and have shown promise for capturing mountain lions. One major limitation of large cage traps is their portability.

Some animals avoid cage traps, while others become "trap happy" and purposely enter traps seeking food and get captured in the process, making the trap unavailable to catch other animals. Cage traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions. Some animals fight once captured and can injure themselves.

Snares: Snares made of wire or cable are among the oldest existing control tools. They can be used effectively to catch almost any species but are most frequently used to capture coyotes, mountain lions, and bears. They have limited applications, but are effective when used under proper conditions. Major advantages are that they are much lighter and easier to use than foothold traps and are not generally affected by inclement weather. The Collarum, a spring-powered neck snare device designed for capturing canines, has not been used by WS-Wyoming.

Snares may be employed as either lethal or live capture devices depending on how and where they are set. Snares set to capture an animal by the neck are usually lethal but stops can be applied to the cable to make the snare a live capture device. Snares positioned to capture the animal around the body can be useful live capture devices. Also, most snares incorporate a breakaway feature to

release non-target wildlife and livestock. These snares can be effectively used wherever a target animal moves through a restricted lane of travel (*i.e.*, "crawls" under fences, trails through vegetation, or den entrances). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is restrained.

The foot snare is a spring-powered nonlethal device, activated when an animal places its foot on the trigger. Foot snares are used effectively to capture black bears and mountain lions. In some situations, using snares to capture wildlife is impractical due to the behavior or morphology of the animal, or the location (residential/urban areas) of many wildlife conflicts. Snares must be set in locations where the likelihood of capturing non-target animals is minimized.

The catch-pole snare is used to capture or safely handle problem animals. This device consists of a hollow pipe with an internal cable or rope that forms an adjustable noose at one end. The free end of the cable or rope extends through a locking mechanism on the end opposite of the noose. By pulling on the free end of the cable or rope, the size of the noose is reduced sufficiently to hold an animal. Catch poles are used primarily to remove live animals from traps without danger to or from the captured animal.

Denning: Denning is the practice of seeking out the burrows of depredating coyotes or red foxes and destroying the young and/or adults to stop or prevent depredations on livestock. Denning is used in coyote damage management efforts primarily in the western States. The usefulness of denning as a damage management method is limited because coyote dens are difficult to locate in many parts of the country and den use is restricted to approximately 2 to 3 months during the spring.

Coyote depredations on livestock and poultry often increase in the spring and early summer because of increased food requirements necessitated by pup-rearing. The removal of pups will oftentimes stop depredations even if the adults are not killed. When the adults are killed, it is customary practice to kill the pups to prevent the pups from starving. Using this method, pups are removed from dens by excavation and then shot, or are killed in the den with a registered fumigant. Denning is highly selective for the target species and family groups responsible for damage. Denning is often combined with calling and shooting. Denning can be labor intensive with no guarantee of finding the den of the target animal.

Shooting: Shooting is used selectively for target species but may be relatively expensive because of the staff hours routinely required. Nevertheless, shooting is an essential management tool. Effective removal of urban coyotes may be achieved by night shooting because urban wildlife are primarily nocturnal. Many airports have perimeter fences for security purposes that also confine resident wildlife populations. Some of these animals occasionally cross or active runways, posing a significant threat to aircraft. Removal of such troublesome wildlife may be effectively accomplished by shooting.

Shooting is frequently performed in conjunction with calling particular predators such as coyotes, bobcats, and foxes. Trap-shy coyotes are often vulnerable to calling. Shooting is limited to locations where it is legal and safe to discharge firearms. Shooting may be ineffective for reducing damage by some species and may actually be detrimental to management efforts.

Aerial Shooting: Shooting from aircraft, or aerial shooting, is a commonly used coyote damage management method. Aerial shooting is species-selective and can be used for immediate damage reduction where livestock losses are severe if weather, terrain, and cover conditions are favorable. Aerial shooting can be effective in removing offending coyotes that have become trap-shy or are not susceptible to calling and shooting. Local depredation problems can often be quickly resolved by the use of aerial shooting.

