Wolf Damage and Conflict Management in Wyoming
Environmental Assessment

GRAY WOLF DAMAGE AND CONFLICT MANAGEMENT IN WYOMING

Lead Agency: UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)
ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS)
WILDLIFE SERVICES (WS) - WYOMING

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U. S. FISH AND WILDLIFE SERVICE

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U.S. FOREST SERVICE

BUREAU OF LAND MANAGEMENT (BLM)

NORTHERN ARAPAHO TRIBE

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ACRONYMS

ADMB	Animal Damage Management Board
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BLM	Bureau of Land Management
CDV	Canine distemper virus
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CPV	Canine Parvovirus
DOW	Defenders of Wildlife
DPS	Distinct Population Segment
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
GTNP	Grand Teton National Park
GYA	Greater Yellowstone Area
IGBC	Interagency Grizzly Bear Study Team
IWDM	Integrated Wildlife Damage Management
IUCN	International Union for Conservation of Nature
LRMP	Land and Resource Management Plan
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NER	National Elk Refuge
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NRDC	Natural Resources Defense Council
NRM	Northern Rocky Mountains
NWRC	National Wildlife Research Center
RAG	Radio Activated Guard
RMP	Resource Management Plan
SHPO	State Historic Preservation Office
T&E	Threatened and Endangered
USC	United States Code
USDA	U. S. Department of Agriculture
USDI	U. S. Department of Interior
USFWS	U. S. Fish and Wildlife Service
USFS	U. S. Forest Service
WA	Wilderness Area
WDA	Wyoming Department of Agriculture
WDM	Wolf Damage Management
WGFC	Wyoming Game and Fish Commission
WGFD	Wyoming Game and Fish Department
WHA	Wolf Hunting Area

WTGMA	Wolf Trophy Game Management Area
WRR	Wind River Reservation
WS	Wildlife Services
WSA	Wilderness Study Area
WYO	Region of Wyoming exclusive of Yellowstone National Park, Grand Teton National Park, The National Elk Refuge and Wind River Reservation.
NEP	Nonessential Experimental Population
YNP	Yellowstone National Park

BACKGROUND AND SUMMARY

There are many positive ecological, ethical and aesthetic benefits associated with maintaining healthy wolf populations in native ecosystems (Weiss et al. 2007). Unfortunately, there are also circumstances when wolves can come in conflict with human interests (Mech 2017). In Wyoming, these conflicts may include predation on livestock and pets and threats to human health and safety associated with habituated wolves. This Environmental Assessment has been prepared to analyze the potential environmental impacts of alternatives for the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) involvement in wolf damage and conflict management in Wyoming.

In 1995, the U.S. Fish and Wildlife Service (USFWS) and cooperators reintroduced gray wolves (*Canis lupus*) as a Nonessential Experimental Population (NEP) (50 CFR 17.84 (i)) in Yellowstone National Park (YNP) and Central Idaho (59 FR 60252)[1]. The USFWS, WS and cooperating federal, state and tribal partners subsequently worked collaboratively on research and monitoring of the wolf population and on wolf conflict management. The Northern Rocky Mountains (NRM) wolf population grew steadily and population recovery criterion of $\geq$ 10 breeding pairs[2] per state (Idaho, Montana, Wyoming) for at least 3 consecutive years was reached by 2002, and has been exceeded every year thereafter (U.S. Fish and Wildlife Service et al. 2016). In 2015, the NRM wolf population (Wolves in ID, MT, WY) was estimated as at least 1,704 wolves in 282 packs including 95 breeding pairs; and additional packs have been confirmed in eastern Washington and Oregon (U.S. Fish and Wildlife Service et al. 2016). At the end of 2016, the Wyoming gray wolf population was estimated to have at least 377 wolves in 52 packs with over 25 breeding pairs (U.S. Fish and Wildlife Service et al. 2017). At least 269 wolves in 41 packs and 18 breeding pairs occurred on lands outside Yellowstone National Park.

On September 10, 2012, the USFWS determined that the gray wolf population in Wyoming had met recovery requirements and was no longer in need of protection under the Endangered Species Act. The decision to delist wolves and the USFWS approval of the state wolf management plan were vacated by the Federal Court for the District of Columbia on September 23, 2014. The U.S. Court of Appeals for the District of Columbia reversed the lower Court's ruling on April 25, 2017 and the USFWS issued a subsequent rule in the Federal Register delisting wolves on May 1, 2017 (82 FR 20284). Our pre-decisional EA on wolf damage and conflict management (USDA Wildlife Services 2015) was presented to the public during the period when wolves in Wyoming were under federal protection as an NEP population. Given that the status of wolves in Wyoming had changed multiple times, the impacts of the alternatives were analyzed under both scenarios (listed and de-listed). Text in this final EA has been adjusted to reflect the status change of wolves, but information on the impacts of management alternatives while wolves were federally listed has been retained for reference.

The WGFD has requested that WS-Wyoming continue its role as an agent of the State for managing wolf conflicts (Wyoming Game and Fish Commission 2011). Any WS-Wyoming wolf conflict management actions would be subject to WGFD, federal agency[3], or tribal decisions and authorizations and applicable federal, state, local and tribal laws and regulations and court rulings. WS-Wyoming wolf conflict management assistance could be provided on private or public property when: 1) authorized by the

[1] This rule established regulations allowing management of wolves by government agencies and the public to minimize conflicts with livestock. The USFWS authorized WS to investigate reported wolf predation on livestock and to implement corrective measures, including nonlethal and lethal actions, to reduce further predation.

[2] A breeding pair is defined as a pack containing $\geq$ one adult male $\geq$ one adult female and two or more pups on December 31.

[3] The U.S. Department of the Interior, National Park Service (NPS) has primary management authority in YNP and Grand Teton National Park and the USFWS has primary authority within the National Elk Refuge,

WGFD, applicable federal agency[3] or tribe; 2) resource owners/managers request assistance to alleviate wolf conflicts; 3) wolf conflict or threats are verified; and 4) agreements or work plans have been completed specifying the details of the conflict management actions to be conducted. Depending upon the applicable management plans and regulations, the types of verified wolf conflicts that could be addressed include: 1) depredation/injury of domestic animals, 2) harassment/threats to domestic animals, 3) property damage, and 4) injury and/or potential threats to human safety (e.g., habituated/bold wolves).

Three alternatives for WS-Wyoming involvement in wolf conflict management are analyzed in this EA, including the No Action/Proposed Alternative which continues the current adaptive wolf conflict management activities, including technical and operational assistance, with practical and effective nonlethal methods preferred before lethal actions are taken (WS Directives 2.101, 2.105). Under this alternative, WS-Wyoming would use and/or recommend the full range of legal, practical and effective nonlethal and lethal methods for preventing or reducing wolf conflicts while minimizing any potentially harmful effects of conflict management on humans, wolves, other species and the environment. This Alternative would serve as the environmental base line against which the potential impacts of the other Alternatives are compared (Council on Environmental Quality 1981).

Under a second alternative, WS-Wyoming would only use and provide advice on nonlethal methods for wolf conflict management. Under the third alternative considered, WS-Wyoming would not be involved in wolf conflict management in Wyoming. The limitations on WS-Wyoming actions under these two alternatives would not prevent the USFWS or WGFD, or property owners from using lethal methods in accordance with applicable federal, state and tribal laws, policies and plans.

The analysis evaluates the ability of each of the management alternatives to meet the established management objectives including the efficacy of the alternatives in reducing conflicts with wolves in Wyoming. Issues considered in detail for each alternative include: 1) impacts on the wolf population, 2) effects on public and pet health and safety, 3) animal welfare and humaneness concerns, 4) impacts to stakeholders including aesthetic impacts, 5) impacts on nontarget species including threatened and endangered species.

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

Gray wolf (*Canis lupus)* populations in North America, including the wolf population in the Northern Rocky Mountains (NRM) and Wyoming, have undergone dramatic recovery since reintroduction. The wolf population in Wyoming has exceeded the numerical, distributional, and recovery goals established by the U.S. Fish and Wildlife Service (USFWS) every year since 2002 (Jimenez et al. 2011, Wyoming Game and Fish Commission 2011, U.S. Fish and Wildlife Service et al. 2017). However, the expansion of the wolf population from backcountry areas into areas of greater human use and habitation has generally increased conflicts between wolves and humans (Wyoming Game and Fish Commission 2011). Conflicts with wolves include predation on livestock and pets and risks to human health and safety from potentially hazardous or threatening wolves. This Environmental Assessment (EA) has been prepared to evaluate the impacts of alternatives for U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) involvement in wolf conflict management in Wyoming.

Wildlife damage management, a specialized field within the wildlife management profession, is the science of reducing damage or other problems caused by wildlife, and is recognized as an integral part of wildlife management (Berryman 1991, The Wildlife Society 2015). WS is authorized and directed by Congress to conduct wildlife damage management to protect American agricultural, industrial and natural resources, property and human health and safety from damage associated with wildlife (Acts of March 2, 1931 (7 U.S.C. 8351-8352), as amended, and December 22, 1987 (7 U.S.C. 8353)). WS' mission is to provide federal leadership in managing conflicts with wildlife (WS Directive 1.201).[4]

WS recognizes that wildlife is an important public resource greatly valued by the American people. Wolves utilize resources (i.e., reproduce, travel, forage, deposit feces, etc.) to meet their basic needs. By its very nature, however, this use of resources can cause damage to agriculture and property, and pose risks to human health and safety. WS conducts research, technical assistance and applied management to resolve problems that occur when human activity and wildlife conflict with one another. As wolf populations increase and expand their range, local decision makers must choose management strategies that balance competing needs for wolves and the reduction of wolf conflicts and wolf-caused damage (Mech 2001, Hochard and Finnoff 2017, Mech 2017).

Within the parameters of state, federal, and tribal management authority, WS generally uses an adaptive integrated wildlife damage management (IWDM) approach (WS Directive 2.101, 2.105) wherein a combination of methods may be used or recommended concurrently or sequentially to reduce damage. IWDM is the application of safe and practical methods for the prevention and reduction of damage caused by wildlife based on local problem analyses (Slate et al. 1992) and the informed judgment of trained personnel. For example, effective damage management projects are not restricted to direct management of the animal(s) in question. Effective damage management may involve adjusting human behavior (tolerance for damage, farming practices, wildlife feeding, etc.), rendering the resource inaccessible to the problem wildlife species, or managing habitat independent of or concurrent with directly managing the wildlife species in question through nonlethal (e.g., frightening devices) or lethal methods. However, at times, the offending animal and select others may need to be removed to alleviate damage.

WS is a cooperatively funded, service-oriented program that provides assistance to requesting public and private entities and government agencies. Before WS responds to requests for assistance and conducts

[4] WS Directives are available for review at the WS website http://www.aphis.usda.gove/wildlifedamage.

any wildlife damage management, a request must be received and a Cooperative Service Agreement must be signed by the landowner/administrator for private lands or other comparable documents for public and tribal lands. WS responds to requests for assistance when valued resources are damaged or threatened by wildlife. Responses can be in the form of technical assistance (advice) or direct control (operational wildlife damage management), depending on the complexity of the wildlife problem, landowner/manager requests, and funding availability. In addition, WS activities are conducted in accordance with applicable federal, state and local laws; Memoranda of Understanding (MOUs) with other state and federal agencies; and other applicable documents (WS Directive 2.210). These documents establish the need for the requested work, legal authorities and regulations allowing the requested work, and the responsibilities of WS and its cooperators.

Normally, individual wildlife damage management actions by WS could be categorically excluded from further National Environmental Policy Act (NEPA) analysis, in accordance with APHIS implementing regulations for NEPA (7 CFR 372.5(c), 60 Fed. Reg. 6,000, 6,003, (1995)). However, in this instance, WS and the cooperating agencies have chosen to prepare an EA to: 1) facilitate planning, interagency coordination and the streamlining of project management; 2) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities; and 3) evaluate and determine if there are any potentially significant or cumulative adverse effects from the proposed activities. WS-Wyoming cooperates with the WGFD, the tribes, and other agencies and groups to address wolf conflicts under the guidance in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011). This analysis relies on existing data contained in published documents (Appendix D), and applicable state and federal regulations and management plans.

1.2 PURPOSE

The purpose of the proposed action is to reduce adverse impacts of wolf depredation on livestock and other domestic animals and wolf-related threats to human health and safety in Wyoming as requested and authorized by the WGFD, and the tribes, as appropriate (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007, Wyoming Game and Fish Commission 2011;2012). This analysis considers actions which may be implemented now that wolves are no longer protected under the Endangered Species Act (ESA). For reference, this EA also includes information on the environmental impacts of alternatives for wolf damage management (WDM) conducted by WS-Wyoming while wolves were federally protected under the ESA (50 CFR 17.84[5]) that was applicable when this EA was made available for public comment.

1.3 HISTORY AND CURRENT STATUS OF THE WYOMING WOLF POPULATION

Gray wolves were extirpated from Wyoming by the 1930s. From that time through the early 1990s, there were occasional wolf sightings in Wyoming, but these appeared to be transients, and there was no evidence of wolf reproduction in the state (Wyoming Game and Fish Commission 2011). In 1995 and 1996, the U.S. Department of the Interior, Fish and Wildlife Service, and cooperators reintroduced gray wolves (*Canis lupus*) as a Nonessential Experimental Population (NEP) (50 CFR 17.84) in Yellowstone National Park (YNP) and Central Idaho (59 FR 60252)[6]. WS, the USFWS, and cooperating federal, state

[5] 50 CFR 17.84 (i) applies to states and tribes that do not have a USFWS-approved wolf management plan and was the rule in effect in Wyoming after the court vacated the USFWS decision to approve the state of Wyoming's wolf management plan in 2014. 50 CFR 17.84 (n) was applicable to wolf management actions on the Wind River Reservation, which has a USFWS-approved wolf management plan.

[6] This rule established regulations allowing management of wolves by government agencies and the public to minimize conflicts with livestock.

and tribal partners have subsequently collaborated on research and monitoring of the wolf population and on wolf conflict monitoring and management. These efforts have included radio-collaring and monitoring more than 1,200 wolves in the NRM to assess population status, conduct research, and as an aid to reducing/resolving wolf conflicts.

The NRM wolf population grew steadily and expanded in number and distribution. The population recovery criterion of ≥ 10 breeding pairs[7] per state (Idaho, Montana, Wyoming) for at least 3 consecutive years was reached by 2002, and it has been exceeded every year thereafter (U.S. Fish and Wildlife Service et al. 2016). In 2015, the USFWS estimated the NRM wolf population contained at least 1,704 wolves in 282 packs, including 95 breeding pairs (U.S. Fish and Wildlife Service et al. 2016). The wolf population has expanded beyond the 3 NRM states, and eastern Washington and Oregon have a combined total of at least 200 wolves in 34 packs with 19 breeding pairs (U.S. Fish and Wildlife Service et al. 2016).

In 2007, the USFWS initiated a process to define a distinct population segment (DPS) of the gray wolf encompassing the eastern ⅓ of Washington and Oregon, a small part of north-central Utah, and all of Montana, Idaho, and Wyoming, as part of the process for eventually delisting wolves in Wyoming (United States Fish and Wildlife Service 2008a). The USFWS also proposed to remove the gray wolf in the NRM DPS from the list of Endangered and Threatened Wildlife under the ESA. The proposal allowed for the retaining of protections in northwestern Wyoming (outside the National Parks) in the final rule if adequate regulatory mechanisms to conserve Wyoming's portion of the wolf population were not developed. As part of the process, the state of Wyoming worked with the USFWS to develop a management plan for gray wolves that met the ESA requirements for preservation of the wolf population after delisting. Wolves in the NRM DPS, including Wyoming, were removed from the federal list of threatened and endangered species in October 2012. The Wyoming Gray Wolf Management Plan, completed in September 2011(Wyoming Game and Fish Commission 2011), as amended March 22, 2012 (Wyoming Game and Fish Commission 2012), and the Wolf Management Plan for the Wind River Reservation (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007) subsequently became the principal guides for managing wolves in Wyoming. In 2012, the first year with a state wolf hunt (Figure 1-2), the WYO[8] end of year wolf population dropped from 230 to at least 186 wolves in 31 packs (includes at least 15 breeding pairs), , consistent with state management objectives (Wyoming Game and Fish Commission 2011;2012). The WYO population increased to at least 199 wolves in 30 packs (including at least 15 breeding pairs) at the end of 2013. Statewide, the wolf population contained at least 277 wolves in 43 packs, with at least 21 breeding pairs in 2012 and at least 306 wolves in 43 packs with at least 23 breeding pairs in 2013 (Wyoming Game and Fish Department et al. 2013, U.S. Fish and Wildlife Service et al. 2014).

On September 23, 2014, the U.S. District Court vacated the USFWS decision to delist wolves in Wyoming and associated approval of the WGFD wolf management plan, and restored prior status as a nonessential experimental population. Management of wolves and wolf damage and conflicts reverted to procedures which were in place prior to the delisting in October 2012 (50 CFR 17.84(i)). The establishment of the Wolf Trophy Game Management Area (WTGMA) and a Predatory Animal status for wolves outside that zone is detailed in Wyoming Game and Fish Commission (2011;2012) and the Wyoming Gray Wolf Management Plan and addendum (Wyoming Game and Fish Commission 2011;2012).

[7] A breeding pair is defined as a pack containing ≥ one adult male ≥ one adult female and two or more pups on December 31.

[8] WYO refers to the area of Wyoming exclusive of Wind River Reservation and Yellowstone National Park, Grand Teton National Park and the National Elk Refuge where WGFD has primary management authority for most resident wildlife.

There was no sport harvest in the Wolf Trophy Game Management Area (WGTMA) in 2014, but 12 wolves were legally harvested by the public in the Predatory Animal Zone before the court restored the state gray wolf population to NEP status (Wyoming Game and Fish Department et al. 2015). The gray wolf population increased in WYO and statewide in 2014 and 2015 to a peak of at least 264 wolves in 36 packs with at least 21 breeding pairs in WYO and at least 382 wolves in 48 packs with at least 30 breeding pairs statewide (Jimenez and Johnson 2016). The population decreased slightly in 2016, with at least 377 wolves in 52 packs (including at least 25 breeding pairs) (U.S. Fish and Wildlife Service et al. 2017). Of the total wolves in Wyoming in 2016, there were at least 108 wolves and 11 packs (including at least 7 breeding pairs) inside Yellowstone, at least 9 wolves and 3 packs (no breeding pairs) in the Wind River Reservation, and at least 260 wolves and 38 packs (including at least 18 breeding pairs) in WYO (Figure 1-1; (U.S. Fish and Wildlife Service et al. 2017)).

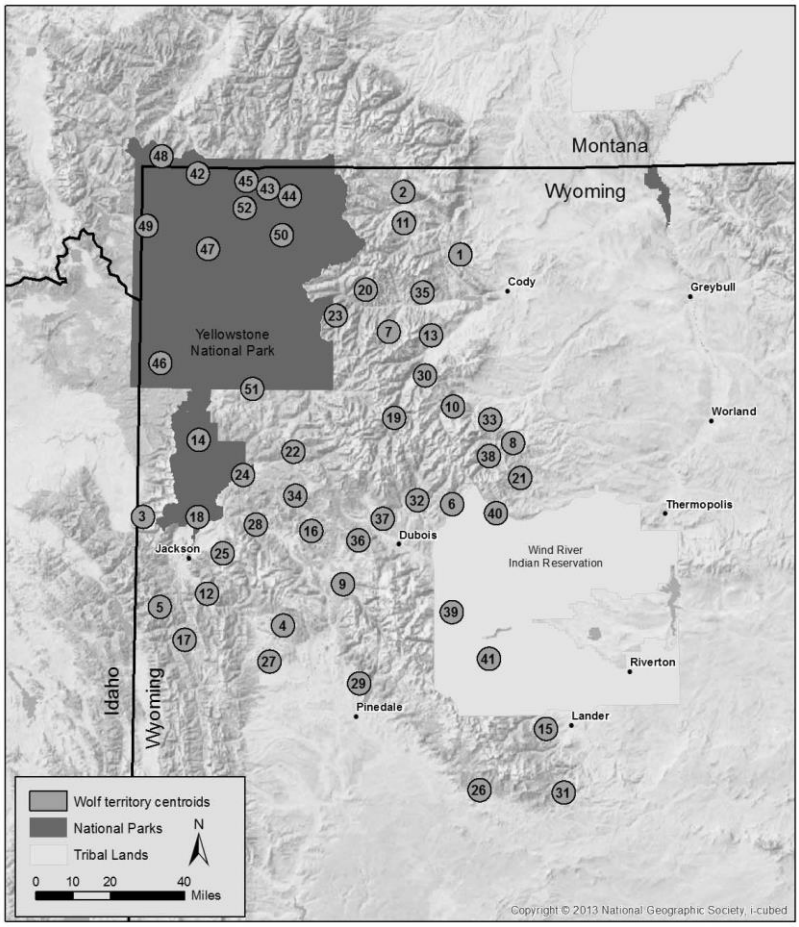


Figure 1-1. 2016 distribution of gray wolf packs in Wyoming (U.S. Fish and Wildlife Service et al. 2017).

On April 25, 2017, the U.S. Court of Appeals for the District of Columbia reversed the lower Court's ruling on the USFWS decision regarding the status of wolves, and the USFWS issued a subsequent rule in the Federal Register delisting wolves on May 1, 2017 (82 FR 20284).

1.4 NEED FOR WOLF CONFLICT MANAGEMENT IN WYOMING

The primary need for action in Wyoming is based on verified wolf depredation, harassment, and threats to livestock, game farm animals, and pets. WS-Wyoming could also help with the rare instances of risks to human safety from potentially hazardous or threatening wolves or habituated/bold wolves. The need exists for a prompt, professional, effective response to minimize wolf damage and conflicts (50 CFR 17.40(o); (U.S. Fish and Wildlife Service 1994, Mech 1995, Boitani 2003, Fritts et al. 2003, Mech and Boitani 2003, Bangs et al. 2004, Treves et al. 2009, Karlsson and Sjostrom 2011, Wyoming Game and Fish Commission 2011, Mech 2017). One of the nation's leading experts in wolf biology and management noted that wolf conservation at the local level may become more socially acceptable if some form of localized wolf control is allowed (Mech 1995). The Wildlife Society is an international

organization of professional wildlife biologists especially focused on North American states. The final position statement of The Wildlife Society regarding wolves in the contiguous United States recognizes the existence of wolf-human conflicts (e.g., domestic animal depredation, competition for wild ungulates with big game hunters, and concerns about public health and safety due to attack, diseases, or parasites) and that many wolf populations will require active management to be tolerated by local residents (The Wildlife Society 2012;Undated).

WS-Wyoming specialists are skilled in capturing wolves. Consequently, WS-Wyoming may receive requests from the WGFD or research institutions to capture and radio-collar wolves for research and population monitoring. These entities may also ask WS-Wyoming to opportunistically collect tissue or blood samples from wolves handled for damage management to facilitate studies on genetics, animal health, and other research on wolves.

The WGFD has expressed interest in WS-Wyoming assistance with wolf conflict management to reduce impacts on prey species (including ungulates), however his type of WDM has not been included in the need for action of this EA. WS-Wyoming would prepare additional analysis pursuant to CEQ and APHIS NEPA implementing requirements before undertaking any involvement in this type of WDM.

1.4.1 Wolf Predation on Livestock and other Domestic Animals

The primary need for action is the need to help individual livestock producers reduce wolf predation on livestock and domestic animals. USFWS and WGFD anticipated problems with wolf predation on livestock and domestic animals during the planning processes for the reintroduction and management of the wolf population (U.S. Fish and Wildlife Service 1994, Wyoming Game and Fish Commission 2011;2012). Other types of conflicts occur and are discussed in the following sections, but these instances are uncommon or have not yet occurred in Wyoming.

Table 1-1. Confirmed livestock depredations and number of wolves killed in damage management actions in Wyoming, calendar years 2000-2016 (U.S. Fish and Wildlife Service et al. 2017).

Depredations	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Cattle	3	18	23	34	75	54	123	55	41
Sheep	25	34	0	7	18	27	38	16	26
Dogs	6	2	0	0	2	1	1	2	0

Goats	0	0	0	0	10	0	0	0	0
Horses	0	0	0	2	0	1	0	1	0
Total Depredations	34	54	23	43	105	83	162	74	67
Wolves Removed	2	4	6	18	29	41	44	63	46

Depredations	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Cattle	20	26	35	44	40	56	72	154
Sheep	195	33	30	112	33	6	62	88
Dogs	7	0	1	3	1	0	0	0
Goats	0	0	0	0	1	0	0	0
Horses	0	1	1	1	0	0	0	1
Total Depredations	222	60	67	160	75	62	134	243
Wolves Removed	31	40	36	43	33	37	54	113

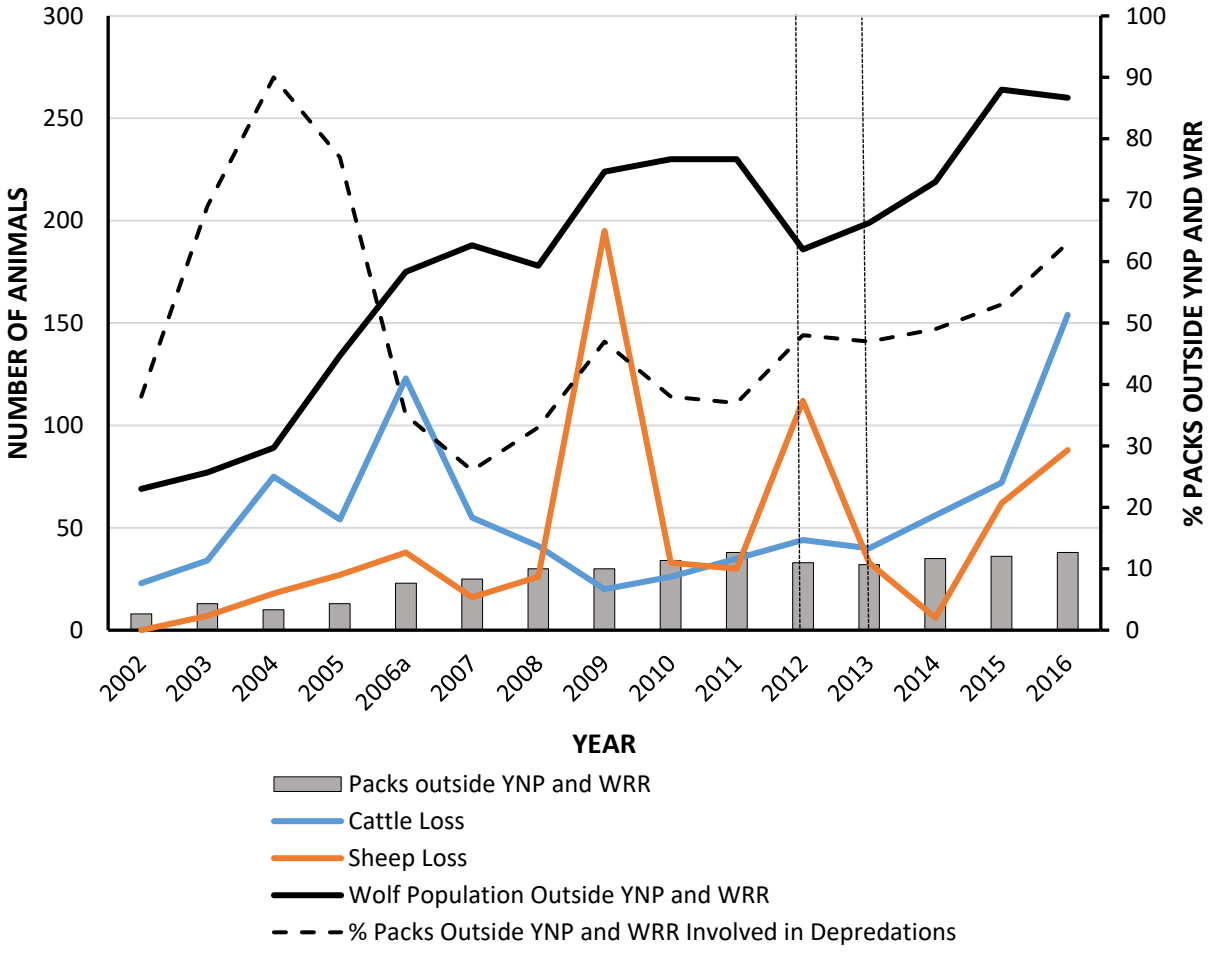


Figure 1-2. Minimum size of the Wyoming wolf population in the area outside Yellowstone National Park (YNP) and the Wind River Reservation (WRR), number of confirmed cattle and

sheep depredations and proportion of packs involved in depredations in Wyoming from 2000 – 2012 (United States Fish and Wildlife Service et al. 2003, United States Fish and Wildlife Service et al. 2004, United States Fish and Wildlife Service et al. 2005, United States Fish and Wildlife Service et al. 2006, Jimenez et al. 2007, United States Fish and Wildlife Service et al. 2008, United States Fish and Wildlife Service et al. 2009, United States Fish and Wildlife Service et al. 2010, United States Fish and Wildlife Service et al. 2011, Jimenez et al. 2012, United States Fish and Wildlife Service et al. 2013, U.S. Fish and Wildlife Service et al. 2014, United States Fish and Wildlife Service et al. 2015, U.S. Fish and Wildlife Service et al. 2016, U.S. Fish and Wildlife Service et al. 2017).

WS confirmed wolf depredation on a total of 243 head of livestock (154 cattle, 88 sheep, and one horse) in Wyoming during 2016 (U.S. Fish and Wildlife Service et al. 2017), and at least one incident of livestock depredation was attributed to each of 25 packs (U.S. Fish and Wildlife Service et al. 2017). Nonlethal WDM was routinely considered and employed. However, in instances where non-lethal WDM was not applicable or cost-effective, WS removed 113 depredating wolves to prevent further losses. In addition, the State of Wyoming paid out $315,062 to compensate cattle and sheep producers who lost livestock to, or had livestock injured by, wolves in 2016 (U.S. Fish and Wildlife Service et al. 2017).

Negative interactions associated with livestock depredation do not necessarily increase proportionately with wolf abundance, but rather are localized events. Figure 1-2 shows the number of wolf packs known to occur outside YNP and WRR, and the proportion of those packs that were involved in at least one verified depredation for each of the 15 most recent years. An assessment of factors that may have contributed to increases in wolf depredations suggested that wolf colonization, range expansion, and learning seemed to contribute to depredation increases (Harper et al. 2005). Wolves are apex predators and social animals, and the young of the year probably learn from the adults about what are acceptable prey items (Fuller et al. 2003). In addition, prey populations, such as deer, often select for agriculture areas (Webb et al. 2013), which may attract wolves to areas with livestock and increase the risk of wolf/livestock conflicts.

The numbers in Table 1-1 represent a minimum number of livestock killed by wolves; WS expects that more livestock were probably killed or injured but not confirmed as wolf predation (Bjorge and Gunson 1985, Oakleaf et al. 2003). Wolf predation is only confirmed in those cases where there is enough evidence remaining to determine that wolves in fact killed the animal. In many cases, wolves may have been responsible for the death of a rancher's livestock, but there was insufficient evidence remaining to confirm wolf predation. In some cases, those portions of the livestock carcass that might have contained the evidence of predation may already have been consumed, carried off, or decomposed. Some of these incidents might be classified as "probable" predation, depending on remaining evidence. But in many cases, there may be little or no evidence of predation, other than the fact that wolves are known to be in the area and some livestock have seemingly just disappeared. Bjorge and Gunson (1983;1985) in Alberta suggested

that cattle dying from predation are less likely to be detected than cattle dying from other causes and their estimates of predation rates during their study were likely low. Bjorge and Gunson (1985) recovered only 1 out of every 6.7 missing cattle during their study. Similarly, Oakleaf et al. (2003) conducted a study on wolf-caused predation to cattle on U.S. Forest Service (USFS) summer grazing allotments and concluded that for every calf found and confirmed to have been killed by wolves, there were as many as 8 other calves killed by wolves but not found by the producer.

Many of the confirmed incidents of wolf predation on livestock in Wyoming have involved one or a few animals killed or wounded per incident, but there have been situations where much larger numbers of livestock have been killed in a single incident, particularly in the case of attacks on sheep. In September 2003, for example, WS personnel confirmed wolf predation on 61 sheep in a single incident near Riggins, Idaho, and an additional 40 sheep were missing and never found after the night of the attack (USDA APHIS Wildlife Services 2004). WS personnel confirmed that 17 ewes and 24 lambs were killed by wolves in a single incident south of Ten Sleep, Wyoming in June 2009. Muhly and Musiani (2009) reviewed data on wolf predation on livestock in Idaho, Montana, and Wyoming from 1987-2002 and found that while most wolf attacks on cattle involved the death of only one animal per incident, wolf attacks on sheep typically involved killing about 14 animals per incident, with up to 98 sheep killed in a single attack.

Of the approximately 221,000 sheep and 240,000 lambs in Wyoming in 2014; and 1,210,000 cattle and 670,000 calves in 2015, 1,700 (0.08%) sheep, 5,700 (2.4%) lambs, 620 (0.05%) cattle, and 2,780 (0.4%) calves, were reported lost to predators (all predators combined)(USDA APHIS Veterinary Services 2015;2017). Among Wyoming livestock operations, 17.9% with sheep and 28.3% with lambs during 2014, and 4.2% with cattle and 7.8% with calves during 2015 reported losses to predation (all predators combined) in 2015. In Wyoming, wolves were the reported cause of 1.3% of sheep and 0.4% of lamb losses to predation in 2014, and 18.4% of cattle and 16.8% of calf losses to predation in 2015 (USDA APHIS Veterinary Services 2015;2017).

However, these summary statistics underestimate the potential impact of predation on individual livestock producers. First, it is important to recognize that these relatively low overall levels of loss are occurring with established conflict management efforts already in place. Losses would likely be higher in the absence of livestock producer efforts to reduce damage and WDM assistance from WS-Wyoming, private and county entities. Also, even though predation losses due to wolves represent a relatively minor portion of total overall death losses nationwide, these losses are never evenly distributed among producers. Impacts to individual producers can be significant (Fritts et al. 1992, Mack et al. 1992, Breck and Meier 2004, Shelton 2004).

Although most livestock producers will experience little or no predation by wolves, other producers in certain areas may suffer significant losses. Coyotes, by virtue of the fact that their populations are typically many times greater and more widely distributed than the wolf population, do cause more overall predation losses, particularly to sheep. However, because of the size and hunting behavior of wolves, some types of livestock (e.g., all age classes of cattle) may be more vulnerable to wolf predation than to predation by coyotes. Assessing the relative likelihood of predation by individual wolves versus individuals of other more abundant and widespread predators provides insight as to why wolf predation is a bigger concern to some livestock producers and wildlife management agencies than is predation by other species. Collinge (2008) compared reported numbers of livestock killed by wolves and other predators with the estimated statewide populations of the four species most often implicated in predation on livestock in Idaho (*i.e*., coyotes, wolves, mountain lions (*Puma concolor*), and black bears (*Ursus*

americanus). By determining the average number of livestock killed per each individual predator on the landscape and comparing these figures among the four species, his results indicate that individual wolves in Idaho are about 170 times more likely to kill cattle than are individual coyotes or black bears. Individual wolves were determined to be about 21 times more likely to kill cattle than were individual mountain lions. These comparisons highlight the importance of being able to implement effective WDM procedures.

Domestic dogs and cats are occasionally killed and eaten by wolves (Fritts and Paul 1989, Treves et al. 2002, Wydeven et al. 2007). From 2000-2016, WS-Wyoming and WGFD verified that wolves killed an average of 1.5 (range: 0-7) domestic dogs per year in Wyoming (Table 1-1). Wolf complaints involving dog depredations usually involve one dog being killed by wolves, but WS has documented multiple dogs killed during a single incident. Wolves may carry the carcass of a dog out of a yard and into a more secluded area. There are probably other instances where wolves attacked dogs, but such incidents were either not reported or the dogs were just assumed to be "missing". Many people are attached emotionally to their pets and have very strong feelings concerning their injury or loss. When wolves come into contact with people and kill or injure their pets, there is both an economic and an emotional loss (Linnell et al. 2002), as well as heightened concern over pet and human safety. The dogs most commonly attacked by wolves in Wyoming are either livestock guarding dogs or hounds which occasionally encounter wolves during the legal sport hunting seasons for mountain lions. Individual livestock guarding dogs may be worth more than $1,000 each, and well trained, experienced mountain lion hounds are often valued at several thousand dollars each.

1.4.2 Potential Role of Wolves in Disease Transmission

Some people have expressed concern regarding the role of wolves in disease and parasite transmission. Although wolves clearly can and do carry diseases that could adversely affect livestock, other wildlife, or humans, the risk of significant disease issues with wolves appears to be low or, as of yet, undetermined. Therefore, WS-Wyoming would not remove wolves to control diseases except in the case of an immediate and demonstrable threat to human safety as might occur in the extremely rare instance of rabies in wolves (See Section 1.4.3). WS-Wyoming would need to conduct additional NEPA analysis prior to conducting any project involving lethal removal of wolves to reduce disease threats to livestock. However, WS-Wyoming has opportunistically collected samples for disease monitoring from wolves handled during damage management and population monitoring activities and, depending on the alternative selected, could do so in the future. Some of the primary disease and parasite issues of concern to members of the public are discussed below.

Neospora caninum

The protozoan parasite, *Neospora caninum*, causes abortions in cattle and has been shown to contribute to significant economic losses in the dairy and beef industry, with infected animals being 3 to 13 times more likely to abort than non-infected cattle (Trees et al. 1999, Dubey 2003, Hall 2005). There are limited reports of antibodies to *N. caninum* in people, but the parasite has not been detected in human tissues (Dubey et al. 2007, Donahoe et al. 2015). Until approximately 1988 when the parasite was officially recognized as a distinct species, many cases of *N. caninum* infection were likely misdiagnosed as toxoplasmosis. Subsequent research has revealed that *N. caninum* can be found around the world (Donahoe et al. 2015). Wolves, dogs and coyotes become infected by ingesting tissues (*i.e.*, placenta, fetuses) contaminated with the organism. They then shed the organism in their feces (Gondim et al. 2004a, Gondim et al. 2004b, Dubey et al. 2011). A cow grazing on a pasture contaminated with these feces can become infected with *N. caninum* (Dubey 2003). The disease may also be spread from infected females

to their offspring (Donahoe et al. 2015). Gondim et al. (2004a) indicated that 39% (n = 164) of wolves from Minnesota and 11% of coyotes in Utah, Colorado, and Illinois (n = 113) tested positive for exposure to *N. caninum*. However, it is unclear whether the presence of wolves would add to the risk already posed by other, usually more common, canids (e.g., coyotes and dogs). It is also unclear whether or not wolves might play a role in reducing the potential of disease spread as suggested for other ungulate (*e.g.*., deer, elk, moose (*Alces alces*), domestic sheep, and domestic cattle) diseases (Stronen et al. 2007).

Echinococcus granulosus

Foreyt et al. (2009) documented that the tapeworm *Echinococcus granulosus* occurred in 62% of wolves examined in Idaho, and that it was common to find thousands of these tapeworms in each infected wolf. *E. granulosus* requires two hosts to complete its life cycle. Ungulates are intermediate hosts for larval tapeworms which form hydatid cysts in the body cavity, often on the liver or lungs. Canids (*i.e.*, dogs, wolves, coyotes, foxes (*Vulpes*, *Urocyon* and *Alopex* spp.) are definitive hosts where larval tapeworms mature and live in the small intestine. Definitive hosts are exposed to larval tapeworms when ingesting infected ungulates. Adult tapeworms, 3-5 mm long, produce eggs which are expelled from canids in feces. Intermediate hosts ingest the eggs while grazing, where the eggs hatch and develop into larvae. Preliminary data collected by WS-Wyoming indicate that approximately 64% of the 22 wolves sampled from outside YNP tested positive for *E. granulosus* (M. Pipas, USDA WS, ongoing research) but no strain typing has been conducted. Interestingly, only 1 of 182 coyotes collected from the same general area also tested positive for *E. granulosus*.

Humans are at risk of becoming infected and developing hydatid cysts, primarily through ingestion of eggs which may be present in soil contaminated by feces or on the fur of infected dogs, wolves or other canids. No human cases in Wyoming are known, but because Echinococcosis is not a reportable disease, it may have been diagnosed in Wyoming and never reported. In Idaho, a recent survey of health care providers found 7 or 8 cases that had not been reported by the medical community. Throughout the world, most human cases occur in indigenous people with close contact with infected dogs, but hunters and trappers handling wolves, coyotes or foxes may be at increased risk.

Mange, Canine Distemper Virus, Canine Parvovirus

Wolves could possibly spread other wildlife diseases to dogs (e.g., sarcoptic mange) should they have contact with a dog or their environment and vice versa. Wolves in the NRM are known to have been exposed to a variety of diseases, including those caused by viruses (e.g., canine distemper, canine parvovirus, and canine infectious hepatitis), bacteria, and both internal (e.g., intestinal worms) and external parasites (e.g., *Sarcoptes scabiei*, lice and ticks) (Idaho Department of Fish and Game 2008, Jimenez et al. 2010b, Jimenez et al. 2011). Given the considerable potential pathogen cross-over between wolves and domestic dogs, wolves that interact with domestic dogs are likely to have higher exposure rates than wolves in remote areas. Despite evidence of ubiquitous exposure to various disease agents, wolves in Wyoming demonstrate high recruitment (Jimenez et al. 2011), suggesting long-term stability of populations. Negative effects on wolf populations associated with diseases are unlikely unless populations reach high densities (Kreeger 2003).

Mange was first detected in Wyoming in 2002 (Jimenez et al. 2010a). Mange is fairly common in wolf populations throughout the world, including wolves in Canada, Alaska, Wisconsin, Minnesota, and Michigan. Based on other areas that have experienced epizootic mange infestations, mange in the northern Rocky Mountain wolf population will most likely be localized in specific areas and not threaten regional wolf population viability (Jimenez et al. 2010b). Other

diseases which are occasionally monitored in Wyoming wolves include canine distemper virus (CDV) and canine parvovirus (CPV). Over 80% of the wolves in Wyoming routinely test positive for CDV and CPV. Based on other areas of the world that have experienced epizootic CDV and CPV infections, these diseases will most likely occasionally cause some mortality, particularly among pups, but will be localized in specific areas/years, and not threaten regional wolf population viability (Wyoming Game and Fish Department et al. 2013).

1.4.3 Wolf Conflict Management to Protect Human Safety

Wolves have high aesthetic and cultural value, and, while hearing and viewing wolves is extremely popular, not all of these interactions have been positive. However, when wolves approach human residences and threaten or kill people's pets or exhibit excessively bold behavior, people often become concerned about human safety. This is especially true when small children are present. Wolf-related threats to human safety are rare. To date, WS-Wyoming has not received any requests for this type of assistance, although habituated wolves have been removed by other agencies in response to safety threats (Repanshek 2009, Hatch 2012). WS-Wyoming could be asked to help respond to these events. Protection of human health and safety is not a primary reason for WDM in Wyoming, however, including this type of WDM in the need for action facilitates a prompt response by WS-Wyoming in the event that such an incident does occur.

Incidence of Aggressive Behavior by Wolves

Attacks on humans have been recorded in Russia, Finland, Scandinavia, Germany, India, Afghanistan, Korea, central Asia, Turkey, Iran, and Greenland, but there have been relatively few reported wolf attacks on people in North America (Linnell et al. 2002, McNay 2002, Geist 2008). There have been only two documented fatal attacks by wolves on humans in North America in recent years. The first fatal attack occurred in November 2005 near Points North, Saskatchewan (McNay 2007) and the other in March 2010 near the village of Chignik Lake, Alaska (Butler et al. 2011). In the first case, evidence suggested several local wolves had become habituated to people, and the victim was attacked while out walking alone in a wooded area. Those wolves had been feeding on the victim's body before searchers found the remains, indicating the attack was likely predatory. This is believed to be the first documented human mortality from wolves in North America. In the second case, Alaska officials concluded wolves killed a 32-year-old woman as she was jogging along a gravel road near the Town of Chignik Lake, on the Alaska Peninsula (Butler et al. 2011). Instances of non-fatal attacks and aggressive behavior toward people in the lower 48 United States are slightly more common, but still rare. Not all incidents of aggressive behavior would necessarily warrant direct management of wolves, particularly situations where wolves appear to be protecting pups at den or rendezvous sites. Examples of nonfatal incidents include a July 2018 event in which a researcher climbed a tree to avoid wolves that dispersed when a helicopter came to pick her up. The aggressive behavior appears to have been a response to the proximity of the individual to a rendezvous site (Walgamott 2018). In August 2013, a camper in Minnesota was bitten on the head by a wolf that was subsequently trapped and killed. Subsequent investigations indicated the wolf had sustained injuries that likely made it difficult for the animal to obtain normal prey (Minnesota Department of Natural Resources 2013). In April 2000, a child was attacked by a wolf while playing in a logging camp near Icy Bay, Alaska. In this instance, food-conditioning may have facilitated the habituation process, but there was no indication that the attack resulted from a food-conditioned approach response (McNay and Mooney 2005).

Factors Contributing to Aggressive Behavior by Wolves

Most of the 51 cases of aggressive behaviors by wolves towards humans in Canada, Alaska or Minnesota during the period of 1900-2001 reviewed by (McNay 2002) appeared to have an apparent causative factor (i.e. rabies (12), self-defense or defense of another wolf (14), presence of dog with person (6). However, in 19 cases, aggressive behavior appeared to be unprovoked. Wolf familiarity with (habituation to) humans appears to be an important factor contributing to aggressive behavior toward humans. Of the 18 unprovoked incidents of aggressive behavior by wolves reported by McNay (2002) for the period 1969-2001, 11 were associated with what he defined as habituated wolves, (*e.g*. wolves which had lost their fear response to humans after repeated non-consequential encounters). Non-habituated wolves in remote areas displayed unprovoked aggression in 7 cases. Bites were inflicted in all 11 cases where habituated wolves displayed unprovoked aggression, but only 2 of the 7 instances of unprovoked aggression by non-habituated wolves resulted in bites; 4 of the 11 bites were severe. The humans defended themselves by hitting the wolf with a heavy object, firing a rifle into the air or, in two instances, killing the wolf.

Linnell et al. (2002) reported several non-fatal attacks from around the world in which non-diseased wolves attacked people, but no humans were killed during the attacks; the wolves, in most cases, were later killed and examined. Similar to the majority of instances reported by McNay (2002) the wolves involved in those attacks seemed to have acclimated to the presence of people and had become more aggressive toward humans. Fortunately, in many of these incidents, other people accompanying the victims were able to drive the wolf away. In many cases the person attacked received only minor injuries and made a full recovery in a few days to weeks.

With a growing wolf population and many people living and recreating in occupied wolf range, opportunities for wolves to become habituated to humans and risks of adverse interactions with humans are likely to increase. The data provided by McNay (2002) and Linnell et al. (2002) indicate the importance of human behavior management and public education programs to prevent adverse human-wolf encounters. These efforts, coupled with nonlethal techniques designed to reduce or prevent wolf habituation to humans, can help prevent or resolve most situations where wolf behavior causes concern for human safety. However, there may be instances where removal of a bold, habituated wolf may be deemed necessary to reduce a human safety risk. There have been two such cases in Wyoming, including one in the Jackson Hole area and one in YNP (Repanshek 2009, Hatch 2012).

Rabies in Wolves

Aggression toward humans can at times be attributed to wildlife disease issues. Although North American wolf populations do not serve as reservoirs for any particular variant of the rabies virus, they are nonetheless susceptible. Consequently, there is serious concern for humans and their pets should they be bitten. McNay (2002) reported two people that died as result of bites from wolves with rabies in Alaska in the 1940s. In 2007, a pack of wolves attacked a group of sled dogs and strays in Marshall, Alaska (Pemberton 2007). The one wolf that was killed by villagers during the attack tested positive for rabies. All dogs involved in the incident were euthanized as well as free roaming dogs that may have been involved in the incident. In response, villagers and government officials were working to increase use of rabies vaccine and fenced enclosures for dogs. However, this type of incident is relatively uncommon, and rabies is very rare in wolves south of the arctic in North America.