Fixed-wing aircraft are typically used for aerial shooting on flat and gently rolling terrain. Because of their superior maneuverability, helicopters have greater utility and are safer in timbered areas, or in broken land where animals are more difficult to spot. In broken timber or areas with deciduous ground cover, aerial shooting is more effective in winter when snow cover improves visibility.

WS aircraft use policies ensure that aerial shooting is conducted in a safe and environmentally sound manner, in compliance with federal and State laws. Pilots and aircraft must be certified under established WS protocols. Only properly trained WS employees are approved as gunners.

Tracking/trailing Dogs: Dogs are essential components for successfully locating mountain lions and bears. Dogs trained for coyote denning are also valuable as decoy dogs to lure adult coyotes into shooting range. Trained dogs are used primarily to locate, pursue, or decoy animals. Training and maintaining suitable dogs requires considerable skill, effort, and expense and, therefore, a sufficient need for dogs must exist to make the effort worthwhile.

Chemical Immobilizing and Euthanizing Agents

WS employees must be trained maintain certifications to use drugs for capturing or euthanizing wildlife. Drugs such as ketamine hydrochloride and xylazine hydrochloride are used as immobilizing agents. Sodium phenobarbital is a common euthanasia drug. Most of these drugs are classified as restricted-use, requiring the acquisition and maintenance of federal and state licenses to legally store and use such drugs.

Pesticides

Several pesticides have been developed to reduce wildlife damage and are widely used because of their efficacy. Pesticides are generally not species-specific, and may be hazardous to other species unless used with care by knowledgeable personnel. The proper placement, size, and type of bait, time of year and weather are keys to selectivity and efficacy. Development of effective pesticides is expensive, and the road to a suitable end product is filled with legal and administrative hurdles. Few private companies are inclined to undertake such costly ventures. Most chemicals are developed and marketed for a given target species, and suitable chemicals are not available for most animals. Available delivery systems make the use of pesticides unsuitable in many wildlife damage situations. This section describes the pesticides used currently for PDM by WS personnel.

Sodium cyanide is used in the M-44 device, a spring-activated ejector device developed specifically to kill coyotes and 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 5-7inch long hollow stake. The stake is driven into the ground, the ejector unit is cocked and placed in the stake, and the capsule holder containing the cyanide capsule is screwed (hand-turned) onto the ejector unit. A fetid 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 device is pulled, a spring-activated plunger propels sodium cyanide into the animal's mouth. Sodium cyanide is an acute toxicant, resulting in death within minutes.

DRC-1339 (EPA. Reg. Nos. 56228-10, 56228-17, 56228-28, 56228-29 (SLN-NV-010006 supplemental label), and 56228-30 (SLN-NV-020005 supplemental label)): DRC-1339 (3-chloro-4-methylbenenamine hydrochloride) is an avicide registered with EPA. For more than 40 years, DRC-1339 has proven to be an effective method of starling, blackbird, gull, crow, raven, magpie, and pigeon damage management (West et al. 1967, Besser et al. 1967, Decino et al. 1966). It is a slow acting avian toxicant that is rapidly metabolized and excreted after ingestion. This chemical is one of the most extensively researched and evaluated pesticides ever developed. Because of the rapid metabolism of DRC-1339 it poses little risk of secondary poisoning to non-target animals, including avian scavengers (Cunningham et al. 1979, Schafer 1984, Knittle et al. 1990). This compound is also unique because of its relatively high toxicity to most pest birds but low-to-moderate toxicity to most raptors and almost no toxicity to mammals (DeCino et al. 1966, Palmore 1978, Schafer 1981). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/ bird to cause death (Royall et al. 1967); many other bird species such as raptors, sparrows, and eagles are classified as non-sensitive. Numerous studies show that DRC-1339 poses minimal risk of primary poisoning to non-target and T&E species. Secondary poisoning has not been observed with DRC-1339 treated baits. During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on birds killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost non-existent. DRC-1339 acts in a humane manner producing a quiet and painless death. Prior to the application of DRC-1339, pre-baiting is required to monitor for non-target species that may consume any bait. If non-target species are observed, then the use of DRC-1339 would be postponed or not applied. Research studies and field observations suggest that DRC-1339 treatments kill about 75% of the blackbirds and starlings at treated feedlots (Besser et al. 1967). Mitigation measures to avoid negative impacts to T&E species as well as the inherent safety features of DRC-1339 that preclude hazards to most species other than the target species listed above.