1.4.4 Indirect Impacts of Livestock Predation

Although direct losses of livestock due to predation are often conspicuous and economically significant, relying solely on direct losses as a measure of impact likely underestimates the total

impact on producers because direct losses do not account for indirect effects of carnivores as a result of livestock being exposed to the threat of predation (Howery and DeLiberto 2004, Lehmkuhler et al. 2007, Laporte et al. 2010, Steele et al. 2013, Ramler et al. 2014). Shelton (2004) suggested that the value of depredated livestock from predators is the "tip of the iceberg" concerning the actual costs that predators impose on livestock and producers, including increased costs associated with efforts to mitigate predation which may include night confinement, improved fencing, early weaning, choice of grazing area, and/or increased feeding costs from a loss of grazing acreage.

The presence of predators near livestock can invoke a fear response in the livestock (Cooke et al. 2017). Fear is a strong stressor (Grandin et al. 1998). Stress can result in disease and weight loss, reduction in the value of meat, and interference with reproduction. Stress prior to slaughter is thought to cause "dark-cutters," meat which is almost purple (Fanatico et al. 1999). Dark-cutters are severely discounted because they are difficult to sell (Fanatico et al. 1999). Harassment due to predators may directly cause weight loss due to increased energy expenditure associated with running and loss of sleep, but may also indirectly reduce the ability of ruminants to convert plant nutrients into weight gain due to decreased rumination time (Howery and DeLiberto 2004).

Cattle and sheep exposed to harassment by predators become very skittish and spend more time remaining vigilant for predators (Kluever et al. 2008). They do not disperse and feed normally, and therefore may not take in the quantity and quality of feed they would have if unstressed, resulting in reduced weight gains at the end of the grazing season (Muhly et al. 2010a). On average, radio-collared cattle in mountainous grazing areas of western Idaho with moderate to high wolf presence traveled less (11.4 km per day) than cattle from areas of eastern Oregon without wolves (13.7 km per day). Unlike cattle in areas without wolves, cattle in areas with wolves also did not exhibit seasonal variability in movement rates. Reduced travel and lack of seasonal variation in travel distances may have been attributable to antipredator behaviors such as increased vigilance, tendency to remain in safer habitats and aggregation into larger less mobile groups (Laporte et al. 2010, Muhly et al. 2010a, Clark 2016). Ramler et al. (2014) compared calf weights between Montana ranches with and without exposure to wolves. There was no difference in calf weights between ranches that did and did not include wolf home ranges. Non-wolf factors such as climate and ranch specific livestock management accounted for the majority of differences among farms. However, on ranches experiencing confirmed wolf depredations, calves weighed an average of 22 pounds less than calves raised on ranches that did not experience wolf depredations with differences potentially attributable to reduced foraging time or stress to females with calves.

Harassment by predators may also cause livestock to become nervous or aggressive. Aggressive or nervous animals may hurt humans, and hurt or stress other cattle, diminishing their productivity. Reducing fear improves both welfare and safety for humans and animals (Grandin et al. 1998). Harassment and predation by wolves can also affect the way cattle respond to livestock handling dogs (Howery and DeLiberto 2004). Cows can also be stampeded through fences in response to wolf hunting/harassment. In addition to injuries sustained by cattle, there are associated costs (time spent fixing fences). Regrouping cattle after they have been stampeded is difficult, time consuming and stressful to the animals. Such efforts take time and money away from other commitments on the ranch, and increases in labor attributed to greater surveillance of pastures increases costs of production (labor, equipment and fuel), resulting in reduced economic returns as well (Lehmkuhler et al. 2007).

Keeping vulnerable animals close to barns and other areas of human activity has been recommended as a strategy to reduce risk of predation. However, this recommendation runs counter to current recommendations for herd health which include adhering to appropriate stocking rates and rotating pastures (Lehmkuhler et al. 2007). However, moving cattle too often results in increased stress and illness and poorer performance. In addition, keeping cattle by the buildings to avoid predators may result in increased exposure to pathogens (Lehmkuhler et al. 2007), and an increased need for supplemental feeding. Concentrating cattle in small areas may increase the risk of transmitting food-borne pathogens due to increases in bacterial populations around the cattle and immunosuppression due to the stress of crowding (Lehmkuhler et al. 2007). Recent research has shown that the prevalence of pathogens in the soil decreases with increasing distance from hay bale rings (Lenehan et al. 2005). It is also widely accepted that post-partum cows and newborn calves should be moved to "clean" pastures as soon as possible following parturition to decrease the risk of disease transmission (Lehmkuhler et al. 2007).

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

1.4.5 Wolf Conflict Management in Wyoming and WS-Wyoming Involvement in Wolf Conflict Management

Wolves can have both negative and positive ecological and social impacts in Wyoming (Wyoming Game and Fish Commission 2011). As wolf populations increase and expand their range, local decision makers must choose management strategies that balance competing needs to preserve the positive aspects of wolves while minimizing wolf conflicts and wolf-caused damage (Mech 2017). The Wyoming Game and Fish Commission (2011) seeks to maintain positive impacts of wolves while keeping negative economic impacts minimal and manageable. Control of offending wolves, improved livestock management practices (e.g., carcass management, fencing, etc.), compensation for losses, communication with the public and professional agency management, including establishment of management zones with varying emphasis on wolf protection and conflict management, have been suggested as means to enhance wolf recovery where wolf-livestock conflicts exist (Fritts et al. 1992, Niemeyer et al. 1994, Bangs et al. 2006, Mech 2017).

Management While Wyoming Wolves Were Protected Under the ESA
At the time of the reintroduction of NEP wolves to Central Idaho and YNP, the USFWS addressed the issue of depredating wolves in their 1994 10j rule [at 50 CFR 17.84(i) (3) (vii)] with this specific language: "All chronic problem wolves (wolves that depredate on domestic animals after being moved once for previous animal depredations) ***will*** [emphasis added] be removed from the wild (killed or placed in captivity)." Thus, even when there were relatively few wolves in Wyoming, the rules under which wolf reintroduction took place required mandatory removal of chronic depredating wolves after relocation had been attempted. The 1994 10j rule definition of a chronic depredating wolf involved relocation of depredating wolves if fewer than six breeding pairs occupied a NEP recovery area, but this approach has not been practiced anywhere in the NRM Recovery Area for many years, because relocation is no longer necessary to ensure viable wolf populations, and because most of the high quality wolf habitat is

already occupied by wolves. [response 12 accompanying the 2005 10j rule (70 FR 1286), provided further rationale for discontinuing relocation of depredating wolves.]

Following the issuance of the 1994 10j rules for management of the nonessential experimental (NEP) gray wolf population in the NRM, subsequent 10j rules (issued in 2005 and 2008) allowed increasingly greater flexibility for wolf management and provided for more aggressive management actions to deal with wolf depredations on livestock and other domestic animals for affected states or tribes with USFWS-approved wolf management plans (70 FR 1286, 73 FR 4720, 50 CFR 17.84 (n)). The Federal District Court Decision in effect from September 2014 to April 2017 vacated the USFWS decision to delist wolves and approval of the Wyoming state wolf management plan. During this period, only the Wind River Reservation had a USFWS approved wolf management plan that met USFWS requirements for the 2008 10j rules (50 CFR 17.84 (n) and for delisting wolves. However, the U.S. Court of Appeals for the District of Columbia reversed the lower Court's ruling on April 25, 2017, effectively restoring the USFWS approval of the Wyoming wolf management plan. Now that wolves are delisted, the Wyoming and Wind River Reservation wolf management plans are the primary documents guiding wolf management in the state.

During the period while wolves were federally protected under the ESA, WS-Wyoming cooperated with the USFWS and WGFD on wolf management. In 1997, a cooperative agreement was developed between USFWS and the APHIS WS Western Regional Office to help reduce wolf depredation in the Northern Rocky Mountains, which includes Wyoming. Assistance provided by WS-Wyoming also included confirmation of livestock losses needed for compensation and capture and radio-collaring of wolves for population monitoring and research. When WS-Wyoming received a report of suspected wolf depredation, or of wolves harassing/chasing livestock or livestock guarding animals, WS-Wyoming typically responded by sending a Specialist to conduct an on-site investigation within 48 hours of receipt of a complaint. Results of each investigation were documented and the incident classified as: 1) confirmed depredation, 2) probable depredation, 3) confirmed non-wolf depredation, and 4) unconfirmed depredation, based on criteria agreed upon by the USFWS and WS-Wyoming.

Management by the State, Tribes and Select Federal Agencies

At present, and during 2012-2014 when wolves were not protected under the ESA, the State of Wyoming and Native American Tribes have primary authority for wolf management. The National Park Service and U.S. Fish and Wildlife Service have additional authority for wildlife management on lands under their jurisdiction. The WGFD is the first responder for most reports of wolf damage in the WTGMA. WS-Wyoming provides occasional help as requested by WGFD in that zone (roughly 10% of requests for assistance). All WS-Wyoming WDM activities, including technical and operational WDM assistance in the WTGMA, are directed on a case-by-case basis by the WGFD. WS-Wyoming reports its verification of losses in the WTGMA to the WGFD on a Wyoming Game and Fish Department Livestock Affidavit. At the direction of WGFD, verification of losses for compensation in the WTGMA uses the standard of "more likely than not." The standard of "more likely than not" is roughly equivalent to the combined ESA classifications of "confirmed" and "probable." As was the case while wolves were protected under the ESA, WS-Wyoming may also capture wolves under the authority of the applicable managing agency or tribe to place collars on wolves for research, population monitoring, and location of depredating packs, if future actions are deemed necessary

Actions on tribal lands are handled in a manner similar to the WTGMA, with tribal authorities instead of WGFD as first responders who may, in turn, request assistance from WS-Wyoming (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and

Wildlife Service 2007). Unlike the WTGMA, no compensation from the State of Wyoming is available for livestock losses to wolves on tribal lands. The WRR authorizes WS-Wyoming to conduct WDM activities on lands at the perimeter of the reservation when working to address damage on adjacent properties.

In the Predatory Animal Zone, WS-Wyoming provides WDM assistance in accordance with agreements with the WDA and counties. In cooperating counties, WS-Wyoming is the first responder to requests for assistance with management of depredation by wolves. Wolf depredations are verified using the same criteria as in the WTGMA, but there is no compensation for wolf depredation on livestock. After being authorized to conduct WDM, WS-Wyoming uses the WS-Decision Model (Section 3.3.3) to develop site-specific management strategies including nonlethal and lethal methods. WS-Wyoming provides technical and operational assistance to the cooperator in implementing these strategies, as requested by the cooperator and allowed within the constraints of available resources. Similar to the WTGMA, WS-Wyoming may also capture wolves under the authority of the applicable managing agency or tribe to place collars on wolves for research, population monitoring and location of depredating packs if future actions are deemed necessary.

1.5 ECOLOGICAL AND SOCIAL BENEFITS OF WOLVES

There are many benefits associated with the presence of a healthy wolf population in its native ecosystem. These benefits are both ecological and social (economic, spiritual, and aesthetic). Plans to address conflicts with wolves must balance the desire to reduce damage and risks to human safety and the benefits derived from wolves.

1.5.1 Social Benefits of Wolves

Wildlife generally is regarded as a source of economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Direct benefits are derived from a user's personal relationship or direct contact with wildlife and may include both consumptive (e.g., using or intending to use the animal such as in hunting or fishing) and non-consumptive uses (e.g., observing or photographing animals, spiritual relationship, etc.)(Decker and Goff 1987). See also discussion of impacts on stakeholders in Section 2.3.5 and in Chapter 4 analysis of impacts on stakeholders for each of the alternatives.

Viewing wolves or hearing them howl in their natural habitat is a popular activity in certain areas and is considered to add value to many people's outdoor experience. Organized tours for the purpose of viewing wolves or hearing them howl are conducted at some U.S. and Canadian national parks such as Yellowstone (Wyoming), Denali (Alaska), Wood Buffalo (Alberta, Canada), and Riding Mountain (Alberta, Canada). Small or large group howling attempts can also be made in any area where wolves are known to be present. Such activities provide not only aesthetic viewing but there are also associated economic (tourism) benefits. A 2010-2012 survey of fishing hunting and wildlife-related recreation (United States Department of the Interior - United States Fish and Wildlife Service and United States Department of Commerce - Bureau of the Census 2014) estimated that there were approximately 518,000 wildlife-watching participants in the state (residents and non-residents combined) that contributed over $350 million to the Wyoming economy. In a 2005 survey of visitors to Yellowstone National Park, wolves were ranked second after grizzly bears as a species visitors would most like to see (Duffield et al. 2008). Visitors to National Parks contribute substantially to the economies of the surrounding communities (Cullinane and Koontz 2017).

Now that wolves are delisted, the WGFD permits harvest of wolves which also generates recreational opportunities for individuals as well as income for the state and local communities. In 2017, 2,527 licenses were sold for wolf harvest with 44 wolves taken in the WTGMA and an additional 33 wolves taken from the Predatory Animal Zone (Wyoming Game and Fish Department et al. 2018).

1.5.2 Importance of Wolves in Native American Culture and Beliefs

Wolves play an important role in Native American culture and beliefs. The exact nature of this relationship and role varies among tribes. An example of the role of wolves in tribal beliefs relevant to the proposed action was provided by the Northern Arapaho Tribal Historic Preservation Office (Yufna Soldier Wolf, Northern Arapaho Tribal Historic Preservation Office, pers. comm. 2/12/18).

> *Wolves played a vital role in our historic past for the Northern Arapaho. Before the introduction of the horse the wolf served as a mode of transportation carrying travois while migrating but they also were protectors, loyal friends and companions. For the Northern Arapaho the wolf goes back to the beginning of time. The role the wolves played during our migration of this land was beneficial to our survival and everyday living.*
>
> *The wolf was also a warrior society and of the utmost importance in medicinal values. The behavior and loyalty of the wolf were seen as virtues true within everyone in the tribe. It was believed that each person has a good and dark wolf inside them in order for them to survive. The wolf was observed in the wilderness for their hunting skills, their hierarchy and most of all their adaptive survival skills. When settlers came and annihilated the wolf the Arapaho knew they would soon be next. The creator said that one day man would inherit the earth but it is up to him to decide, if it would be the good or dark wolf which would prevail.*
>
> *"The importance of the wolf's teaching's needs to be listened to today. We cannot continue to look at nature as a separate entity but as an encompassing entity in which all humans live in today. If we as a society do not take care of the caretakers of the Mother Earth, we too shall diminish." "Like the wolf we are managed, like a resource". (Elder Mark Soldier Wolf) The teachings and values of the wolf are only natural and a part of nature. We all learn from one another, but ignorance of a teaching is unheard of. The Northern Arapaho's creation story includes the story of the Wolf and the Raven. This story has taught our tribe in how to continue in life when things get difficult. Without these teachings we would not be where we are today.*

The USFWS, WGFD and WS recognize the importance of wolves in tribal culture and will continue to work with individual tribes and Shoshone and Arapaho Tribal Fish and Game Department to try and address their concerns regarding WDM in the state. Specific measures to address tribal concerns are noted in Standard Operating Procedures presented in Section 3.6. WS-Wyoming will also work with the tribes on any new issues relative to WS-Wyoming's involvement in the implementation of the state wolf management plan.

1.5.3 Ecological Benefits

Impact on Disease in Prey Populations

Wolves are important predators of species including ungulates such as elk (*Cervus elaphus*)(Laundré et al. 2001, Wright et al. 2006), caribou (*Rangifer tarandus*)(Carbyn 1983, Fortin et al. 2005), moose (*Alces alces*) (Carbyn 1987, Gasaway et al. 1992), white-tailed deer (*Odocoileus virginianus*)(Latham et al. 2013), and mule and black-tailed deer (*Odocoileus hemonius*)(Darimont et al. 2004). Available data indicates wolves preferentially prey on older, younger, sick and injured individuals which can have a beneficial impact on prey population health (Mech 1970, Stronen et al. 2007, Mech et al. 2015a, Mech et al. 2015b). Predators and scavengers may also help to reduce risk of disease transmission by reducing prey population density, rapidly consuming potentially infected carcasses and other tissues (e.g., aborted fetuses). Reduction of disease in wild ungulates may also reduce the risk of disease transmission from wild ungulates and livestock (Stronen et al. 2007). However, the nature of the impact of wolves on disease in prey may vary depending on prey-selectivity, prey population dynamics, nature of the disease and other factors (Stronen et al. 2007).

Models of selective take by wolves have predicted reduced incidence of Chronic Wasting Disease, and its eventual elimination in closed systems where wolves were predicted to selectively remove infected deer (Wild et al. 2011). In a more realistic model of open systems, where infected animals entered from the surrounding area or where infection from environmental contamination occurred, reduction of the disease in prey populations was predicted to be slower and might not result in eradication of the disease from the population (Hobbs 2006). (Miller et al. 2008) and DeVivo et al. (2017) documented selective predation by mountain lions and coyotes on Chronic Wasting Disease positive deer, but neither provided evidence that predation was limiting Chronic Wasting Disease transmission, and the question of wolf impacts was not explicitly studied. The role of wolves in controlling Chronic Wasting Disease in cervid populations may be complicated by the potential for wolves to spread Chronic Wasting Disease prions in the environment through their feces in the same way as has been documented for coyotes (Nichols et al. 2015). Overlap between wolf populations and known cases of CWD in deer and elk are still in the early stages and field data are not yet available to assess the predictions of Wild et al. (2011). However, Chronic Wasting Disease continues to spread through Wyoming including into areas occupied by wolves (Wyoming Game and Fish Department 2019).

Brucellosis is a bacterial disease that primarily occurs in cattle, elk, bison and swine in North America. The disease can cause abortions, decreased milk production, weight loss, infertility and lameness in affected animals. It was originally introduced to the U.S. in cattle and was subsequently transmitted to wild elk and bison. A Brucellosis eradication campaign initiated in 1954 has eliminated the disease from almost all domestic cattle and bison in the U.S. The presence of brucellosis in free-ranging bison and elk in the Greater Yellowstone Area (GYA), Yellowstone National Park and Grand Teton National Park and the area around those parks, threatens the brucellosis status of the surrounding states and the health of their cattle and domestic bison herds, which are free of the disease (USDA APHIS 2018). In theory, wolves could aid in the reduction of Brucellosis in elk and bison through the same mechanisms discussed above for Chronic Wasting Disease.

Scavenger Use of Wolf Kills

Twelve different species of scavengers have been recorded using wolf kills in YNP and five visit virtually every kill and include coyotes, ravens (*Corvus corax*), magpies (*Pica pica*), golden eagles (*Aquila chrysaetos*) and bald eagles (*Haliaeetus leucocephalus*) (Wilmers et al. 2003b, Wilmers and Getz 2005). Spatially and temporally, carrion is more available to scavengers post-wolf introduction. However, if wolves reduce elk numbers, less total carrion might be available, but carrion more evenly distributed might compensate for any negative effect of reduced carrion biomass (Wilmers et al. 2003b). Besides avian scavengers, many mammals also scavenge wolf

kills. Black bears are subordinate to wolves at carcasses (Ballard et al. 2003), although lone wolves or young wolves can be at a disadvantage to large black bears. Grizzly bears benefit from wolf-killed prey throughout the year, whereas prior to wolf restoration, carrion was primarily only available in late winter (Wilmers et al. 2003a, Wilmers and Getz 2005). Carcasses may also be important to bears during fall when other food sources, such as whitebark pine nuts, fail or are scarce (Mattson 1997).

Invertebrate scavengers, plus indirect effects of wolf predation on flora and soil nutrients are important as well. (Sikes 1994) found 23,365 beetles in 445 species in two field seasons examining wolf-killed carrion. This likely underestimates the number of decomposers such as insects, mites, invertebrates, bacteria, and fungi, attending these carcasses (Hebblewhite and Smith 2005). In addition, even longer-term effects of carcasses are the localized nutrients they deposit (Bump et al. 2009).

Impact on Other Predators

Intra-guild predation by wolves on coyotes may have ecological consequences (Flagel et al. 2016b), such as the reduced coyote abundance noted for YNP . Wolf predation on coyotes also may release red foxes, which historically were less abundant in the absence of wolves (Newsome and Ripple 2015). Coyote population responses to the presence of wolves have included reduced survivorship (Berger and Gese 2007), increased vigilance in high wolf-use areas and while feeding or resting near wolf-provided carrion (Switalski 2003), and behavioral changes and avoidance (Arjo and Pletscher 1999). Shifts in prey selection by mountain lions have been noted for areas with recolonizing wolves, (Atwood et al. 2007, Kortello et al. 2007, Bartnick et al. 2013), as an apparent consequence of avoidance, as well as carcass loss and actual mountain lion mortality (Kortello et al. 2007). In addition, Cubaynes et al. (2014) reported intraspecific aggression among wolves in YNP, with density-dependence in that phenomenon possibly being related to prey densities in the Northern Region of the park, but not in the other area studied.

Indirect Impacts on Prey Populations, Vegetation and Trophic Cascades

Wolves may indirectly affect plant life because of changes to herbivore density and behavior. For example, elk have been reported to reduce their use of riparian areas where wolves are present in an apparent effort to reduce their risk of predation (Creel et al. 2005, Fortin et al. 2005, Mao et al. 2005, Beyer 2006, Gude et al. 2006, Ripple and Beschta 2006, Beschta and Ripple 2016). Research conducted in YNP suggests that aspen (*Populus tremuloides*) regeneration has increased as a consequence (Ripple et al. 2001, Ripple and Beschta 2004, Fortin et al. 2005, Ripple and Beschta 2007, Painter et al. 2014, Painter et al. 2015). Similar increases in willow (*Salix* spp.)(Beyer et al. 2007) and cottonwood (*Populus* spp.)(Ripple and Beschta 2003) have also been reported to have occurred due to this phenomenon. However, (Allen et al. 2017) raises important questions about many published studies that suggest that ecosystem health hinges upon individual large carnivore species and related management decisions, citing substantial flaws in study design, assumptions, and data collection and analysis. Key questions related to the effects of other large predators, the effects of beavers, and the complex behavioral ecology of elk in the presence of wolves remain to be answered before definitive conclusions can be drawn about the impacts of a single species over entire ecosystems (Smith et al. 2016).

As a result of predation-mediated release of vegetation, a variety of biota, including songbirds are benefitting (Baker and Hill 2003, Hansen et al. 2005). It has been hypothesized that a reduction in herbivore foraging pressure created by wolves would result in an increase in browse, providing for more songbird habitat, riparian restoration and stability, and an increase in the number of beavers (*Castor canadensis*). In addition, wolves prey on beavers (Fuller 1989, Tremblay et al. 2001), which as a keystone species (Naiman et al. 1986), also have impacts on forest and wetland

structure and dynamics, and trout and salmon habitat (D'Eon et al. 1995, Jensen et al. 2001, Curtis and Jensen 2004).

Active predators, especially those that roam over large landscapes, such as wolves, rarely produce consistent predation risks at any one location or in any one habitat type (Schmitz 2005). Given the high costs of prey anti-predator behavior (i.e., habitat avoidance, foraging reductions), prey of active-hunting predators may be relatively unresponsive to predators and thus unlikely to demonstrate risk-induced changes in foraging or habitat selection necessary to bring about "behaviorally mediated trophic cascade" changes (Lima and Bednekoff 1999, Schmitz 2005). Initially, elk responded to the reintroduction of wolves by increasing vigilance (Laundré et al. 2001). However, elk behavioral observations (i.e., patterns of vigilance, anti-predator movement, and risk of death) are consistent with the gradient of predation risk (Kauffman et al. 2010). For example, in response to wolf presence, elk have made short-term shifts away from habitat types that Creel et al. (2005) and Gude et al. (2006) classified as risky. But these anti-predator behaviors have not resulted in detectable shifts in broad scale, habitat use across YNP's Northern Range as observed from analyses of radio-collared elk before and after wolf reintroduction (Mao et al. 2005). Creel et al. (2008) showed that elk in YNP and in habitats adjacent to YNP responded to "risky times" but not "risky places," a pattern attributed to elk risk allocation strategies.

Elk in search of winter foods continued to forage on aspen trees and elk did not respond to a "landscape of fear" (i.e., the fear of wolf predation)(Kauffman et al. 2007, Kauffman et al. 2010). The elk did respond behaviorally to predation risk posed by wolves, but the small behavior changes to feeding and movements across the landscape did not translate to long-term benefits for aspen growing in areas risky to elk (Kauffman et al. 2010). In fact, Kauffman et al. (2010) did not find that the effects of wolf predation risk translate down to the aspen stands foraged by elk and their results are consistent with work evaluating elk behavioral responses to wolves (Gude et al. 2006, Liley and Creel 2007, Winnie Jr. and Creel 2007, Creel et al. 2008). In contrast, Kauffman et al. (2010) reported that aspen sucker survivorship was actually lower near the cores of wolf territories, likely due to wolves maintaining territories in areas of high elk density (Mao et al. 2005). In an analysis of elk movements, Fortin et al. (2005) found no evidence that elk avoid core wolf-use areas. What emerges from behavioral studies of elk and wolves is that, while elk do respond to the predation risks posed by wolves, their responses are subtle and, over the course of an entire winter, do not result in meaningful cumulative changes in habitat use (Kauffman et al. 2010). Annual variation in other factors such as wolf territory locations and pack sizes, snow levels, and elk distribution may further act to erode the spatial consistency in wolf predation risk and thus limit cascading impacts of predation risk (Fortin et al. 2005). A recent detailed evaluation of daily elk and wolf movement patterns and space use, provides some illumination relative to the apparent dichotomy of a strong anti-predator behavioral response by prey but limited ecological consequences of the prey response (Kohl 2018). The authors used fine-scale observations of elk diurnal movement patterns to show that elk adjusted their feeding locations to take advantage of risky places during times of the day when wolf activity was low. The authors concluded that this behavioral complexity may explain why predator avoidance responses in prey may have relatively weak ecological impacts in comparison to impacts associated with simple reductions in prey populations through direct killing by predators.

Kauffman et al. (2010) indicated that aspen stands exposed to elk browsing have not grown to heights necessary for them to be invulnerable to elk. Similarly, Rogers et al. (2015) reported that elk have suppressed aspen regeneration in northern Utah. Kauffman et al. (2010) also contended that aspen have not benefitted from the reported "landscape of fear" effect reportedly created by wolves, that claims of an ecosystem-wide recovery of aspen in the presence of wolves are

premature and unsubstantiated, and that landscape-level aspen recovery is likely only if elk numbers are further reduced.

On Isle Royale National Park in Lake Superior, balsam fir growth has been linked to wolf-moose interactions (McLaren and Peterson 1994). When wolves were relatively scarce, moose numbers grew, which led to depletion of balsam fir forage. It was observed that vegetation response followed moose response. When wolf numbers were higher, moose numbers were low and balsam fir growth increased (McLaren and Peterson 1994). These studies suggest that wolf recovery may present a management tool for helping to restore certain types of vegetation and to conserve biodiversity (Ripple et al. 2001, Ripple and Beschta 2004).

Since the 1990s, deer populations in much of northern Wisconsin have been above management goals, thus any predation by wolves may potentially reduce some of the negative effects of deer herbivory on native plant communities. Wolves also influence white-tailed deer impacts to forest regeneration and understory vegetation. For example, Flagel et al. (2016a) found that the presence of wolves reduced deer abundance and visit duration which in turn resulted in changes to forest composition over time. Differential use by wolves of core and edge portions of their territories cause deer to spend less time in the interior, and more time on the edge of wolf territories (Mech and Harper 2002).

In conclusion, there is evidence for direct and indirect effects of wolves in YNP (Hebblewhite and Smith 2005, Bartnick et al. 2013, Cubaynes et al. 2014, Beschta and Ripple 2016). Direct effects include limitation or regulation of elk by wolves, behavioral avoidance of wolves by elk, and competition with other carnivores. Indirect effects include the influence of wolves on willow and aspen growth, species that rely on these plants such as songbirds and beavers, and apparent competition between elk and alternate prey such as bison, moose, and caribou.

1.6 WYOMING STATE POLICIES GOALS AND PROCEDURES FOR GRAY WOLF MANAGEMENT

The WGFC and WGFD have developed a state wolf management plan (Wyoming Game and Fish Commission 2011;2012) which meets state goals and objectives and the USFWS requirements for preservation of a healthy and viable wolf population in Wyoming(Wyoming Game and Fish Commission 2011;2012). The WGFC and WGFD implemented the gray wolf management plan while wolves were federally delisted, from October 2012 to September 2014, and after April 2017 when the U.S. District Court of Appeals restored the USFWS decision to delist wolves in Wyoming and USFWS approval of the state wolf management plan in the issuance of a final rule in the Federal Register (82 FR 20284). Wyoming's plan establishes the framework for wolf management that provides for a recovered, stable, and sustainable wolf population that is connected genetically to other subpopulations of the NRM DPS (Wyoming Game and Fish Commission 2011;2012). The plan includes the requirement to reasonably ensure that there are at least 100 wolves and 10 breeding pairs in the area outside the WRR and YNP. The state is expected to manage for a wolf population above the minimum requirement because management at the minimum recovery level would pose a risk that management actions or biological factors could reduce the population below the minimum for delisting. Wolves in the WRR and YNP would also contribute to additional wolves above the minimum population objective (Wyoming Game and Fish Commission 2011;2012).

The state wolf management plan, which was approved by USFWS,-(Wyoming Game and Fish Commission 2011;2012) includes provisions for WGFD to collect, to the maximum extent practical, biological information, including genetic material, from all wolves that are killed by the public. Under

the state wolf management plan, WGFD will also monitor Wyoming's wolves using scientifically accepted methods[9] to determine the number of wolves and breeding pairs outside YNP and the WRR. The final plan includes provisions for: 1) maintaining a state wolf population of sufficient size to support the long term sustainability of state and regional wolf population; 2) providing opportunities for public harvest and using public harvest and agency control, when necessary, to reduce conflicts with livestock, ungulate herds[10], or humans; 3) maintaining a genetically viable wolf population; and 4) facilitating natural dispersal and genetic interchange within the NRM metapopulation by monitoring gene flow and genetic connectivity between subpopulations in the NRM. Wolf conservation measures will include, but are not limited to, revising genetics monitoring protocols, adjusting wolf management strategies to facilitate effective migrants, working with other states to promote natural dispersal into and within the GYA and, if necessary, relocating healthy, wild wolves between subpopulations.

1.6.1 Statewide WGFD Goals and Objectives

A detailed description of goals and objectives for wolf management in Wyoming can be found in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011) and its addendum (Wyoming Game and Fish Commission 2012).

1. Manage for a self-sustaining, viable wolf population that provides for a diversity of values and uses.
2. Manage wolves as part of the native resident wildlife resource.
3. Provide for interchange of resident wolves with wolves from adjacent states/provinces as part of a larger metapopulation objective.
4. Allow wolves to persist where they do not cause excessive conflicts with humans or human activities.
5. Manage wolf populations so that wolf numbers will not adversely affect big game populations or the economic viability of those who depend on healthy big game populations[13].
6. Minimize wolf conflicts and adverse impacts where they occur.
7. Establish a strong and balanced public education program.

1.6.2 Population Objectives

The USFWS wolf population recovery plan requires 30 or more breeding pairs (an adult male and an adult female that raise at least 2 pups until December 31) comprising 300+ wolves well-distributed between Montana, Idaho, and Wyoming functioning as a metapopulation (a population that exists as partially isolated sets of subpopulations) with genetic exchange (either natural or, if necessary, agency–managed) between subpopulations. This requires Montana, Idaho, and Wyoming to each maintain a population of at least 10 breeding pairs and at least 100 wolves at the end of each year. In order to ensure these minimum levels are never compromised, Montana and Idaho each are required to manage for a population minimum of at least 15 breeding pairs and at least 150 wolves at the end of the year.

Under delisted status, Wyoming must maintain no less than 10 breeding pairs and at least 100 wolves outside the WRR and YNP, with a number of wolves and breeding pairs above the minimum to ensure that the population does not inadvertently go below the minimum needed for

[9] The monitoring program will rely on accepted techniques using radio collars (both VHF and GPS) and aerial surveys. Monitoring and population status information will be published annually and provided to the USFWS and made available to the public.

[10] WGFD plans and research include monitoring and response to potential adverse impacts of wolves on wild ungulate populations, but WS is not proposing to become involved in WDM for game species population protections at this time.

recovery (Wyoming Game and Fish Commission 2011;2012). In addition, state statute authorizes the WGFC to establish regulations to allow public harvest in designated areas when the wolf population is sufficient to sustain harvest. When developing or recommending wolf hunting seasons, the WGFD will consider the following: 1) wolf breeding seasons; 2) short and long range dispersal opportunity; 3) survival; 4) success in forming new or joining existing packs; 5) current year and average mortality; 6) conflicts with livestock; and 7) the broader game management responsibilities related to ungulates and other wildlife. Hunting of wolves may be promoted in areas with conflict as well (Wyoming Game and Fish Department, personal communication, 11/20/2018). WHAs will be small enough to direct harvest toward wolves in specific areas while managing harvest to maintain at least the minimum wolf population.

Wolves that occupy areas outside the WTGMA are designated as predatory animals, and the state does not regulate the killing of wolves in those areas [Wyoming Statute 23-1-302(a)(ii)]. Unlike other trophy game species, the state wolf management plan prohibits the WGFC from establishing zones and areas within the WTGMA in which wolves may be taken as a predatory animal [Wyoming Statute 23-1-302(a)(ii)]. WGFD has no authority over wolves designated as predatory animals, but will, to the maximum extent practical, acquire genetic samples from wolves killed as predatory animals.

1.6.3 Population Monitoring

When wolves were protected as a nonessential experimental population under the ESA, the USFWS was responsible for monitoring the wolf population. Now that wolves are delisted, the WGFD and tribal authorities are responsible for monitoring all occupied habitat outside YNP, Grand Teton National Park (GTNP), the National Elk Refuge (NER), and the WRR. The National Park Service monitors wolves inside YNP (Wyoming Game and Fish Commission 2011) and GTNP; the USFWS Lander Fish and Wildlife Conservation Office and Shoshone and Arapaho Tribal Fish and Game Department monitor wolves on the WRR (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007); and the USFWS monitors wolves on the NER. The agencies have agreed to share information regarding wolf population status, cause-specific mortality events, depredation statistics, genetics monitoring, and other pertinent wolf information from within their respective jurisdictions.

1.6.4 Wolf Mortality

Average annual wolf mortality rates in unexploited populations can be 45% for yearlings, and 10% for adults (U.S. Fish and Wildlife Service 1994). However, human-caused mortality is the major factor in most wolf populations (Fuller 1989). Human-caused mortality includes legal and illegal harvest, agency management, vehicle accidents, and research-related mortalities such as capture myopathy. An important component of Wyoming's proposed WDM activities will be to adequately monitor human-caused mortality and all forms of known wolf mortality will be considered when making management decisions.

Of 363 wolf death reported by Smith et al. (2010) in the northern Rocky Mountains during 1982–2004, legal lethal control accounted for 30% of overall mortality, while illegal take (24%), natural causes (12%), accidents and strife (21%) and unknown (12%) causes accounted for the rest. Diseases and parasites have the potential to impact wolf population distribution and demographics (Mech et al. 2008, Almberg et al. 2009). Wolf population monitoring by WGFD will identify and track wolf mortality caused by diseases and parasites.

1.6.5 Research:

Past research conducted by the WGFD or their partners has focused on obtaining information that will help meet wolf population objectives, address potential impacts on ungulates, improve survey techniques, and manage wolf-related conflicts. Future research priorities are expected to include improving techniques to assess the status of the wolf population, including assessment of gene flow and genetic viability. Future research is also likely to include investigation of wolf habitat use patterns, prey selection and consumption rates, pack and territory sizes, age and rate of dispersal, gene flow, population growth rate, responses to hunting, and mortality factors. Research on wolf/wildlife interactions would be focused in areas of the state where wildlife may be most impacted by wolf predation, such as on elk feed-grounds and crucial wintering areas for ungulates.

1.6.6 Genetics/Connectivity

The genetic connectivity requirements for delisting wolves state that the NRM recovery areas must be functionally connected through emigration and immigration events, resulting in the exchange of genetic material between subpopulations. This relationship is consistent with the biological intent of the recovery plan and is an underlying prerequisite for successful wolf recovery in the NRM.

Designation of specific habitat linkage zones or migration corridors is impractical for a habitat generalist and highly mobile species like the wolf (Fuller et al. 2003). Outside refuges such as national parks, legal protection across broad landscapes and public education will facilitate those connections (Forbes and Boyd 1997). YNP and wilderness areas function as refuge throughout the geographic distribution of wolves in the NRM. The network of public lands in western Montana, central Idaho, and northwest Wyoming facilitate connectivity between the subpopulations. The legal protections and public outreach described in the Wyoming gray wolf management plan (Wyoming Game and Fish Commission 2011) preserves the integrity of wolf movement between the GYA subpopulation and other subpopulations in the NRM. Specific linkage corridors are not needed within Wyoming, because the wolf population inhabits one contiguous block in northwest portion of the state.

The WGFD recognizes dispersing wolves will travel through some habitats that are unsuitable for long-term occupancy due to high conflict potential. The majority of these areas will be outside of the WTGMA where the WGFD has no management authority. Public education efforts will emphasize that lone wolves sighted in previously unoccupied habitat may be dispersing animals, and that these sightings do not necessarily mean a pack is forming in any particular area.

The WGFD is committed, to the extent practical, to ensuring that genetic diversity and connectivity issues never threaten the GYA wolf population (Wyoming Game and Fish Department et al. 2012). This will be accomplished by encouraging migration into the GYA wolf population. Conservation measures will include, but not be limited to, working with other states to promote natural dispersal into and within various portions of the GYA, if necessary by relocation or translocation of healthy, wild wolves in order to promote genetic diversity. The WGFD will coordinate with the USFWS, Montana, and Idaho to develop protocols to monitor genetic connectivity and viability of the NRM wolf population and assess whether genetic connectivity goals are being met. If the desired level of genetic connectivity is not being achieved, the WGFD will consult with the USFWS, Idaho and Montana to identify measures such

as translocation or other management techniques necessary to completely resolve the issue (Wyoming Game and Fish Department et al. 2012).

1.7 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

1.7.1 Final EIS on the Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho

The USFWS issued a Final EIS (U.S. Fish and Wildlife Service 1994) and ROD regarding the potential impacts of reintroducing wolves to YNP and Central Idaho. U.S. Fish and Wildlife Service (1994) and 50 CFR 17.84 provide guidance on when, where, and how gray wolf conflict management may be conducted. Part of the analysis in the EIS assessed potential impacts of a fully-recovered wolf population on livestock, ungulate populations, and hunter opportunity. The EIS also assessed the anticipated impact of wolf removals for protection of livestock. Any decision made because of the WS-Wyoming EA process would be consistent with that guidance, if applicable.

1.7.2 Endangered and Threatened Wildlife and Plants; Final Rule to Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife.

In 2009, the USFWS defined the NRM distinct population segment to include Idaho, Montana, Wyoming, the Eastern 1/3 of Washington and Oregon, and portions of north-central Utah (74 FR 15123). It also determined that the wolf population in the NRM DPS had met recovery goals and that protection under the ESA was no longer warranted in the DPS except in Wyoming where the existing management plans and regulation did not provide adequate regulatory mechanisms for purposes of the Act. This decision was later overturned by a U.S. Federal Court in August 2010.

1.7.3 Endangered and Threatened Wildlife and Plants; Reissuance of Final Rule to Identify the Northern Rock Mountain Population of Gray Wolves as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife.

Consistent with Congressional direction, in 2011 the USFWS reissued the final rule defining the NRM distinct population segment and delisted gray wolves in Idaho, Montana, the eastern portions of Washington and Oregon, and a small part of north-central Utah because threats have been reduced or eliminated (76 FR 25590). The decision retained NEP status and associated protections for wolves in Wyoming.

1.7.4 Endangered and Threatened Wildlife and Plants; Removal of the Gray Wolf in Wyoming from the Federal List of Endangered and Threatened Wildlife and Removal of the Wyoming Wolf Population's Status as an Experimental Population.

In 2012, the USFWS determined that adequate management and regulatory mechanisms were in place in Wyoming and that further protection as a NEP population under the act was no longer warranted (77 FR 55530). This Decision was vacated by a U.S. federal court in September 2014.

1.7.5 Endangered and Threatened Wildlife and Plants; Reinstatement of Removal of Federal Protections for Gray Wolves in Wyoming.

In 2017, the USFWS issued this rule to comply with a court order that reinstated the removal of federal protections for the gray wolves in Wyoming under the Endangered Species Act of 1973, as amended (82 FR 20284).

1.7.6 Environmental Assessment for Proposed Revision of Special Regulation for the Reintroduction of Gray Wolves into the Central Idaho and Yellowstone Areas (The latest 10j Rule)

The United States Fish and Wildlife Service issued a Final EA and Decision in January 2008 on proposed changes to the 2005 10j rule [50 CFR 17.84(n)] which would allow greater flexibility in managing wolves shown to have an unacceptable adverse impact on ungulate populations(United States Fish and Wildlife Service 2008b). The USFWS EA assessed the ecological and other impacts related to the potential increase in take of wolves for protection of ungulates and domestic dogs. The changes only applied to states and tribes with USFWS-approved wolf management plans, and did not apply to the WYO during the period of 2014-2017 when a federal court decision vacated the USFWS approval of the State wolf management plan (Wyoming Game and Fish Commission 2011;2012).

1.7.7 Wyoming Gray Wolf Management Plan

The decision by the USFWS to approve the most recent version of the Wyoming wolf management plan (Wyoming Game and Fish Commission 2011) was vacated by a Federal Court in 2014, but on March 3, 2017 this ruling was overturned and wolves were once again delisted in Wyoming. That ruling restored the USFWS approval of the 2011 Wyoming Gray Wolf Management Plan and 2012 amendment. The plan establishes the framework for wolf management in Wyoming and provides for a recovered, stable, and sustainable population of wolves that is connected genetically to other subpopulations of the NRM DPS. The goal of the Wyoming gray wolf management plan is to ensure the long-term survival of wolves in Wyoming while minimizing wolf conflicts that result when wolves and people live in the same vicinity (Wyoming Game and Fish Commission 2011). Any subsequent state plan will reflect the need for maintaining a genetically viable wolf population, and facilitation of natural dispersal and genetic interchange within the NRM metapopulation (Figure 1-1). This EA will be reviewed and supplemented, as needed, for consistency with any subsequent state plan updates. All WS-Wyoming wolf management actions included within the Proposed Alternative in this EA would be implemented in a manner consistent with the provisions of the Wyoming Gray Wolf Management Plan.

1.7.8 Addendum: Wyoming Gray Wolf Management Plan

A peer reviewed report on the Wyoming Gray Wolf Management Plan identified several areas in the state plan where additional information or clarification was warranted. The 2012 (Wyoming Game and Fish Commission 2012) addendum was prepared to address these needs, and provides details on how the state would maintain additional wolves above the minimum population needed for delisting, the role of adaptive management in Wyoming wolf management, provisions for genetic monitoring, and monitoring mortality in wolves.

1.7.9 Categorical Exclusion Records (CEs) for WS Wolf Conflict Management in Wyoming

In addition to the above-described EAs, WS-Wyoming prepared CE records in 2008-2017 for wolf conflict management to be conducted at the request of the USFWS or WGFD, where wolf

monitoring was desired and wolf predation on livestock had occurred. These documents analyzed the potential impacts of wolf removals expected to occur as a result of WS-Wyoming response to depredations on livestock. These analyses indicated that expected wolf management actions would cause no significant impacts on Wyoming's wolf population, or on the populations of any nontarget species.

1.7.10 Memorandum of Understanding (MOU) Between WS and the Wyoming Animal Damage Management Board

This document outlines the roles and responsibilities of WS-Wyoming and the Wyoming Animal Damage Management Board in dealing with a variety of wildlife damage problems in Wyoming, including wolf conflicts. Any actions conducted under either the Current or Proposed Alternative would be consistent with the guidance in this MOU or any updated version of the current MOU. The current MOU was signed in 2013, but this document has been revised several times over the years by mutual agreement to most effectively facilitate responses to wildlife damage problems in Wyoming.

1.7.11 USFS Land and Resource Management Plans (LRMPs)

USFS has LRMPs, or "Forest Plans," for their National Forests. WS, under a national MOU, has authority to conduct wolf management for the protection of private resources on their lands and is responsible for NEPA compliance. The USFS provided review of this EA to help ensure the alternatives included adequate provisions to ensure that WS-Wyoming actions on USFS lands are consistent with applicable LRMPs and other applicable agency policies and procedures. WS-Wyoming, USFS, and WGFD have annual work plan meetings to discuss management actions that are anticipated on each USFS National Forest (Caribou-Targhee NF, Bridger-Teton NF, Shoshone National Forest, Bighorn National Forest, Medicine Bow-Routt NF, Black Hills NF, and Thunder Basin National Grassland), with the exceptions of Wasatch-Cache National Forest and Ashley National Forest. WS-Wyoming does not conduct WDM on the Ashley National Forest. In the future, WS-Wyoming may conduct WDM activities on the Wasatch-Cache National Forest. Prior to any WDM activities occurring on the Wasatch-Cache National Forest an annual work plan would be developed, and annual work plan meetings would occur. During these meetings, USFS identifies anticipated activities that may be inconsistent with their LRMP and other special land and resource use considerations (e.g., shifts in recreational activity, known locations of T&E species). Any inconsistencies would be identified and resolved before a WDM project was conducted on a National Forest (e.g., by restricting or adjusting WDM strategies in the area of concern).

1.7.12 BLM Resource Management Plans/Environmental Impact Statements (RMP/EISs)

The BLM uses RMPs to guide land use decisions and management actions on specific properties they administer. Any decision made as a result of this EA process will be consistent with guidance in these RMPs. In Wyoming, WS-Wyoming 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-Wyoming actions are consistent with the RMPs for their district (https://www.blm.gov/programs/planning-and-nepa/plans-in-development/wyoming) and any additional information on other special land and resource use considerations (e.g., shifts in recreational activity, known locations of T&E species)

applicable to WDM decisions. Any inconsistencies would be identified and resolved before a WDM project was conducted on BLM lands,

1.7.13 Interagency Grizzly Bear Committee Guidelines

The Interagency Grizzly Bear Committee Guidelines (United States Forest Service 1986) address when and how management of nuisance and depredating grizzly bears would occur and defines agency roles and responsibilities. Any decision arising from this EA process would be consistent with the 1986 guidelines.

1.7.14 WGFD Wildlife Management Plans

WGFD has prepared strategic plans for big game and game birds, and management plans for black bear and mountain lion. These plans outline the management goals, objectives, strategies and methodologies for these species, and as other plans are developed, the EA would be reviewed to ensure consistency with the objectives of these species management plans.

1.7.15 Proposal to Permit Take as provided under the Programmatic Environmental Impact Statement (PEIS) for the Eagle Rule Revision

Developed by the USFWS, the PEIS (United States Department of the Interior - United States Fish and Wildlife Service 2016) evaluated the potential impacts to the human environment that may result from implementation of proposed revisions to permit regulations that authorize take of bald and golden eagles and eagle nests pursuant the Bald and Golden Eagle Protection Act (16 USC 668-668d). The alternative selected in the 2016 Record of decision provides a mechanism for limited 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 incidental to otherwise lawful activities (United States Department of the Interior - United States Fish and Wildlife Service 2016). The USFWS published a Final Rule implementing the Record of Decision on December 14, 2016 (81 FR 91494-91554).

1.8 DECISION TO BE MADE

Based on agency relationships, MOUs and legislative direction, WS is the lead agency for this EA and, therefore, responsible for the scope, content, and decisions made. The WGFD and USFWS were cooperating agencies in the preparation of the EA. WS-Wyoming also consulted with USFS, BLM, WDA, and Northern Arapaho Tribe. The WGFD, USFWS, and consulting agencies had the opportunity to provide input during preparation of the EA to ensure an interdisciplinary approach in compliance with NEPA and agency mandates, policies and regulations.

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

- Should WS-Wyoming work with the WGFD and WDA to provide coordinated WDM assistance to alleviate damage to agriculture, property, and human health and safety? If so, what kind of alternative should be implemented?
- Would the proposed action have significant impacts on the quality of the human environment and, therefore, require preparation of an EIS?

1.9 GOALS AND OBJECTIVES

The goal of the proposed project is to conserve wolf populations while protecting livestock, other domestic animals, and human health and safety in Wyoming, as requested and authorized by the WDA WGFD, and Tribes. The following objectives were developed to achieve the overall project goal:

- The proposed action must not jeopardize the recovery of the state or regional wolf population.
- Management actions should not have significant adverse effects on nontarget species populations.
- Wolf damage management activities must be conducted in accordance with authorities provided by the USFWS, WGFD, WDA, Tribes and applicable federal, state, and local regulations.
- Wolf conflict management strategies should include a range of damage management techniques that allow for development of site-specific plans to effectively reduce damage and conflicts with wolves, meet landowner/manager objectives for site use, and minimize potential for adverse environmental impacts.
- WDM assistance should be provided by personnel trained and qualified in wolf damage management.
- There should be a system for monitoring the effect of management actions and cumulative impacts on the wolf population.