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. DRC-1339 tightly binds to soil and has low mobility. The half -life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (i.e., degradation chemicals) have low toxicity. Aquatic and invertebrate toxicity is low.

DRC-1339 concentrate is used effectively under seven EPA-registered labels (including 24c labels) in Wyoming to reduce damage caused by birds designated on the respective labels. These labels include:
Staging Areas (EPA Reg. No. 56228-30): for control of red-winged blackbirds, brown-headed cowbirds, grackles, and starlings in noncrop staging areas associated with nighttime roosting sites using a variety of bait types to include rice, barley, cracked corn and poultry pellets

Feedlots (EPA Reg. No. 56228-10): for control of blackbirds, brown-headed cowbirds, grackles, starlings, ravens, crows, magpies, pigeons and Eurasian collared doves in feedlots using a variety

of bait types to include various grains, peas, lentils, unpopped popcorn, distiller's grain and dry dog food/dry cat food, various bread products and other bait types

Staging Areas and Feedlots (EPA Reg. No. 56228-30, SLN WY-070002): for control of blackbirds, brown-headed cowbirds, grackles, starlings, ravens, crows, magpies, and pigeons in non-crop staging areas associated with nighttime roosting sites using a variety of bait types to include various grains, poultry pellets, meat, eggs, dry dog food/dry cat food, cull French fries and croutons

Livestock, Nest & Fodder Depredations (EPA Reg. No. 56228-29): for control of crows, ravens and magpies in rangeland or pastureland settings for protection of livestock, silage/fodder bags and the eggs/young of threatened, endangered or sensitive species; meat and egg bait types only

Livestock, Nest & Fodder Depredations (EPA Reg. No. 56228-29, SLN WY-110002): for control of crows, ravens and magpies for protection of livestock, sensitive wildlife species, HHS and structure damage; bait type is limited to dry dog food/dry cat food

Pigeons (EPA Reg. No. 56228-28): for control of pigeons at roosting or loafing areas using whole kernel corn

Gulls (EPA Reg. No. 56228-17): for control of gulls (six species) at non-crop feeding sites (airports, industrial sites, dumps, landfills) or in gull nesting colonies using bread cubes

The use of DRC-1339 according to label instructions will have no effect on T&E species in Wyoming. Observation of sites to be treated during the prebaiting period is required in order to determine the presence of non-target species. DRC-1339 baits cannot be used directly in water or in areas where runoff is likely.

Fumigants or gases used to control burrowing wildlife are efficient but often expensive. Fumigants are only used in rodent burrows and predator dens.

Gas Cartridge/Large Gas Cartridge (EPA Reg. Nos. 56228-2 and 56228-21): Fumigants or gases used to reduce burrowing wildlife damages are efficient but often expensive. In the Wildlife Services Program, fumigants are only used in rodent burrows and predator dens, and there use is not allowed on public lands. The Wildlife Services Program's Pocatello Supply Depot manufactures gas cartridges especially formulated for fumigation of dens and burrows. The cartridges are placed in the active burrows of target animals, the fuse is lit, and the entrance is then tightly sealed with soil. The burning cartridge causes death by oxygen depletion and carbon monoxide poisoning. Properly placed gas cartridges have minimal to no risk of starting a fire because they are placed and covered in the dens and burrows. In addition, the use of gas cartridges is highest in spring when the potential for fire is low.