1.10 SCOPE OF THIS ANALYSIS

1.10.1 Actions Analyzed

This EA evaluates alternatives for WS-Wyoming involvement in wolf conflict reduction to protect agriculture, human and animal health and safety and property in cooperation with the WGFD, USFWS and the other cooperating agencies [11]. Prompt, professional response to wolf conflicts would maintain and enhance local tolerance and acceptance of wolves (Fritts and Carbyn 1995, Mech 1995, Boitani 2003, Fritts et al. 2003). Any direct action taken by WS-Wyoming to address wolf conflicts would be conducted at the request of the responsible management agency (the WGFD, WDA or Predator Management Districts in this case) or a specific tribe and in accordance with established management plans for gray wolves. It should be noted that these entities could implement WDM on their own or contract for WDM assistance from entities other than WS-Wyoming. WS-Wyoming has no authority to regulate the management decisions made by the WGFD, WDA or Predator Management Districts and content and policies established by these entities is outside the scope of this EA.

1.10.2 American Indian Lands and Tribes

Wolves play an important role in some tribal cultures and beliefs, but the exact nature of this relationship varies among tribes. WS-Wyoming recognize the importance of wolves in tribal culture and will continue to work with individual tribes in an attempt to address their concerns

[11] Tribal wolf management decisions are outside the scope of this analysis and decisions made in this EA do not alter the tribes' authority or rights relating to wolf management. However, this analysis does include the types of assistance WS may offer the tribes, if requested.

regarding wolf conflict reduction in Wyoming. Currently, WS-Wyoming has an MOU with the Eastern Shoshone and Northern Arapaho Tribes to conduct conflict management activities. WS-Wyoming would only conduct wolf conflict management on tribal lands at the request of the tribe. Non-Indian-owned fee title lands within the Wind River Reservation would be subject to the WGFD management plan and relevant laws and regulations.

1.10.3 Resources Not Currently Protected by WS Wolf Damage Management

WS-Wyoming only conducts WDM activities on a small percentage of properties in Wyoming. However, wolves are highly mobile, and the range of wolves continues to slowly expand into new areas. Because the proposed action is to reduce conflicts, and because WS's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional management efforts could occur. The EA anticipates this potential expansion and analyzes the impacts of such efforts (See also Section 1.10.5 regarding site specificity).

The WGFD has expressed interest in WS-Wyoming assistance with wolf conflict management to reduce impacts on prey species (including ungulates), however this type of WDM has not been included in the need for action of this EA. WS-Wyoming would prepare additional analysis pursuant to CEQ and APHIS NEPA implementing requirements before undertaking involvement in this type of WDM.

1.10.4 Period for which this EA is Valid

If it is determined that an EIS is not needed, this EA will remain valid until WS-Wyoming identifies potential changes in impacts or issues which would warrant revision of the analysis, in accordance with the NEPA and Council of Environmental Quality, and APHIS NEPA implementation regulations.

This EA was originally prepared to address potential WS WDM actions in Wyoming, both while wolves were federally protected as a NEP population and after delisting, when primary management authority was transferred to the WGFD, tribes and land management agencies. Wolves in Wyoming were delisted in May, 2017. This final EA retains some information on wolf management practices while wolves were federally protected for reference to aid agency decision-makers and the public in understanding the similarities and differences between proposed practices and past management activities.

1.10.5 Site Specificity

This EA analyzes the potential impacts of WS-Wyoming wolf conflict management on all public, private, and tribal lands in Wyoming under MOU, Cooperative Agreement, and in cooperation with the WGFD and other cooperating management agencies.

This EA emphasizes major issues as they relate to specific areas whenever possible; however, many issues apply wherever wolf conflict, or potential wolf conflict, occurs and management actions are taken. WS personnel use the WS Decision Model (Slate et al. 1992) as the *"on the ground"* site-specific procedure for handling each damage management action conducted by WS. The Decision Model is a thought process that guides WS though the analysis and development of the most appropriate individual strategy to meet the need for action while minimizing risk of detrimental environmental effects from conflict management actions (see Chapter 3, Section 3.3.3 for a description of the Decision Model). The Decision Model (Slate et al. 1992) and WS

Directive 2.201 describe the site-specific thought process that is used by WS. Decisions made using the model would be in accordance with plans, goals, and objectives of WS, USFWS, and WGFD, and any protective measures described herein and adopted or established as part of the decision.

We analyzed the impacts of current WDM activities, and the other alternatives in this EA, against the issues that were raised. These issues were analyzed at levels that are *"site specifically"* appropriate. Wyoming has two primary management zones for wolves, and a relatively small area where status of wolves is split between the two zones, depending on season. Authority for wolf management, wolf management objectives, and regulations pertaining to WDM vary between the two zones. Where appropriate, the analysis of impacts is split to address differences between the two wolf management zones.

Determining effects requires that WS look at the *context* of the issue and *intensity* of the action. Wolf packs can range over a large area that includes different land ownerships and political boundaries. Damage management actions are conducted in specific areas likely to be used by individual wolves or wolf packs. These areas comprise a much smaller portion of the total range of wolves. Wildlife biologists/managers from WS, WGFD, and the other cooperating agencies analyzed effects of management actions on wolf populations, understanding that the damage situation with wolves may change at any time in any location because wildlife populations are dynamic and mobile.

Planning for the reduction of wolf conflicts is conceptually similar to federal or other agency actions whose missions are to stop or prevent adverse consequences from anticipated future events, for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, insurance companies, etc. Although some of the sites where wolf conflicts will occur can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. The high degree of variability in the level of WDM work conducted in each zone and the relatively low level of damage recurrence (defined as cooperators requesting WS-Wyoming assistance in 3 or more of the last 6 years), and lack of much of the necessary wolf population and WDM information at a smaller geographic scale, precludes a highly site-specific analysis. For example, only 3% of cooperators in the WTGMA and 8% of cooperators in the Predatory Animal Zone had recurring conflicts with wolves. Even within zones, the extent of WDM work that may be conducted from year to year can vary widely with the number of WS-Wyoming hours worked in the WTGMA, ranging from 16 to 71% of all WS-Wyoming WDM work hours over the period of 2013-2014 and 2016-2017.[12] Consequently, the analyses in this EA are intended to apply to any action that may occur *in any locale* and at *any time* within each of the two wolf management zones in Wyoming. As noted above, this EA emphasizes major issues as they relate to specific areas whenever possible; however, many issues apply wherever wolf conflicts and resulting management actions occur, and are treated as such. In this way, WS-Wyoming believes the EA meets the intent of NEPA with regard to site-specific analysis and that this is the only practical way for WS-Wyoming to comply with NEPA and still be able to meet needs for assistance with WDM in a timely fashion.

In summary, we have prepared an EA that uses the best available data and conforms to state and federal regulation and policy to analyze the potential impacts from the alternatives. Thus, the EA addresses substantive environmental issues pertaining to wolf conflict management in context of

[12] Data not available for 2015.

state management practices and regulations, and the scale of available data applicable to the analysis(Slate et al. 1992)

1.11 SUMMARY OF PUBLIC INVOLVEMENT

Issues related to the proposed action were initially developed by WS, USFWS, WGFD and the other cooperating agencies based on an awareness of issues that have previously been raised regarding predator damage management in general, and wolf conflicts in particular in Wyoming and nearby states. As part of the WS environmental analysis process, and as required by the Council on Environmental Quality (1981) and APHIS-NEPA implementing regulations, this document was made available to the public through "Notices of Availability" (NOA) published in the *Wyoming Tribune Eagle*, on the WS NEPA webpage; the federal rulemaking portal (http://www.regulations.gov/#!docketDetail;D=APHIS-2015-0029); email notices to entities who have registered for WS announcements (https://public.govdelivery.com/accounts/ USDAAPHIS/subscriber/new), and mailings to additional entities within the state and elsewhere who had requested print notification. The EA was made available for public comment from October 23 –November 25, 2015. The public notification process regarding the availability of a final EA and Decision will be identical to that used for the public comment period on the EA.

1.12 PREVIEW OF THE REMAINDER OF THIS EA

The remainder of this EA is composed of six Chapters and five Appendices. Chapter 2 discusses the issues considered in detail for each alternative, issues not analyzed in detail, and the affected environment. Chapter 3 describes each alternative, alternatives not considered in detail, specific damage management methods and Protective Measures for wildlife conflict management techniques. Chapter 4 analyzes the environmental impacts associated with each alternative considered in detail. Chapter 5 provides a list of issues raised in public comments on the EA and agency response to issues. Chapter 6 is a list of preparers, consultants and reviewers. Appendix A contains a copy of the depredation investigation form and describes criteria for classification of reported depredation incidents, Appendix B discusses the legal authorities of federal and state agencies and several relevant laws and Executive Orders. Appendix C is a discussion of Wielgus and Peebles (2014) "Effects of wolf mortality on livestock depredations". Appendix D lists the literature cited in the preparation of this document is a discussion of Wielgus and Peebles (2014) "Effects of wolf mortality on livestock depredations" and Appendix E provides details on potential management actions that may be conducted on federal or state lands.

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES IDENTIFIED AND EVALUATED IN THE EA

2.1 INTRODUCTION

Chapter 2 contains a discussion of the issues relevant to the analysis, including issues that received detailed environmental impact analysis in Chapter 4 (Environmental Consequences) and issues not considered in detail, with rationale. The identified issues have been or could be concerns to the public and/or professional communities regarding the environmental impacts of wolf conflict management activities. Issues relating to the reduction of wolf damage were identified based on comments provided on similar analyses for wolf damage and conflict management in Montana, Idaho, and Wisconsin (United States Department of Agriculture - Animal and Plant Health Inspection Service - Wildlife Services 2008;2011, USDA APHIS Wildlife Services et al. 2012, USDA APHIS Wildlife Services 2013) and during the interdisciplinary approach used in preparing this EA.

Pertinent portions of the affected environment are included in the discussion of issues to be addressed in detail. Additional information on the affected environment is incorporated into the discussion of the need for action and the benefits of wolves in Chapter 1, the description of issues in Chapter 2, descriptions of current conditions in Chapter 3, and the analysis of impacts of Alternative 1 in Chapter 4.

2.2 AFFECTED ENVIRONMENT

2.2.1 Wolf Habitat in the NRM and Wyoming

Historically, wolves in North America were well distributed and considered habitat generalists. They occurred in oak (*Quercus* spp.) savannah habitats of Mexico, prairies of the Great Plains, the Rocky Mountains, and the forest and tundra regions of the U.S. and Canada. The persistence of wolves in an area is primarily dictated by the availability and quality of habitat for its prey, although land use (e.g., agriculture, housing) and societal tolerance for wolves are also factors. Availability of suitable habitat for denning is of secondary importance.

Wolves historically occurred throughout the NRM; however, much of their historical range has been modified for human use (i.e., housing, roads, industry, and agriculture). The vast majority of current suitable wolf habitat and associated wolf populations are secure in mountainous forested federal public land (National Parks, wildernesses, roadless areas, and on some lands managed for multiple uses by the USFS and Bureau of Land Management) that is off limits or unsuitable for intensive levels of human development (United States Fish and Wildlife Service 1993;1996, Servheen et al. 2003, United States Fish and Wildlife Service 2007a, United States Forest Service 2009). The ranges of wolves and grizzly bears overlap in many parts of Wyoming and the GYA, and mandatory habitat guidelines for grizzly bear conservation on public lands guarantee, and exceed, necessary criteria for maintaining suitable habitat for wolves (United States Forest Service 2009). Wolves are currently well distributed from the Canadian border, south through Wyoming, and from the Washington and Oregon borders east into Montana and Wyoming. Of the 38 known wolf packs present in Wyoming at the end of 2011, home ranges of most were predominantly on USFS lands (Figure 1-1) (Jimenez 2012).

The USFWS used two models to identify wolf habitat (Carroll et al. 2006, Oakleaf et al. 2006), which predicted different amounts of theoretically suitable wolf habitat in the NRM. Habitat quality for wolves was based on adequate prey and security from excessive human-caused

mortality. The NRM Recovery Area (United States Fish and Wildlife Service et al. 2015) occupied by persistent wolf packs was determined by circumscribing a line around the outer points of radio-telemetry locations of all known wolf pack territories in 2006 (United States Fish and Wildlife Service et al. 2007). The overall distribution of wolf packs within the NRM Recovery Area was similar over the period of 2000 to 2014, despite a wolf population that increased by >300% (United States Fish and Wildlife Service et al. 2001, United States Fish and Wildlife Service et al. 2015). Although there has been some increase in range in Wyoming in recent years and the density of packs and the habitat occupied by persistent wolf packs fluctuates (U.S. Fish and Wildlife Service et al. 2017). In addition to the NRM Recovery Area, the western gray wolf population has been gradually colonizing areas in surrounding states including Washington, Oregon and Northern California (U.S. Fish and Wildlife Service et al. 2017).

Wyoming has a diverse landscape, ranging from high mountains to high deserts. Almost half of the state is public land, much in vast contiguous tracts. Carroll et al. (2006) ranked 29,808 mi^2 (77,202 km^2) in Wyoming as suitable habitat; approximately 30% of the state. The GYA is considered suitable wolf habitat because of large populations of natural prey and low potential for wolf conflicts (Wyoming Game and Fish Commission 2011). Outside of the GYA, much of the wolf's historical range within Wyoming has been modified for human use with land ownership and human use patterns resulting in varying levels of potential conflict with wolves. Eastern Wyoming is predominantly private agricultural land. While lone wolves can travel through, or temporarily live, almost anywhere (Jimenez et al. 2011), much of Wyoming is no longer suitable habitat for wolf packs and breeding pairs (Carroll et al. 2006, Oakleaf et al. 2006).

The GYA, which includes portions of Wyoming, is one of the last remaining large, nearly intact ecosystems on Earth; it encompasses an area of 19,000,000-20,000,000 acres, and includes Yellowstone and Grand Teton National Parks as well as a variety of surrounding federally managed lands in Montana, Idaho and Wyoming. A small portion of privately held lands is encompassed in the GYA as well, and the GYA provides secure wolf habitat and abundant ungulate populations (U.S. Fish and Wildlife Service 1994) and lands are not available for development due to their land-use classifications, management guidelines for other species (i.e., grizzly bears, Canada lynx), habitat, access, and geological characteristics (United States Fish and Wildlife Service 1993;1996, Servheen et al. 2003, United States Forest Service 2006, United States Fish and Wildlife Service 2007a). Thus, these areas will continue to provide suitable habitat for a resident wolf population and will be a dependable source of dispersing wolves to help maintain a viable wolf population in the NRM and Wyoming (U.S. Fish and Wildlife Service 1994)(76 FR 61782). State regulatory mechanisms in Wyoming and federal land management practices/guidelines restrict the location and extent of development on public lands, and these activities are not expected to substantially impact prey or wolf security ((United States Forest Service 2006), 76 FR 61782).

At the end of 2010, "occupied areas" (including both pack-occupied areas and unsuitable areas between core recovery segments used only for dispersal) were estimated at approximately 18,000 mi^2 (46,600 km2) in Wyoming (76 FR 61782). This occupied area extended slightly further east than the WTGMA, included about the western-third of the WRR and extended south to about Big Piney, Wyoming. The distribution of known packs has increased slightly in recent years and dispersing wolves routinely travel through unsuitable habitat and packs occasionally occupy such habitat (U.S. Fish and Wildlife Service 1994, Bangs 2002, Jimenez et al. 2011, United States Fish and Wildlife Service et al. 2011, U.S. Fish and Wildlife Service et al. 2017). However, during the past 17 years, Wyoming wolf packs have been unable to persist in areas intensively used for livestock production, primarily because of wolf conflicts (i.e., livestock depredations) with resultant agency removal of problem wolves and illegal killing (76 FR 61782).

WGFD manages resident ungulate populations at densities compatible with habitat conditions and to provide for hunter harvest. In 2016, more than one million wild ungulates, including approximately 104,800 elk, were estimated to inhabit Wyoming. Twenty-nine of Wyoming's 33 elk management units were at or above the WGFD numeric objectives for those herds in 2016 (Wyoming Game and Fish Department 2017). The GYA is expected to continue to support large populations of ungulates, and Wyoming will continue to maintain ungulate populations at densities that can support a recovered wolf population well into the foreseeable future (76 FR 61782).

Livestock occur at varying densities in the GYA, with large expanses of the area not used for livestock production due to its land classification status (national parks, wilderness areas). However, in recent years, more than 500,000 acres (200,000 hectares) of public land grazing allotments have been purchased and retired in areas of chronic conflict between livestock and large predators, including wolves. Most wolf packs outside the public land areas have interacted with livestock, primarily cattle. Livestock and livestock carrion are routinely used by wolves, but wolf conflict management seeks to discourage chronic killing of livestock (74 FR 15123, 76 FR 61782)(U.S. Fish and Wildlife Service 1994, Wyoming Game and Fish Commission 2011;2012). Conflicts between wolves and livestock have routinely resulted in the removal of wolves, but the NRM wolf population remains at a level well above recovery goals (Bangs et al. 1995, Bangs et al. 2004, Bangs et al. 2005, U.S. Fish and Wildlife Service et al. 2017)(See also Section 4.3.1.2).

Human population growth and development will continue in the NRM and in Wyoming, including conversion of private low-density rural lands to higher density urban and suburban development; accelerated road development, and increases in energy transmission infrastructure (pipelines and transmission lines); additional contributions include: resource extraction (primarily oil and gas, coal, and wind development in certain areas); and increased recreation on public lands (Robbins 2007, Wyoming Game and Fish Commission 2011). In the Wyoming counties in which wolves are most common (Park, Teton, Sublette, Fremont, Hot Springs, and Lincoln Counties), the human population is projected to increase approximately 11.5% by 2030, from 128,288 in 2018 to 143,030 (Wyoming Department of Administration and Information-Division of Economic Analysis 2008). Despite efforts to minimize impacts to wildlife (Brown 2006), development will make some areas of Wyoming and the GYA less suitable for wolf occupancy, particularly portions of Park, Teton, and Lincoln counties where the increase will be greatest. However wolf habitat does not appear to be greatly affected by human-land uses such as snowmobiling, off-road vehicle use, or logging activities, except when these uses result in accidental or, intentional killing of wolves or changes in prey density (Fuller et al. 2003). Even active wolf dens can be resilient to nonlethal disturbance by humans (Frame et al. 2007).

The proposed action would include wolf conflict management by WS-Wyoming on any private and/or public lands where wolf damage is occurring or could occur where: 1) resource owners/managers request assistance to alleviate damage, 2) management is authorized by the WGFD or other responsible agency, 3) wolf damage or threats are verified, and 4) agreements or work plans have been completed specifying the details of the damage management action to be conducted.

Although no significant threats to suitable wolf habitat in Wyoming are known to exist in the foreseeable future, wolf managers will be required to regulate human harvest and illegal mortality, and manage conflict resolution. None of the human-use developments or increased human presence threatens wolf recovery or meaningfully impacts the amount of suitable wolf habitat in Wyoming or the NRM in the foreseeable future (76 FR 61782). Wolves are habitat

generalists and one of the most adaptable large predators in the world, and only became extirpated because of deliberate human persecution (Boitani 2003, Fuller et al. 2003).

2.2.2 Human Environment

The term "human environment" refers to existing relationships between people and the environment. The CEQ's NEPA Implementing Regulations define "human environment" as:

"*Human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment" (40 CFR 1508.14).*"

Therefore, existing human relationships with the animal species found in the affected environment, as well as all of the direct and indirect effects of those species on other aspects of the environment, are part of the "human environment" to which we must compare the effects of WS-Wyoming's proposed actions. Wolf conflict management by WGFD is part of the human environment that exists, or will exist, in the absence of any assistance actions by WS-Wyoming. Wolf conflict management methods used by WS-Wyoming can also be used by other agencies, such as WGFD or even by members of the public in accordance with state and local laws. At present, funding for WDM in Wyoming is provided by the WGFD and the ADMB. These entities could readily redirect these resources in the absence of assistance by WS-Wyoming. All of these types of human relationships and interactions are established components of the human environment. Cultural, economic, social, legal, and other components of the affected environment are given further consideration in Section 2.3.3, 2.3.4 and 2.3.5 of this chapter and in Chapters 3 and 4.

2.2.3 The Environmental Baseline

To determine impacts of federal actions on the human environment, an environmental baseline needs to be established with respect to the issues considered in detail so that the impacts of the alternatives can be compared against the baseline. Based on the existing human environment described above, and the numerous types of human relationships that are established components of that environment, the baseline appropriate to use for analysis in this EA is not a "pristine" or "non-human-influenced" environment, but one that is already heavily influenced by human actions and direct management. Another way to evaluate impacts of the federal action in this situation is to compare against the *status quo* for the human environment that would exist with no federal WS involvement in wolf removals for conflict management purposes in Wyoming.

There are two possible scenarios that we have to consider when determining the "human environment" as defined by CEQ and to which we must compare the impacts of WS-Wyoming's wolf management assistance actions under the various alternatives analyzed in the EA:

Scenario 1: Wolves are delisted – This is the current scenario for wolf management in Wyoming. In this scenario, the "human environment" and environmental baseline upon which we, as a federal agency, are evaluating our impacts in Wyoming, will be one in which the particular relationship of people with wolves in the environment is determined primarily by the tribes and by the State of Wyoming in their gray wolf management plans (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007, Wyoming Game and Fish Commission 2011;2012). Further facts relevant to this scenario are:

- State wildlife management actions are not subject to NEPA compliance because NEPA only applies to *federal* actions.

- The states have the authority to manage populations of resident wildlife species. This includes wolves now that they are delisted, without oversight or control by federal agencies with the following exceptions; 1) the state must have a USFWS approved management plan for wolves prior to delisting; 2) federally delisted T&E species are subject to a 5-year period of monitoring and oversight by USFWS following delisting to ensure that the species remains recovered; and 3) state management of previously listed species are also subject to long-term USFWS review to ensure that management actions do not pose a significant threat to the wolf population and will not reduce the population below thresholds established for recovery. The State does not have authority for wolf management in YNP or the WRR.
- Each state, including Wyoming, determines how resident wildlife will be managed within its boundaries by passing laws, regulations and policies via its representative form of government and through the development of management plans, as warranted.
- Each state's representative system of government is the established mechanism for determining the "collective" desires or endorsements of the people of a state. This is how a state determines the environmental condition, or *environmental status quo,* for those aspects of the human environment that are comprised of, or are directly or indirectly affected by, resident wildlife.
- It is reasonable and proper to rely on the representative form of government within a state as the established mechanism for determining the "collective" desires or endorsements of the people of a state.

Scenario 2: Wolves were listed under the ESA - In this scenario, the "human environment" upon which we, as a federal agency, evaluated our impacts in Wyoming, was one in which the authorizations for WDM have already been established by another federal agency – the USFWS – through its 10j rules established under the authority of the ESA. Although Wyoming wolves are no longer protected under the ESA, this was the management option in place for years. We have chosen to retain the description of this scenario in the EA for comparative purposes. Further facts relevant to this scenario are:

- As authorized by the ESA, the USFWS established regulations to govern wolf management when wolves were listed for protection under the ESA. Those regulations are the 10j rules formerly described in 50 CFR 17.84 (i) and (n) (depending on whether the state or tribe has a USFWS approved wolf management plan).
- WS-Wyoming's potential actions as described herein were to assist the USFWS in carrying out the decisions for wolf conflict management that the USFWS had already made via its 10j rules.
- The USFWS 10j rules governing wolf management authorized the management of wolves to reduce predation on livestock and domestic animals, pets and risks to human health and safety.

2.3 ISSUES CONSIDERED IN DETAIL FOR EACH OF THE ALTERNATIVES

Issues were identified based on an awareness of concerns previously expressed by representatives from various environmental and industry organizations, the general public, and other agencies. Some were used to prepare the detailed impact analyses of the Alternatives in Chapter 4. The issues were also used to identify minimization measures and to develop protective measures for reducing or eliminating the likelihood of adverse environmental effects from implementation of the proposed action. Some issues, however, did not receive detailed analysis for reasons articulated in Section 2.4. The following issues were determined relevant based on public and agency comments, and are analyzed in detail in Chapter 4:

- Ability of alternatives to meet management objectives and efficacy of methods
- Effects on the Wyoming wolf population
- Effects on public and pet health and safety
- Animal welfare and humaneness of methods to be used
- Impacts to stakeholders, including aesthetics of wildlife
- Impacts on nontarget species, including T/E species and ecosystems

2.3.1 Ability of alternatives to meet management goal and objectives

This section reviews the ability of each of the alternatives to achieve the management goal and objectives established in Section 1.9. The overall goal of the proposed action is to conserve wolf populations while protecting livestock, other domestic animals, and human health and safety. Six objectives were identified in Section 1.9 as important to achieving the stated goal. This section reviews each alternative to determine if the alternative could be successful in meeting the objectives. This section includes a discussion of the available information on the efficacy of PDM methods. This evaluation is distinct from the environmental impact analysis, and is intended to aid the decision-maker in making a well-informed decision that considers both the ability of the alternative to meet the management objectives and the environmental consequences of the PDM alternatives.

2.3.2 Effects on the Wyoming Wolf Population

Wolves in Wyoming are currently managed in accordance with the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011;2012) and the Wolf Management Plan for the Wind River Reservation (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007). The state plan includes provisions to ensure the ongoing health and viability of the gray wolf population in the state and the NRM. Some members of the public have expressed concern that wolf conflict management might result in cumulative adverse effects on the viability of the Wyoming and NRM wolf population. This section reviews the potential direct, indirect and cumulative impacts from WS involvement in wolf conflict management in Wyoming in the context of applicable state, federal and tribal regulations and plans for the protection and management of wolves.

2.3.3 Effects on Public Safety and Pet Health and Safety

One aspect of WDM actions is their ability to reduce risks to public safety and domestic animals from wolf attacks and/or predation. At the same time, it is important to consider potential risks to public safety and domestic animal safety from methods used in conducting wolf conflict management. In particular, there may be concerns that the mechanical methods used for wolf capture and/or removal (*i.e*., trapping, snaring, aerial shooting) or certain nonlethal methods such as use of livestock guarding dogs may be hazardous to people and pets. Other individuals may be concerned that continued increases in wolf populations might threaten public and pet health or safety. Procedures for addressing risks to human health and safety from wolves are outlined in the state and tribal wolf management plans (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007, Wyoming Game and Fish Commission 2011)

2.3.4 Animal Welfare and Humaneness of the Methods to Be Used

In recent years, the number of individuals and organizations concerned about animal welfare and animal rights has increased substantially (George et al. 2016). While the goal of some animal

welfare and rights groups is to ban trapping and all other lethal methods altogether, many groups are concerned with reducing the suffering of animals that are captured or killed by traps or snares, as well as potential risks to nontarget animals and pets. Animal welfare organizations and private individuals are concerned that some methods used to capture wildlife may cause pain and suffering in animals. Pet owners and livestock producers are also concerned about the humane treatment of animals under their care and the need to protect those animals from pain and suffering caused by wolves.

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. Some aspects of humaneness can be measured and assessed such as an animal's physiological reactions to events (e.g., measurements of heart rate and blood chemistry) and physical condition (i.e., whether or not use of a capture device caused physical damage). However, humaneness is also an individual's perception of harm or pain inflicted on an animal and people may perceive the humaneness of an action differently. Perceptions of humaneness of an action are also linked to individual values relative to the need for and appropriateness of WDM.

Pain obviously occurs in animals, but assessing pain experienced by animals can be challenging. The key component of this definition is the perception of pain. For pain to be experienced, the cerebral cortex and subcortical structures must be functional. If the cerebral cortex is nonfunctional because of hypoxia, neural depression, or physical disruption, pain is not experienced (American Veterinary Medical Association 2013).

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 (American Veterinary Medical Association 2013).

The AVMA states *"... euthanasia is the act of inducing humane death in an animal" and "...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*" (American Veterinary Medical Association 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 "*For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible*." (American Veterinary Medical Association 2001).

American Veterinary Medical Association (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… 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."

American Veterinary Medical Association (2013) recognizes that there is "*an inherent lack of control over free-ranging wildlife, accepting that firearms may be the most appropriate approach to their euthanasia, and acknowledging that the quickest and most humane means of terminating the life of free-ranging wildlife in a given situation may not always meet all criteria established for euthanasia (i.e., distinguishes between euthanasia and methods that are more accurately characterized as humane killing). Because of the variety of situations that may be encountered, it is difficult to strictly classify methods for termination of free-ranging wildlife as acceptable, acceptable with conditions, or unacceptable. Furthermore, classification of a given method as a means of euthanasia or humane killing may vary by circumstances. These acknowledgments are not intended to condone a lower standard for the humane termination of wildlife. The best methods possible under the circumstances must be applied, and new technology and methods demonstrated to be superior to previously used methods must be embraced.*

Multiple federal, state, and local regulations apply to the euthanasia of wildlife. In the United States, management of wildlife is primarily under state jurisdiction. However, some species (e.g., migratory birds, endangered species, 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 control of wildlife species, and, the public may identify and/or present individual animals to state or federal personnel because they are orphaned, sick, injured, diseased (e.g., rabid), or becoming a nuisance."

Analysis of this issue must consider not only the welfare of the animals captured, but also the welfare of humans, livestock and other domestic animals 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. Use of livestock guarding animals is commonly considered a humane management alternative, but in some instances livestock guarding animals may also be injured or killed by wolves.

2.3.5 Impacts to Stakeholders, Including Aesthetics of Wildlife

2.3.5.1 Variations in Perception of Wildlife Damage

During the last 200 years, broad-scale changes in land-use patterns (*e.g.*, housing developments, agriculture, roads, industrial complexes, etc.) have occurred as the

increasing human population settled North America. Notable is the large-scale conversion of natural landscapes to agricultural and urban environments. As humans encroach on wild habitats, they compete with wildlife for habitat and other resources, which increases the potential for conflicts. Concurrent with this growth and change is a desire by some segments of the public to completely protect all wildlife, which can create localized conflicts with resource managers and individuals experiencing problems with wildlife.

Biological carrying capacity is the limit of the land or habitat to support healthy populations of species without long-term degradation of either the health of the species or the associated environment (Decker and Purdy 1988). The wildlife acceptance capacity (also known as cultural carrying capacity) is the limit of human tolerance for wildlife, or the maximum number of a given species that can coexist compatibly with local human populations (Decker and Purdy 1988). These capacities are especially important in areas inhabited by humans because they define the sensitivity of a local community to a specific wildlife species/problem. For any given situation involving a wildlife conflict, individuals directly or indirectly affected by the damage will have varying degrees of tolerance for the damage and the species involved in the damage. This tolerance determines the "wildlife acceptance capacity," which is often lower than the "biological carrying capacity." For example, the biological carrying capacity of gray wolves in Wyoming could be higher than their current population; however, for some individuals and groups, the area has as many or more wolves than can be tolerated (*i.e.*, for these individuals, the wildlife acceptance capacity has been reached or exceeded). Once the wildlife acceptance capacity of a species is reached or exceeded, humans will demand implementation of projects, both lethal and nonlethal, to reduce damage or threats of damage.

The human attraction to animals has been well documented throughout history, an idea supported by prehistoric cave paintings and the domestication of wild animals. Today's American public is no exception, as evidenced by the large percentage of households that have pets or observe wildlife. Some people also may consider individual wild mammals and birds as "pets" and exhibit affection toward these animals. They may also want to have more wild animals in their immediate environment. Some people feel a spiritual bond with wild animals and/or feel a moral or spiritual obligation to preserve wildlife species or individual animals. Conversely, some people have no emotional attachment to wildlife; some may even fear the presence of wild animals in their vicinity and demand their immediate removal. Others may have a more utilitarian relationship with wildlife and desire the preservation of species populations, but may also support removal of individual animals if their activities cause damage or threaten human health and safety.

Ideas about how conflict management activities should be implemented and conducted are as unique as the almost infinite combinations of philosophies, psyches, aesthetic values, personal attitudes, and opinions found in humans. These differences of opinion result in concerns that the proposed action or the Alternatives would result in the loss of aesthetic or cultural/spiritual benefits to the general public and resource owners.

2.3.5.2 Aesthetic and Sociological Values of Wildlife

Wildlife generally is regarded as a source of 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 the philosophy dealing with the nature of

beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective, dependent on what an observer regards as beautiful. Wildlife populations also provide a range of direct and indirect social and economic benefits (Decker and Goff 1987). Direct benefits are derived from a user's personal relationship or direct contact with wildlife and may include either consumptive (*e.g.*, using or intending to use the animal such as in hunting or fishing) or non-consumptive use (*e.g.*, observing or photographing animals)(Decker and Goff 1987). Indirect benefits, or indirect exercised values, arise without a human being in direct contact with an animal and are derived from experiences such as 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). Two forms of indirect benefits exist according to Decker and Goff (1987): bequest and pure existence. Bequest benefits arise from the belief that wildlife should exist for future generations to enjoy; pure existence benefits accrue from the knowledge that the animals exist in the human environment (Decker and Goff 1987) or that they contribute to the stability of natural ecosystems (Bishop 1987).

Some people directly affected by problems caused by wolves insist on the lethal removal of the problem animal(s) from the area where the conflict occurs. Others hold the view that all wildlife involved in conflicts should be captured and relocated to another area to alleviate the problem, or that humans should learn to live with the conflict. Individuals not directly affected by a conflict may be supportive of affected humans, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Those who oppose removal of wildlife may do so because for emotional or spiritual reasons and may totally oppose wolf conflict management if lethal methods may be used

The goal of human-wolf conflict management is to provide relief from damage or threats of damage while minimizing the potential for negative impacts on the environment including aesthetic and social values. WS-Wyoming would only conduct human-wolf conflict management in consultation with WGFD in the WTGMA as appropriate and in the Predatory Animal Zone after a request has been received from citizens, organizations, and others who are experiencing problems (*i.e.*, where a need exists).

2.3.6 Effects on Nontarget Species Populations, Including Threatened and Endangered Species and Ecosystems

A common concern among members of the public and wildlife professionals, including WS-Wyoming and the WGFD, is that the proposed action or any of the alternatives might have adverse impacts on populations of other native wildlife species, particularly state or federally-listed threatened and endangered species. A current list of federally listed T&E species was obtained from the USFWS IPaC system. At the time this EA was completed, the federal list of T&E, proposed, nonessential experimental and candidate species obtained for Wyoming includes six mammals, four birds, one amphibian, six fish, and six plants. Of the species and subspecies currently listed in Wyoming under provisions of the federal ESA, excluding those listed but not found in Wyoming, 10 species are endangered, 10 species are threatened and two are proposed or candidate species. Additionally, there is a nonessential, experimental population (NEP) of black-footed ferrets in the state. Critical habitat has been identified for Canada lynx, yellow-billed cuckoo, desert yellowhead and Colorado butterfly plant. Special efforts are made to avoid jeopardizing threatened and endangered species through biological evaluations of the potential effects of the alternatives and the establishment of special restrictions or standard operating procedures. Land management agencies (e.g., BLM, USFS) also have lists of sensitive species and species of concern on the lands under their jurisdiction. During work plan meetings and any

project-specific discussions, these agencies inform WS-Wyoming of mitigation measures needed to threatened, endangered and sensitive species, water quality and other resource values of concern.

There may also be concerns that WS-Wyoming's activities could result in the disturbance of eagles that may be near or within the vicinity of WS-Wyoming's 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 Eagles 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 environmental consequences evaluation conducted in Chapter 4 of this EA will discuss the potential for WS-Wyoming's activities to disturb eagles as defined by the Act.

In addition to direct impacts on target species through unintentional capture, injury, death or disturbance, there are also concerns that removal of wolves for damage management may result in indirect adverse disruptive impacts on ecosystems and biodiversity. Predators are an essential component of healthy native ecosystems. There are concerns that reductions in wolf populations could result in increases in other predators such as coyotes that could have different, or even greater adverse effects on livestock and or other wildlife species. There are also concerns that reductions in or absence of wolf populations could result in increases in herbivore populations, shifts in prey foraging behavior and, ultimately, changes in plant communities (i.e., impact trophic cascades). Chapter 4 reviews the potential for the proposed action to affect these ecosystem-level processes.

2.4 OTHER ISSUES RELEVANT TO THE ANALYSIS

Some issues were considered, but not addressed in detail for each of the alternatives. Reasons for not including these issues in the analysis in Chapter 4 are discussed below, but may relate to factors including: 1) the issue is a question or statement instead of an environmental impact and is not suitable for comparative analysis or 2) the response to the issue is essentially the same for each alternative, so there would be little benefit from comparative analysis.

2.4.1 Lethal removal of wolves during the spring and early summer months could potentially result in litters of wolf pups becoming orphaned.

Depending on the circumstances, lethal removal of wolves to address livestock depredation problems or risks to human health and safety may involve removing most or all members of a specific wolf pack, as authorized by the WGFD or other responsible management agency. If these types of removals occur during the spring or early summer months, and the decision has been made to remove the entire pack, concerted efforts are made to remove all of the pups as well as the adults, in order to avoid orphaning the pups. When not all adult wolves are removed from a pack, a remaining wolf or wolves may continue to feed and care for the remaining pups (Boyd and Jimenez 1994, Packard 2003). There may be occasional circumstances however, where in spite of concerted efforts to humanely remove any pups left after all adult wolves have been removed, one or more pups may be left without any adult wolves to feed or care for them. The only way to avoid this circumstance altogether would be to limit wolf removal efforts during this time frame, so as to always ensure that at least one or more adult wolves were left to care for any pups. In some circumstances, this would be inconsistent with the objective of stopping recurring predation on livestock by specific packs.

We expect the orphaning of wolf pups would occur very infrequently, if ever, and find no reason to believe that it would result in a significant adverse effect on the ability to maintain a viable wolf population in Wyoming as desired by WGFD and USFWS.

2.4.1 Appropriateness of preparing an EA (rather than an EIS) for such a large area, rather than preparing multiple EAs for smaller, more site-specific areas.

Federal agencies have the discretion to determine the geographic scope of their NEPA analyses [*Kleppe v. Sierra Club*, 427 U.S. 390, 414 (1976)] and WS-Wyoming has determined that preparation of this EA to address wolf conflict management statewide is appropriate and consistent with wolf management objectives and plans as established in the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011)and state regulations for wolf management. The United States Fish and Wildlife Service (2008b) prepared a single EA to collectively address specific aspects of WDM in the three NRM wolf states (*i.e.*, Idaho, Montana and Wyoming), whereas this EA only covers one state. If a determination is made through this EA that the proposed action would have a significant impact on the quality of the human environment, then an EIS may be prepared in compliance with NEPA. In terms of considering cumulative impacts, one EA covering the entire state of Wyoming may provide a better analysis than multiple EA's covering smaller zones within the state. A more detailed and site-specific level of analysis would not likely contribute to substantial improvement in the decision-making process, (See Section 1.10.5).

2.4.2 Concerns that the Proposed Action may be highly controversial and its effects may be highly uncertain, both of which would require that an EIS be prepared.

The failure of any particular group or individual to agree with every act of a federal agency does not necessarily create a controversy, and NEPA does not require the courts to resolve disagreements among various scientists as to the methodology used by an agency to carry out its mission [Marsh v. Oregon Natural Resource Council, 490 U.S. 360, 378 (1989)]. Although there is some opposition to wolf conflict management, there is not substantial scientific controversy in terms of the projects' size, nature, or environmental effect. If a determination is made through this EA process that the proposed action would have a significant effect on the quality of the human environment, then an EIS would be prepared. Studies identified by the agencies and the public that come to conclusions that express concerns regarding the efficacy and impacts of WDM have been considered, and are discussed in applicable sections of the EA (e.g., Sections 4.3.1.1, 4.3.1.6, Appendix C).

2.4.3 If lethal control is implemented, effort must be taken to target the individual wolf or wolves responsible for the depredation.

WS personnel are highly trained in science-based methods for identifying wolf depredations (Acorn and Dorrance 1990). Agency personnel strive to target the specific wolf or wolves involved in depredation to stop the problem as quickly as possible and to reduce control and damage costs. However, as with any wildlife management action in an uncontrolled situation, one cannot guarantee that the wolf taken is always the specific individual involved in the depredation incident(s). In wolves, identification of depredating individuals is complicated by pack hunting behavior. When a pack is involved in a depredation incident, multiple individuals may have been involved in the depredation event and agency personnel cannot always determine which specific individuals were responsible. Pups also learn to identify appropriate prey items from adults. The 1994 Final USFWS EIS defined problem wolves as including adult and yearling

wolves that depredate as well as pups of the year that feed on livestock killed by other pack members. Measures used to identify and target depredating wolves include, but are not limited to, careful analysis of wolf sign at the site by trained professionals, review of information on radio-collared wolves in the vicinity of the depredation, and focusing wolf capture efforts in areas near the depredation site. Sign at the depredation site can often be used to determine if the depredation was caused by an individual wolf or multiple wolves. Because wolves are very territorial, the wolf or wolves responsible for the depredation are the ones most likely to return to the depredation site, and traps set near the kill site are most likely to capture the wolf or wolves involved in the depredation. When radio-collared individual wolves or packs are implicated in depredations on livestock (by proximity in time and space to the depredation), telemetry monitoring can be used to help target those wolves either through trapping efforts on the ground or by aerial shooting.

2.4.4 Producers should not expect to prevent all predation losses and some losses are a cost of doing business.

Livestock producers recognize that some level of predation losses are likely to occur, in spite of their efforts and agency responses to such losses. The agencies involved in wolf damage management do not expect to prevent all losses, nor are they proposing lethal WDM as a solution to all depredation incidents. WS-Wyoming and WGFD use an integrated approach to resolve wolf damage complaints. In some situations the use of nonlethal methods alone may be adequate for resolving wolf depredation complaints, but there will always be some situations which cannot be resolved with exclusive use of nonlethal methods. Most instances of wolf predation on sheep, for example, occur in spite of the use of herders and livestock guarding dogs by sheep producers to protect sheep from predation. For example, a recent 2014 survey of sheep producers collected data on nonlethal methods used to reduce predation (USDA APHIS Veterinary Services 2015). In Wyoming, 79% of sheep operations and 14% of cattle and calf producers used at least one nonlethal method to deter predation on livestock ((USDA APHIS Veterinary Services 2017), USDA, unpub. data, 2015). Use of nonlethal methods by Wyoming sheep producers was above the national average of 58% and use of nonlethal methods by cattle producers was slightly below the national average of 19% (USDA APHIS Veterinary Services 2017). In Wyoming, nonlethal methods employed by sheep producers that used at least one nonlethal method included livestock guarding dogs (36% of operations); guard llamas (16%); guard donkeys (7%); fencing (24%); shed lambing (47%); herders (13%); night penning (34%); frightening devices (7%); carcass removal (20%); culling vulnerable stock (34%); changing bedding grounds (13%); frequent checks (30%); altered lambing schedules to avoid period of greatest predation risk (5%); and other nonlethal methods (8%) (USDA APHIS Veterinary Services 2015). Nationwide, cattle producers that used at least one nonlethal method, used guard dogs (23%); fencing (6%); frequent checks (5%); a combination of guard dogs and fencing (4%); carcass removal and culling older cattle (4%); carcass removal (4%); carcass removal, culling and frequent checks (3%); culling older cattle (3%); other methods used singly (7%); other combinations of methods (29%) (USDA APHIS Veterinary Services 2017). Historically, the Defenders of Wildlife (DOW), a private wildlife and habitat conservation organization, voluntarily compensated Wyoming livestock producers 100% of the value of livestock that were confirmed by WS-Wyoming as killed or injured by wolves and 50% of the value of livestock that were designated by WS-Wyoming as "probable" wolf predation. The Defenders of Wildlife compensation program has been discontinued, however, since 2008, the WGFD pays for livestock losses verified as killed by wolves in the WTGMA [Wyoming Statute 23-1-901 and Wyoming Game and Fish Commission (WGFC) Chapter 28, Regulation Governing Big or Trophy Game Animal or Game Bird Damage Claims]. In some instances, WGFC regulations additionally allow for payment of missing

livestock in open range settings if the producer had verified wolf-caused losses during the grazing season.

2.4.5 Impacts on Cultural, Archaeological and Historic Resources and Tribal Cultural Properties in Wyoming

The activities described under the alternatives analyzed in this EA would not cause any significant ground disturbances and would not otherwise have the potential to significantly affect the visual, audible, or atmospheric elements of historic properties and thus are not undertakings as defined by the National Historic Preservation Act (NHPA). A consultation between WS-Wyoming and the SHPO resulted in a letter of concurrence from SHPO that WS-Wyoming activities as proposed in this EA would not likely result in any effects on historic properties (2/18/2015 letter to Rod Krischke). WS-Wyoming also offered the opportunity to initiate consultation on WS WDM actions in Wyoming and/or participate in preparation of the EA to the Eastern Shoshone and Northern Arapaho Tribes to identify any potential concerns regarding possible impacts of WS' wolf conflict management activities on tribal cultural properties in Wyoming (letter 3/13/2014).

2.4.6 Irreversible and Irretrievable Commitments of Resources

The following resource values within Wyoming would not be adversely affected by any of the alternatives analyzed in this EA: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, or range. We are aware of studies documenting the return of wolves to ecosystems where they have been absent for decades and associated changes in physical and biological components of ecosystems (Beschta and Ripple 2008, Beschta and Ripple 2012). Analysis in Section 4.3.1.6 indicates that proposed actions by WS-Wyoming will not individually or cumulatively be of sufficient magnitude or scope to affect trophic changes associated with the return of wolves to native ecosystems including impacts on riparian zones and river morphology. These resource values will not be analyzed further.

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, WS-Wyoming WDM activities result in negligible impacts on the supply of fossil fuels and electrical energy.

2.4.7 Does NEPA and the CEQ require an economic analysis for informed decision-making? Does WS-Wyoming need to do a cost:benefit analysis? Is the proposed action cost effective, or will WS-Wyoming spend $1,000 protecting a $100 lamb?

Section 102(2)(B) of NEPA requires agencies to: *"[I]identify and develop methods and procedures...which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations…*"

NEPA ensures that federal agencies appropriately integrate values and effects that are difficult and sometimes impossible to quantify from an effects or cost-effectiveness standpoint into decision-making. For example, the intrinsic value of wildlife and to some extent, human health and safety, are more difficult to quantify (USDA, APHIS, WS NWRC, personal communication, January 5, 2018). The CEQ regulations at 40 CFR § 1502.23 take a similar position: "*If a cost-benefit analysis relevant to the choice among environmentally different alternatives is being*

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

Ecosystems services of value to humans such as the role of wolves in maintaining healthy ecosystems and species diversity (Section 3.2.5.1) can be considered in qualitative and/or economic terms. The Memorandum entitled "Incorporating Ecosystem Services into Federal Decision Making" issued by the CEQ, the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) on October 7, 2015 (https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2016/m-16-01.pdf) does not require an economic test for the ecological services to be considered valuable. The Memorandum *"[d]irects agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. (Consideration of ecosystem services may be accomplished through a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services, and, where appropriate, monetary or nonmonetary values for those services.).*" The Memorandum also states that *"[a]doption of an ecosystem-services approach is one way to organize potential effects of an action within a framework that explicitly recognizes the interconnectedness of environmental, social, and, in some cases, economic considerations, and fosters consideration of both quantified and unquantified information.*"

Therefore, neither NEPA nor CEQ guidance requires economic analyses for informed decision-making unless such analyses are relevant to understanding the differences among alternatives. Some people who commented on the EA felt that an economic analysis was needed to make an informed decision among the alternatives. WS-Wyoming has also evaluated these concerns.

A common concern expressed about government-supported WDM is whether the value of livestock losses are less than the cost of using at least some public funds to provide WDM services. This concern is often expressed by comparing losses which have occurred with WDM activities already in place to the cost of WS assistance. However, this concern and the associated calculation indicates a misconception of the purpose of WDM, which is not to wait until the value of losses is high, but to prevent, minimize, or stop losses and damage where it is being experienced, where the property owner's level of tolerance has been reached, and where assistance is requested. Hypothetically, WDM would reach its maximum success if it prevented all losses or damage, which would mean the value of losses or damage due to wolves would be zero. The losses that occur when WDM activities are conducted by WS are the losses that occurred before WDM assistance was requested from the applicable entity, and losses that occurred until an effective resolution of the conflict was identified and implemented. Comparing the losses that occur when WDM is implemented to the cost of WS-Wyoming WDM activities fails to consider the value of losses prevented by the successful implementation of WDM actions.

Evaluating the economic value of losses that would be avoided or minimized with implementation of WDM is inherently difficult and very complex (Shwiff and Bodenchuk 2004).

Differences in prey density, life stage of the predator and prey, habitat, individual predator behavior, environmental conditions, and differences in livestock husbandry practices combine to make predation rates highly variable among producers and among seasons and years for individual producers (Baker et al. 2008). At best, data on losses that occur in the absence of WDM are limited because of the difficulty in predicting which producers will be impacted in a given year (complicates establishment of rigorous experimental design) and because few producers are willing to forsake damage management assistance just so researchers can determine how severe their problem can get. What data are available are not of sufficient scale or scope to permit extrapolation to the range of situations where WDM occurs. Relevant scientific literature on predation management generally suggests that, in the absence of predation management, predation rates on livestock would likely increase (Bodenchuk et al. 2002, Baker et al. 2008, Bradley et al. 2015).

Cost-effectiveness is an important factor in WDM decisions but not the primary goal of WS-Wyoming. Effective wildlife damage management involves not only consideration of the direct costs (costs of actual lethal and nonlethal management), but also the considerations regarding minimization of risks to people, property, and the environment, and social considerations (Shwiff and Bodenchuk 2004). Whenever a request for assistance is received, WS-Wyoming field personnel consider additional constraints, such as environmental protection, land management goals, regulatory and policy constraints on methods which may be used, presence of people and pets, and social factors using the WS Decision Model (Section 2.3.1,WS Directive 2.201). These constraints may increase the cost of implementing WDM actions while not necessarily increasing its effectiveness, yet they are a vital part of the WS-Wyoming's decision-making process (Connolly 1981, Shwiff and Bodenchuk 2004).

In addition to the challenges associated with providing an economic evaluation of losses prevented, WS-Wyoming has determined that there are also important qualitative values that are relevant and important to its decision-making that cannot be readily monetized, including recreational, aesthetic, safety, ecological and spiritual benefits. For these reasons, WS-Wyoming has determined that a formal cost:benefit analysis would not contribute substantively to WS' decision making at this time.

2.4.8 EA needs to consider findings of Musiani et al. (2003, 2005), Harper (2008), and Muhly et al. (2010) that indicate that lethal wolf removal for damage management does not work. EA also needs to consider Peebles et al. (2013), Lambert et al. (2006), Maletzke et al. (2014), Smith et al. (2015), and Treves et al. (2010).

Section 3.4.2 provides an overall discussion of the efficacy of WDM methods including lethal removal and the studies by Musiani et al (2003, 2005), Harper et al. (2008), and Muhly et al. (2010a).

Peebles et al. (2013), Lambert et al. (2006), Maletzke et al. (2014), and Smith et al. (2015) are studies of mountain lions. (Treves et al. 2010) is an evaluation of bear hunting. Given the differences in biology and behavior between primarily solitary lions and bears and social canids such as wolves, we do not believe the findings of these studies are directly applicable to understanding behavior and depredation in wolves. Additionally, Peebles et al. (2013), Lambert et al. (2006), and Treves et al. (2010) addresses the utility of sport hunting as a tool to reduce conflicts with mountain lions. Maletzke et al. (2014) evaluates the impact of sport hunting at intensities intended to reduce lion populations or lion behavior. The use of sport hunting to address losses, now that wolves are delisted, is at the discretion of the WGFC and not WS-

Wyoming. Nonetheless, recent information on wolf hunting as a tool for WDM has been added to Section 3.4.1.4.

CHAPTER 3: ALTERNATIVES

3.1 INTRODUCTION

This Chapter consists of six parts: 1) an introduction, 2) a description of alternatives considered and analyzed in detail, 3) a description of wildlife damage management strategies and methodologies, 4) a list of WDM methods that could be used or recommended by WS-Wyoming, 5) a description of alternatives considered, but eliminated from detailed analysis, and 6) a table of protective measures used to help reduce the risk of adverse environmental impacts. Three alternatives were recognized, developed and analyzed in detail; and six alternatives were considered but not analyzed in detail, with supporting rationale presented.

As of April 17, 2017 the state and tribes are the primary entities responsible for wolf management outside YNP including WDM (82 FR 20282). WS-Wyoming acts as an agent of the WGFD in conducting wolf conflict management in the WTGMA and the WDA in the Predatory Animal Zone (Letter to R. Krischke, WS from B. Nesvik, Chief Wildlife Division, WGFD October 4, 2011 and as evidenced in annual work agreements with WGFD and WDA) and could also act as an agent of the tribes. Under all of the alternatives discussed below, the state and the tribes retain their authority to implement or authorize nonlethal or lethal actions in addition to any actions taken by WS-Wyoming as their agent. In the absence of WS-Wyoming involvement, the state and tribes may conduct WDM on their own, designate another entity to act as an agent of the state/tribe, or increase authorizations for private individuals to resolve their own conflicts with wolves in accordance with applicable state and tribal regulations and management plans (Shoshone and Arapaho Tribal Fish and Game Department 2007, WGFC 2011, 2012)(Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007, Wyoming Game and Fish Commission 2011;2012). While wolves were federally protected under the ESA, WS worked in a similar manner as an agent of the USFWS (Letter to R. Krischke, WS-Wyoming from M. Jimenez, USFWS, Wyoming Wolf Recovery Project Leader, October 22, 2014).

Wyoming Gray Wolf Management Plan

The Wyoming gray wolf management plan splits the state into three management zones: the WTGMA, the seasonal WTGMA and the Predatory Animal Zone (Figure 3-1). The boundary and size of the WTGMA is established by state statute and cannot be changed through WGFC rule or regulation. In the trophy game management zone, the WGFD has primary authority for gray wolf management. WGFD responds to all requests for assistance with WDM, verifies the need for action and provides compensation for livestock losses to wolf predation. The WGFD determines the methods to be used to address the conflict (e.g., wolf removal, operational assistance with nonlethal methods, technical assistance) and develops a management strategy consistent with the provisions of the Wyoming gray wolf management plan (Wyoming Game and Fish Commission 2011;2012). The WGFD may request WS-Wyoming assistance in responding to requests for assistance, verifying losses and/or implementing the selected management methods. All WS-Wyoming costs for implementing WDM are paid by WGFD. The only federal expenditures are for administration and supervision. WS-Wyoming management decisions in the WTGMA are limited to whether or not to provide the specific service requested by WGFD (e.g., wolf removal, operational assistance with nonlethal methods, research assistance, and technical assistance).

The boundary of the WTGMA will expand seasonally to facilitate wolf dispersal and gene flow between central Idaho and GYA wolf populations (Figure 3-1). From October 15 to March 1 each year, the area in the seasonal WTGMA will be managed in the same manner as the WTGMA. From March 2 to October 14, wolves in the seasonal WTGMA will be managed in the same manner as wolves in the Predatory Animal Zone.

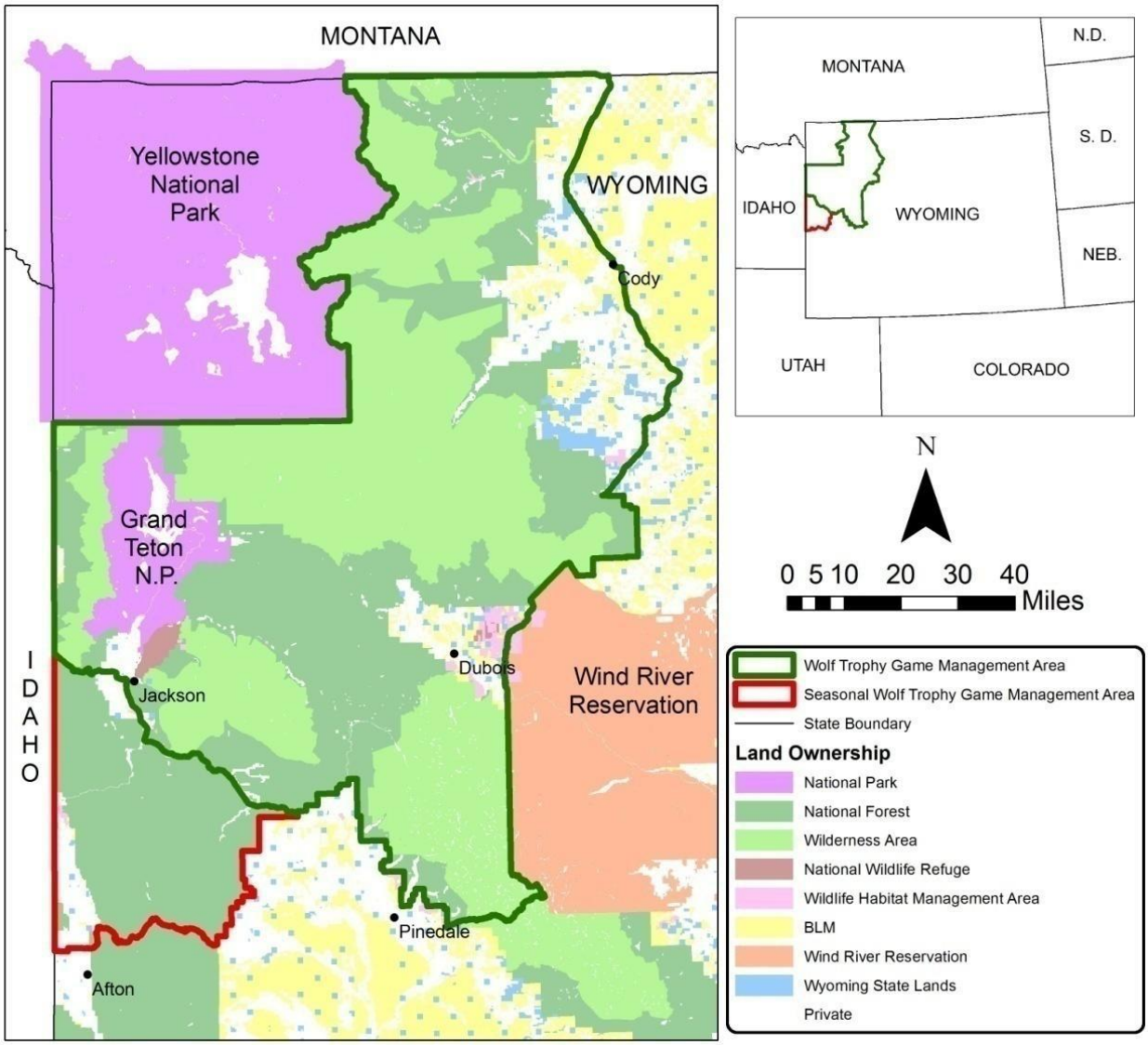


Figure 3-1. Wyoming Wolf Trophy Game Management Zone, and Seasonal Wolf Trophy Game Management Zone. All other portions of the state exclusive of the Wind River Reservation and Yellowstone National Park are classified as the Predatory Animal Zone.

Outside of the WTGMA wolves will be designated as predatory animals, and the WDA will have primary authority for wolf management. An analysis of wolf habitat in Montana, Idaho, and Wyoming indicated suitable wolf habitat in Wyoming is mostly restricted to the northwestern corner of the state, and breeding pairs can persist outside the suitable habitat areas identified by Oakleaf et al. (2006). Wolves are increasingly observed in this region. However, because of lower habitat quality and the greater degree of development and human activity, the probability of conflicts between wolves and humans is much higher in the Predatory Animal Zone. The WGFD collects data on wolves outside the WTGMA and counts wolves in this area as part of the total state wolf population, but does not depend on wolves in the Predatory Animal Zone to meet management objectives. (Pers. Com. Kenneth Mills WGFD 2018)

In the Predatory Animal Zone, WS-Wyoming has been the primary entity responding to requests for WDM assistance. WS-Wyoming verifies the need for action, but there is no compensation for livestock losses to wolf predation in the Predatory Animal Zone. WS-Wyoming uses the WS Decision Model (Slate et al. 1992), Directive 2.201) to identify an integrated WDM strategy consistent with state management objectives, laws and regulations, WS policy and Directives, and landowner management objectives while minimizing risk of adverse environmental impacts. Wolves in the Predatory Animal Zone may be taken by anyone at any time without a permit, but state statute and regulation require any person who harvests a wolf designated as a predatory animal, including non-Indian owned fee titled land in the WRR, to notify the WGFD within 10 days of the date the wolf was killed. Although state law allows take of wolves at any time within the Predatory Animal Zone, WS-Wyoming only takes wolves in response to verified conflicts with wolves. WS-Wyoming receives funding through the ADMB that covers the majority of costs for implementing gray wolf WDM in the Predatory Animal Zone. The only federal expenditures are for administration and supervision.

3.2 DESCRIPTION OF THE ALTERNATIVES ANALYZED IN DETAIL

The proposed alternatives represent the full range of WS-Wyoming involvement in Wyoming wolf conflict management from no involvement to integrated use of all legally available WDM methods. Under the first two alternatives, WS-Wyoming wolf conflict management assistance could be provided on private or public property and tribal lands when: 1) resource owners/managers request assistance to alleviate wolf conflicts and management is authorized by the WGFD, WDA or the tribes, 2) wolf damage or threats are verified, and 3) agreements or work plans have been completed specifying the details of the management action to be conducted. Before WS-Wyoming could conduct wolf conflict management on tribal-owned lands, the tribal game and fish agency, the Council or other governing board would provide specific authorization for the action.

3.2.1 Alternative 1 - Continue Current Wolf Conflict Management Activities (No Action/Proposed Action)

The No Action Alternative serves as the baseline against which the impacts of management alternatives can be compared and can be defined as a continuation of current management practices (Council on Environmental Quality 1981). At the request of the appropriate agency, WS-Wyoming has assisted the USFWS, WGFD, and WDA with implementation of wolf damage management, population monitoring, and research since wolves were re-introduced in 1995. Consequently, Alternative 1 will be used as the No Action alternative and the baseline for comparison with the other alternatives to determine if the real or potential impacts are greater, lesser, or similar. Analysis of this alternative emphasizes data and WS-Wyoming actions from October 2012 to September 2014, and from May 2017 to the present, when wolves have been under state and tribal management. This alternative would continue WS-Wyoming wolf conflict management actions to protect livestock and other domestic animals and human safety as currently provided for under applicable agreements and state and tribal wolf management plans (Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department and U.S. Fish and Wildlife Service 2007, Wyoming Game and Fish Commission 2011;2012). Although the state wolf management plan allows for wolf management in situations where predation is limiting ungulate populations to levels below state management objectives, as noted in Section 1.10.3, WS-Wyoming would not be involved in WDM to enhance ungulate populations. After reviewing public comments on the EA, we have modified this alternative to include increased reporting of WS-Wyoming use and recommendation of nonlethal methods, collection of data on nonlethal methods implemented by WS-Wyoming cooperators, a prohibition on preventive lethal WDM in the Predatory Animal Zone and a cap on annual statewide lethal take of wolves. This information

will be used to inform agency technical and operational assistance with practical and effective nonlethal WDM methods.

1. WDM activities in the WTGMA

(Wyoming Game and Fish Department et al. 2018)Under Alternative 1, in the WTGMA, the WGFD is the lead agency in responding to conflicts with wolves (Wyoming Game and Fish Commission 2011). The WGFD places emphasis on preventing or minimizing wolf conflicts by incorporating wolf conflict prevention into the WGFD information and education program. Technical assistance provided to livestock producers by WGFD may include guidance on carcass disposal, fencing, scare devices, and other non-lethal or lethal control methods. The WGFD also administers a compensation program for wolf depredation on livestock in the WTGMA and a carcass disposal assistance program in Park County (Wyoming Game and Fish Commission 2011). The WGFD is also responsible for most capture and radio-collaring of wolves in the WTGMA, although WS-Wyoming could assist with capture and radio collaring wolves at their request.

In most cases (approximately 90%), the WGFD would be responsible for verifying the need for action, but they may occasionally request that WS-Wyoming verify the cause of the loss. After verifying a wolf conflict, WGFD would determine the management strategy to be implemented (e.g., no action, technical assistance, permit to landowner, operational assistance with nonlethal or lethal WDM). If operational assistance with WDM is warranted, the WGFD makes a determination as to whether or not to request assistance from WS-Wyoming. In the limited instances when WS-Wyoming verifies depredation by wolves, the results of the investigation are provided to the WGFD, and the WGFD determines the management action to be taken. If the loss is verified as depredation by wolves, WS-Wyoming would complete the state Livestock Damage Affidavit (EA Appendix A) needed by producers when applying for compensation from the WGFD. WGFD currently pays all costs for operational WDM assistance requested from WS-Wyoming in the WTGMA. Costs for the WS-Wyoming portion of the overall WDM effort in the WTGMA were $19,565 in fiscal year 2017 and $18,429 in 2018.

WS-Wyoming may provide technical assistance on the use of nonlethal and lethal WDM methods upon request as resources allow. When providing technical assistance on WDM, preference would be given to nonlethal methods when they are deemed practical and effective (WS Directive 2.101). With current funding WS-Wyoming would provide operational assistance with nonlethal methods as directed on a case-by-case basis by the WGFD. However, if other funding sources are identified in the future, WS-Wyoming could provide additional operational assistance with nonlethal methods in the WTGMA without case-by-case direction by WGFD, although special authorization for some methods may be needed (EA Sections 3.4.1.2 and 3.4.1.3). WS-Wyoming assistance with nonlethal and lethal wolf conflict management could be provided on private and public lands[13] in Wyoming, as directed by the WGFD, when the resource owners/managers request assistance to alleviate wolf damage, wolf damage is verified by WGFD or WS-Wyoming, and a Cooperative Service Agreement or other work authorization documents have been completed. WS-Wyoming WDM assistance would be provided in accordance with applicable laws and regulations, guidance and requirements of land management agencies and WS policy and Directives. Under this alternative, WS-Wyoming would be able to assist with

[13]WS-Wyoming could use lethal wolf damage management methods on public land to reduce depredation when coordinated with the WGFD, WDA and the respective public land management agency.

wolf research, wolf population monitoring and wolf removal when requested and authorized by the WGFD and WDA, as appropriate.

Specific nonlethal methods that may be recommended by WS-Wyoming would include but are not limited to: changes in ranch management practices and pet care/supervision, livestock guarding/management with herders or range riders, carcass disposal, frightening devices, exclusion, livestock guarding animals, and habitat modification. WS-Wyoming would encourage use of services like the Park County livestock carcass disposal program when and where such programs are available. Nonlethal methods used operationally or recommended by WS-Wyoming may include: fladry and turbo-fladry, foot-hold traps, snares with "stops" (used to live capture wolves for attaching radio-collars), frightening devices (e.g., remote activated guard (RAG) devices), aversive conditioning (e.g., modified dog training collars) and nonlethal projectiles (e.g., rubber bullets, bean bag rounds). Methods which require capturing and handling of wolves, aversive conditioning and other experimental damage management techniques would require special authorization from the WGFD (EA Section 3.4.1.2, and 3.4.1.3). Lethal methods could include shooting, calling and shooting, aerial shooting, and euthanasia of wolves live-captured in foot-hold traps, snares or other live-capture devices.

There are no WDM methods restricted to exclusive use by WS-Wyoming, and the WGFD is not required to use the services of WS-Wyoming in the WTGMA. The WGFD could conduct the work on their own authorize the landowner/manager to conduct the work, or designate an entity other than WS-Wyoming to serve as an agent of the state (Wyoming Game and Fish Commission 2011). The WGFD may also adjust quotas in wolf hunt areas to help alleviate conflicts with livestock and domestic animals. Under the Wyoming Gray Wolf Management Plan, WGFD may issue "lethal take permits" authorizing property owners to kill wolves in areas experiencing wolf depredation (Wyoming Game and Fish Commission 2011;2012). Additionally, no permit is required for property owners to immediately kill a wolf biting, wounding, grasping, or killing livestock or domesticated animals, or chasing, molesting, or harassing livestock in a manner that would indicate to a reasonable person that biting, wounding, grasping, or killing is likely to occur. Take without a permit must be reported to the WGFD within 72 hours, and all evidence must be preserved for investigation by the WGFD. The WGFD could conduct WDM on their own, authorize the landowner/manager to conduct the work, or designate an entity other than WS-Wyoming to serve as an agent of the state (Wyoming Game and Fish Commission 2011). Nonlethal methods may be implemented by anyone, with the exception of methods described in 3.4.2 and 3.4.3, which require authorization by the agency with primary responsibility for WDM. Nonlethal methods listed in sections 3.4.2 and 3.4.3 may be implemented by entities other than WS-Wyoming with applicable authorization of the WGFD, tribes, and land management agencies.

Statewide, the majority of wolves taken by WS-Wyoming for WDM are taken using aerial shooting. Although aerial shooting requires specialized training and equipment, it is legal for private and other commercial entities to preform aerial shooting in Wyoming. There are several aerial operations that could, if authorized, provide the aerial wolf management services currently provided by WS-Wyoming. WDA informed WS-Wyoming there were 77 aircraft in Wyoming registered to do aerial shooting on February 1, 2019 (K. Hart, WDA pers. comm. 2019). This does not include the 5 aircraft used by WS-Wyoming. In 2018, the WDA issued permits for aerial shooting to 32 private pilots and 95 gunners. The difference in the number of registered pilots and registered planes is attributable to licensed pilots being able to register multiple aircraft. All permit holders are allowed to request wolves be added to their permits at the time of application, and some permittees in the Predatory Animal Zone currently have wolves on their

permits (K. Drake & K. Hart, WDA, pers. comm. 2018). Both the USFS and the BLM report having processes in place that alternative WDM service providers could use to request permission to conduct aerial WDM operations (B. Owens, BLM, pers. comm 2018 and C. Jones, USFS, pers. comm. 2018).

2. WDM activities in the Predatory Animal Zone

Under Alternative 1, in the Predatory Animal Zone, WS-Wyoming would continue wolf conflict management on private and public lands, as currently authorized by the WDA, when the resource owners/managers request assistance to alleviate wolf damage, wolf damage is verified, and a Cooperative Service Agreement or other work authorization documents have been completed. WS-Wyoming would provide technical assistance and operational WDM using and/or recommending nonlethal and lethal management methods after applying the WS Decision Model (Slate et al. 1992), Directive 2.201). The state does not provide compensation for depredation by wolves in the Predatory Animal Zone. The ADMB currently pays for all operational costs of WDM in the Predatory Animal Zone. WS-Wyoming costs for WDM in the Predatory Animal Zone were $202,830 in 2017 and $60,532 in 2018. Unlike the WTGMA, WS is the primary agency providing assistance with WDM, so costs for WS assistance are greater in this zone. Additional services may be available in some areas, through county Predatory Animal District Boards or from private contractors.

In determining the most appropriate wolf conflict management strategy, preference would be given to nonlethal methods when they are deemed practical and effective (WS Directive 2.101). Lethal methods would be used to reduce damage after practical and appropriate nonlethal methods have been considered and determined to be ineffective or inappropriate to reduce damage to acceptable levels, or used and failed to reduce or stop the damage. In some instances, however, the most appropriate response to a wolf damage problem could involve concurrent use of a combination of nonlethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy (*e.g.*, some instances of risk to human safety from bold wolves or situations where the landowner has already implemented practical and effective nonlethal methods prior to contacting WS-Wyoming and is still experiencing damage problems). Lethal methods could include shooting, calling and shooting, aerial shooting, and euthanasia of wolves live-captured in foot-hold traps, snares, or other live-capture devices. WS will not use M-44s for WDM in Wyoming.

After reviewing public comments, we have modified this alternative so that WS-Wyoming will only use lethal WDM methods in the Predatory Animal Zone in response to a verified conflict with wolves (i.e., WS-Wyoming will only use lethal methods as a corrective WDM method). The methods available for use or recommendation by WS-Wyoming in the Predatory Animal Zone are the same as those for the WTGMA. In the Predatory Animal Zone, WS-Wyoming may obtain authorization to radio collar wolves at or near a depredation site in order to monitor individual animal and pack movements. This information may be used to determine if a particular pack is in the area when a depredation occurs and, on occasion, it may be used to locate and remove a depredating pack. Due to the labor and expense involved, WS-Wyoming does not commonly use this method, with collars used only once or twice per year.

There are no limits on the lethal take of wolves by private citizens in the Predatory Animal Zone, although individuals who have taken a wolf must report the take to WGFD within 10 days of the take. Specific methods that may be used for WDM, and access to WDM methods is similar to the WTGMA. Eight counties in the Predatory Animal Zone either do not currently contract with

WS-Wyoming for WDM or only contract aerial services. In some of these counties, wolf WDM is already occurring without the assistance of WS-Wyoming, and this will likely continue into the foreseeable future. Under the current legal framework this is completely acceptable and serves as a working example of how animal damage management will occur in Wyoming with or without the presence of WS-Wyoming.

3.2.2 Alternative 2 – WS Nonlethal Wolf Conflict Management Only

This Alternative would work in a similar manner as Alternative 1 except WS-Wyoming would only use and provide advice on nonlethal wolf conflict management methods. The WGFD, tribes and property owners would still be able to use lethal methods in accordance with state and tribal laws and regulations, and land management agency guidance and regulations as noted for Alternative 1.

Nonlethal methods used or recommended by WS-Wyoming could include animal husbandry practices including the use of herders/range riders, installation of fencing, electronic guards, fladry and turbo-fladry, aversive conditioning, nonlethal projectiles, use of livestock guarding animals, and/or other nonlethal methods as appropriate. Given that the WGFD provides all funding for operational WDM in the WTGMA and the fact that most current requests for assistance have involved assistance with implementation of lethal WDM methods, WS-Wyoming involvement in WDM in the WTGMA is likely to be much less than under Alternative 1.

In the Predatory Animal Zone, WS-Wyoming would still investigate reports of wolf depredations and could assist WGFD with radio-collaring wolves for monitoring purposes and/or to enhance effectiveness of nonlethal deterrents such as the RAG. WS-Wyoming could live-capture wolves , but the responsible management agency would decide about the disposition of any animals captured. As noted for Alternative 1, all costs for operational WDM are paid by the state and counties in the Predatory Animal Zone. Given the general preference for integrated WDM that includes access to lethal WDM methods (e.g., (Wyoming Game and Fish Commission 2011) and past requests for assistance, these entities are likely to seek assistance for lethal WDM from other sources, or, as with counties described for Alternative 1, may shift all requests for WDM assistance to alternate sources.

As noted for Alternative 1, there are no WDM methods restricted to exclusive use by WS-Wyoming although some methods may require special authorization from WGFD, or land management agencies. There has been some question as to whether private individuals could make up for the lack of aerial operations by trained personnel with WS-Wyoming under this Alternative and Alternative 2. As noted in Section 3.2.1 above, there are far more private aircraft, pilots and gunners registered to conduct aerial operations than WS-Wyoming personnel and aircraft available for the same purpose. Both the USFS and the BLM report having processes in place that alternative WDM service providers could use to request permission to conduct aerial WDM operations (B. Owens, BLM, pers. comm 2018 and C. Jones, USFS, pers. comm. 2018). Based on this information we conclude that there may be a brief decline in use of aerial operations while alternative sources for this service are identified and applicable authorizations are established, but that eventually there is enough private capacity for aerial operations in the state to make up for loss of operations by WS-Wyoming under this alternative.

Under this alternative WS-Wyoming could assist with capturing wolves to install tracking collars for use in research, population monitoring, or for use with nonlethal methods such as the RAG. WS could not be involved in use of collars intended to facilitate removal of a pack. The radio tracking collars used for this purpose are less expensive than the collars used for satellite

telemetry, with most of the equipment costs going toward the initial purchase of collars and receivers. Given the prioritization of data collection by WGFD in the WTGMA (Wyoming Game and Fish Commission 2011), and the issuance of Chapter 33 permits to collar wolves being limited to state or federal wildlife, natural resource, or agricultural agencies, adoption of this alternative could lead to fewer wolves being collared in the Predatory Animal Zone.

3.2.3 Alternative 3 – No Wolf Conflict Management by WS in Wyoming

Under this Alternative, WS-Wyoming would not be involved in WDM in Wyoming, but the WGFD, tribes, and property owners would still be able to use lethal and nonlethal methods in accordance with state and tribal laws and regulations as noted for Alternatives 1 and 2. All requests for wolf conflict management would be referred to the WGFD, tribes, or other responsible management agency as appropriate.

3.3 WOLF DAMAGE MANAGEMENT STRATEGIES AND METHODOLOGIES

Wildlife damage management is defined as the alleviation of damage or other problems caused by or related to the presence of wildlife, and is an integral part of wildlife management (The Wildlife Society 2004). Wildlife damage management approaches and strategies that could be used are described below.

3.3.1 Integrated Wildlife Damage Management (IWDM)

IWDM draws from the largest possible array of options to create a combination of techniques for specific situations. During more than 90 years of resolving wildlife conflicts, WS has considered, developed, and used numerous methods for reducing wildlife damage problems. WS' efforts have involved research and development of new methods, improving existing methods and implementing effective strategies to resolve and prevent wildlife damage. Usually, the most effective approach to resolve wildlife damage is to integrate the use of several methods simultaneously or sequentially. Adaptive IWDM is the implementation and application of legally available, 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 implements an IWDM approach to reducing damage through use of the Decision Model for developing site-specific, adaptive management strategies (Slate et al. 1992). IWDM may incorporate cultural practices, habitat modification, animal behavior modification, removal of individual animals, local population reduction, or a combination of these, depending on the characteristics of the specific damage problem. The philosophy behind IWDM is to implement effective management techniques while minimizing the potentially harmful effects to humans, target and nontarget species, and the environment. .

3.3.2 IWDM Strategies

3.3.2.1 Technical Assistance (implementation is generally the responsibility of the requester)

Technical assistance includes site visits, demonstrations and/or recommendations on the proper use of some management devices (*e.g.*, propane exploders, electronic guards, fladry, RAG, etc.) and information on animal husbandry, wildlife habits, habitat

management and animal behavior modification. Technical assistance is generally provided during a site visit or verbal consultation with the requester. Typically, several management strategies are described to the requester for short and long-term solutions to damage problems. These strategies are based on the level of risk, need and practical application. Technical assistance may require substantial effort by WS-Wyoming personnel to evaluate, demonstrate and discuss methods and follow up visits, but the actual implementation of the recommended methods is the responsibility of the requester. Technical assistance also includes verification of the cause of damage as may be necessary for available compensation and financial assistance.

Education is an important element of WS activities because wildlife damage management is about finding "balance" or coexistence between the needs of people and needs of wildlife. WS-Wyoming has participated in workshops that discussed nonlethal methods for WDM in 2016, and worked with the Natural Resources Defense Council on a fladry demonstration project in 2017. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, presentations and demonstrations are provided to ranchers, homeowners and other interested groups. Education and public outreach information is available from the WGFD, Montana Fish, Wildlife and Parks and the Idaho Department of Fish and Game on their websites, and is also made available through news releases, and presentations to interested groups and organizations by the state agencies and WS-Wyoming. Additionally, technical papers are presented at professional meetings and conferences so that WS-Wyoming personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies.

3.3.2.2 Operational Damage Management

Situations in which WS-Wyoming personnel conduct WDM activities are referred to as operational damage management or assistance. Operational assistance is sometimes provided when the problem cannot practically be resolved through technical assistance and cooperator-implemented measures (e.g., guarding dogs, exclusion, and herd management). The initial investigation defines the nature and history of the problem, extent of damage, and verifies whether or not the problem was caused by wolves. Professional assistance is often required to resolve problems effectively, especially if the problem is complex, or the management technique requires the direct supervision by or involvement of an experienced wolf damage management professional. Wolf biology, ecology and behavior and other factors are considered (WS Decision Model, Figure 3-1) when developing site-specific damage management strategies (Slate et al. 1992). Operational assistance may include helping with implementation of WDM methods for research or demonstration projects. For example, in 2016, WS-Wyoming partnered with the Natural Resources Defense Council to install turbo fladry in a demonstration project conducted in Northwestern Wyoming. Demonstration projects like the fladry project are a combination of technical (education) and operational assistance (installing the fladry).

3.3.2.3 Research

WS operations works closely with researchers at the NWRC, the research arm of WS. The NWRC is the leading wildlife damage management research complex in the world and scientists there are dedicated to developing new methods to reduce predator damage. Research associated with NWRC and work conducted in partnership with other

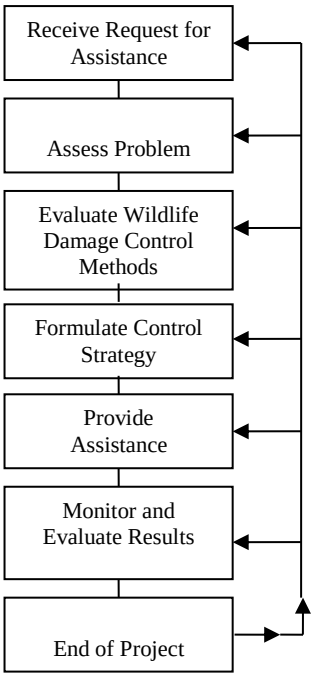
organizations has been critical to the testing and development of nonlethal methods for WDM (Shivik 2001, Shivik and Martin 2001, Breck et al. 2002, Shivik et al. 2002, Shivik et al. 2003, Lance et al. 2010, Young et al. 2015, Marlow 2016) and has improved the selectivity, humaneness and efficacy of capture devices (Sahr and Knowlton 2000, Darrow and Shivik 2008). State WS offices assist the NWRC with research projects and, because of the close collaboration between NWRC and the state offices, the latest research findings are available to be incorporated into state operational activities and technical assistance. WS also monitors the scientific literature and attends professional meetings to obtain information on recent developments in WDM that can be used to improve WDM activities and reduce risks of adverse environmental impacts.

WS-Wyoming also receives requests for information and assistance from other researchers. For example, WS-Wyoming occasionally provides blood and/or tissue samples from captured wolves to WGFD for disease surveillance and a better understanding of wolf genetics

3.3.3 WS Decision Model used for Decision Making

WS uses the WS Decision Model (Slate et al. 1992) for assessing, and responding to, instances of wildlife damage (Figure 3-1) which resembles the problem-solving process used by wildlife management agencies when addressing wildlife conflicts. The Decision Model is a thought process not intended to require documentation or a written record each time it is used, and it necessarily oversimplifies complex thought processes. Decisions made using the model would be in accordance with the alternative selected for implementation and associated protective measures established as part of the decision. Trained personnel assess the problem, and evaluate the appropriateness and availability (legal and administrative) of damage management strategies and methods based on biological, economic and social considerations including:

Figure 3-1. WS Decision Model



- Species responsible for the damage (*e.g.*, did wolves cause the problem or was it something else?)
- Magnitude, geographic extent, frequency, historical damage and duration of the problem including review of animal husbandry practices and producer efforts at nonlethal WDM
- Status of target and nontarget species, including T&E species
- Local environmental conditions
- Potential biological, physical, economic and social impacts
- Potential legal restrictions
- Costs of damage management[14]

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

The thought process and procedures of the APHIS-WS Decision Model include the following steps (Figure 3-1):

1. **Receive Request for Assistance**: WS-Wyoming only provides assistance after receiving a request. Employees can respond by providing professional technical assistance on-site or through verbal or written communication. If the requester needs further on-site operational assistance, WS-Wyoming and the requester will agree to the level of service desired and enter into a work agreement.
2. **Assess Problem**: The specialist gathers and analyzes damage information in the field to determine what species was responsible for the damage and the type, extent, and magnitude of the damage. Other factors that WS-Wyoming's employees often consider include the current economic loss or current threat, such as the threat to human safety, the potential for future losses or continued damage, the local history of damage in the area, environmental considerations, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. **Evaluate Management Methods**: Once a problem assessment is completed, the field specialist conducts an evaluation of available management methods to recommend the most effective strategy, considering available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, social, and cultural factors.
4. **Formulate Management Strategy**: The field specialist formulates a management strategy using the methods that the employee determines to be practical and effective for use, after consideration of additional factors essential to formulating each management strategy, such as available expertise, property owner land use and management objectives, legal constraints on available methods, costs, and effectiveness. Preference is given to use and recommendation of practical and effective nonlethal methods (WS Directive 2.101).
5. **Provide Assistance**: After formulating a management strategy, technical assistance and/or direct operational assistance is provided as appropriate (see WS Directive 2.101).
6. **Monitor and Evaluate Results of Management Actions**: Monitoring is conducted during and after implementation of the management strategy to assess the effectiveness of the strategy. Effectiveness of the management strategy is monitored, primarily by the cooperator, with assistance by WS-Wyoming when appropriate. Monitoring is important for determining whether further assistance is required or whether the management strategy resolved the problem.
7. **End of Project**: If the strategy is effective, the need for further management is ended. When providing technical assistance, a project normally ends after the WS-Wyoming field specialist provides recommendations. Direct operational assistance ends when WS-Wyoming's field specialist is able to eliminate or reduce the damage or threat to levels acceptable to the cooperator. Some damage situations may require continuing or intermittent assistance from WS-Wyoming and may have no well-defined termination point, as work must be repeated periodically to maintain damage at low levels. If one method or a combination of methods fails to stop damage, that strategy is revised or a different strategy is implemented. In terms of the WS Decision Model (Slate et al. 1992), most damage management efforts consist of a continuous feedback loop between receiving the request and monitoring the results, with the damage management strategy reevaluated and revised periodically as necessary.

3.3.4 Local Decision Making Process

Wolf conflict management in Wyoming follows a "co-managerial approach" to address wolf conflicts as generally described by Decker and Chase (1997). Within this management model, trained personnel provide technical assistance regarding the biology and ecology of wolves and effective, practical and reasonable methods available, including nonlethal and lethal methods, to requesters of WS-Wyoming assistance to reduce wolf conflicts. Technical assistance on alleviating damage caused by wolves is also available from WGFD, the USFWS and private organizations. WS-Wyoming, WGFD or tribal leaders, as appropriate, may also facilitate discussions at local community meetings when resources are available, and may make recommendations. Resource owners and others affected by wolf damage or conflicts have opportunity for direct input into the strategies to resolve the problem(s). They may implement management recommendations provided by WS-Wyoming or others, or may request management assistance from WS-Wyoming, WGFD or the tribes, as appropriate. Local resource owners compare the benefits versus the damage when deciding which nonlethal methods they would want implemented. Resource owners must weigh the cost of implementing each methodology or a series of methodologies.

3.3.5 Consistency with Forest Service Land and Resource Management Plans (LRMPs) and BLM Resource Management Plans (RMPs)

Before any WS-Wyoming action specified under the alternatives presented in this EA may be implemented on public lands, it must be found consistent with the applicable land management plans, and other procedures and requirements for protection of the special features and uses of the site. On National Forest System or BLM lands, it must be found consistent with the land management and/or resource management plans. These are termed Land and Resource Management Plans (LRMP) or more commonly "Forest Plans" in the Forest Service; on BLM lands, the equivalent documents are called Resource Management Plans (RMP). These measures are established as part of the agency planning process which includes NEPA analysis and opportunity for public comment.

In areas where WS-Wyoming anticipates they may be requested to work (i.e., areas with livestock grazing within known wolf range), special needs of the site and consistency of WDM methods with management plans, and agency directives and policy, are assessed in advance in work plans. The land management agency informs WS-Wyoming of special management areas, sensitive resources, and other areas where protective measures are needed or where other requirements must be met prior to conducting work. The agency and WS work collaboratively to identify acceptable strategies that may be used to resolve wolf predation while also remaining consistent with the requirements specific to the area where they are working. No WDM method would be implemented on public lands unless any potential inconsistencies have been resolved. In areas where WDM may not be as likely or was not anticipated, consistency with agency land and resource management plans, and directives would be assessed on a case by case basis prior to implementing WDM. For actions which are proposed for Wilderness Areas, WS-Wyoming would work with the land management agency to ensure that a Minimum Requirements Analysis is prepared for the proposed action, with the methods to be used subject to the provisions of the analysis. Appendix E provides a list of special land classes in the state, notes the probability that WS-Wyoming could be asked to work at the site, and notes methods which might or might not be available for use.

While some of the resources and issues of concern may be fixed over time, some may change over the life of the agency resource management plan. For example, sensitive species range may change, additional species of concern may be identified, livestock grazing authorizations may shift to different areas, special events and patterns of public use may also change. Use of the

annual work plan process in combination with the public planning process of the land management agencies and the NEPA process for this EA allow the agencies to meet the need to include the public in the planning process while retaining the flexibility needed to adapt to a dynamic environment.

3.4 WOLF CONFLICT MANAGEMENT METHODS

The following section lists the WDM methods that could be used or recommended for use by WS-Wyoming.

3.4.1 Description of Methods

3.4.1.1 Nonlethal Methods Available to All

Some wolf conflict management methods are available for anyone to use. These consist of nonlethal preventive methods such as cultural practices (*e.g.*, possible changes in livestock management, timing and use of higher-risk pastures, etc.) and localized habitat modification (*e.g.*, clearing brush, improving fencing, etc.) on private property.

Many of these methods require ongoing effort and/or regular (at least daily) or sustained presence with the livestock for extended periods of time (e.g., some livestock management practices listed below, guarding and hazing, range riders, care of livestock guarding animals). Given the dispersed nature of WS-Wyoming service recipients and current resource limitations, these types of actions are best implemented by the resource owners/managers. Similarly, actions such as construction of permanent fencing may be most efficiently and economically handled by the land manager, or a private business that specializes in fence construction and WS does not generally provide this type of assistance. WS-Wyoming's primary role involving these techniques is to encourage livestock producers and resource owners/managers to use these methods, based on the level of risk, need and professional judgment on their effectiveness and practicality. WS-Wyoming would also provide guidance (technical assistance) on the safe and effective implementation of these methods and, may have information on sources of supplies and assist with demonstration projects (Section 3.3.2.2). Technical assistance with nonlethal methods provided by WS-Wyoming also includes verification of losses for purposes of the compensation program in the WTGMA at the request of the WGFD.

A recent survey of sheep producers collected data on nonlethal methods used to reduce predation (all predators combined) (USDA APHIS Veterinary Services 2015). The proportion of Wyoming sheep producers implementing at least one nonlethal predator damage management method (79%) was considerably higher than the national level (58%)(USDA APHIS Veterinary Services 2015); (USDA, unpub. data, 2015). In Wyoming, among producers that reported using at least one nonlethal method, methods employed included livestock guarding dogs (36% of operations), guard llamas (16%), guard donkeys (7%), fencing 24%, shed lambing (47%), herders (13%), night penning (34%), frightening devices (7%), carcass removal (20%), culling older stock (34%), changing bedding grounds (13%), frequent checks in high risk areas (30%), altered lambing schedules to avoid period of greatest predation risk (5%), and other nonlethal methods (8%)(USDA APHIS Veterinary Services 2015).

Differences in livestock production practices (e.g., herders are used with range bands of sheep whereas cattle are generally allowed to disperse throughout allotments), and differences in vulnerability of cattle to common predators other than wolves (e.g., coyotes) contribute substantially to the differences in adoption of nonlethal methods. Methods such as livestock guarding animals and frightening devices are dependent, in part, on the animals to be protected being concentrated in an area that can be protected. While these types of methods may work for some calving areas, they are generally ill suited to cattle in large pastures or open range. In Wyoming, 10% of cattle producers reported losses to any predators and 14% of producers reported using nonlethal methods (USDA APHIS Veterinary Services 2017). Meanwhile, nationwide, 9% of cattle producers reported losses to predation and 19% reported using at least one nonlethal damage management method(USDA APHIS Veterinary Services 2017). The 2015 survey of cattle producers did not provide state-specific data on use of nonlethal methods, but nationwide, the most common methods employed either as a sole method or in combination with other methods were livestock guarding animals used singly or in combination with other methods (33%), fencing (20%), frequent checks (15%), culling sick/injured/older animals (14%), carcass removal (14%), and other combinations of methods not specified in the report (23%)(USDA APHIS Veterinary Services 2017).

Livestock Management Practices are implemented to prevent or reduce wolf conflicts and may include approaches such as: 1) properly disposing of dead livestock carcasses (*i.e*., removal, burying, liming, or burning), 2) conducting calving or lambing operations in close proximity to the ranch headquarters, when practical, 3) penning vulnerable livestock at night where practical, 4) monitoring livestock on a regular basis to detect any disease, natural mortality, or predation, 5) moving weak, sick or injured animals to areas with reduced risk of predation (e.g., near ranch headquarters), and 6) incorporating other nonlethal methods. Property owners and land managers may implement these management practices, request the assistance of other agencies or private organizations to implement them, or take no action. Harper et al. (2008) observed that even attempting to trap without capturing wolves, appeared to reduce re-depredation rates over not attempting to trap, indicating that the increase in activity near depredation sites associated with setting and monitoring traps (daily) can aid in reducing losses. Similar increases in activity without necessarily setting traps may also be beneficial.

Like other authors, Muhly et al. (2010b) found relationships between site characteristics and losses to wolf predation in Alberta, Canada, with losses to wolves higher in areas with greater elk density, areas farther from roads, sites closer to woodlands, and in areas with more level terrain. Unlike other authors, losses were greater in quarter sections closer to buildings, but this may have been an artifact of low population density in the project area. However, Muhly et al. (2010b) found that husbandry practices were more strongly correlated with losses to wolf predation than site characteristics. Consistent with findings of other studies, frequent checking of livestock in winter and spring was correlated with reduced livestock losses. Conversely, checking livestock in the fall was associated with increased livestock losses. The study was correlational in nature and while it did identify relationships among factors, it did not provide reasons for the relationships. The authors hypothesized that the difference between Winter/Spring and Summer/Fall checking may have to do with the fact that most producers in the area increased checking in Winter/Spring as a preventive measure, but that increases in checking in Summer/Fall may have been the response of individual producers to depredation events. Yearling cattle herds also appeared to be more vulnerable to predation than other groups including cow/calf groups. The combination of information

on the impact of site characteristics and husbandry indicates that, when the option is available, moving more vulnerable stock to areas with a lower risk of predation may help decrease losses.

Exclusion with some type of fence or other barrier may be used to prevent or limit access by predators to livestock pastures, calving or lambing areas, or livestock confinement areas. Where practical, sheep, calves or other vulnerable livestock may be penned near ranch buildings at night.

Fladry is a form of barrier and wolf deterrent involving red flags measuring approximately 3 x 18 inches, strung about 20 inches apart, hanging from a thin rope or cord suspended about 30 inches above the ground. Fladry is installed around pastures or other areas where livestock are confined to discourage wolf access. Part of the repellency provided by fladry is probably related to the frequent human visitation required to ensure that the flags remain freely suspended and that the line is properly maintained. Like many other frightening devices, wolves may eventually habituate to this deterrent. However, Musiani et al. (2003) reported that fladry was at times effective and reduced the need for lethal control in their study for up to 60 days, and Davidson-Nelson and Gehring (2010) reported that if maintained, fladry can exclude wolves from livestock for up to 75 days. However, Shivik et al. (2003) found that disruptive stimulus devices outperformed fladry as a WDM preventive measure.

Turbo-Fladry is very similar to regular fladry with the exception that the cord is substituted with electrified wire attached to a standard livestock electric fence generator. As wolves habituate to the fladry line and try to cross under it, the negative stimulus they receive after getting shocked by the electrified barrier can increase the amount of time the barrier may remain effective. In pen trials, Lance et al. (2010) found that electrified fladry was 2–10 times more effective than fladry at protecting food in captivity, but that hunger increased the likelihood of wolves testing these.

Livestock guarding animals such as large, aggressive breeds of guarding dogs (*e.g.*, Great Pyrenees, Akbash, etc.) have been used with some success to protect livestock from wolves, but multiple guard dogs work better than just one or two guard dogs (Bangs et al. 2005, Urbigkit and Urbigkit 2010). Even with 3 or more dogs present, wolves occasionally kill or severely injure livestock guarding dogs. Livestock guarding dogs are generally not killed as prey but because of interspecific aggression (Bangs et al. 2005). Ongoing research by the NWRC has been working to identify livestock guarding dog breeds that are better suited to protecting livestock from larger predators such as wolves and bears (Marlow 2016).

Other types of livestock guarding animals, such as llamas, which have been shown in some circumstances to be effective in protecting sheep from coyotes, are not as effective in deterring wolves. Wolves probably view llamas as prey, and multiple instances of wolves killing and feeding on, or injuring llamas have been documented in the NRM (United States Fish and Wildlife Service et al. 2002, United States Fish and Wildlife Service et al. 2003, United States Fish and Wildlife Service et al. 2005, United States Fish and Wildlife Service et al. 2007, United States Fish and Wildlife Service et al. 2008, United States Fish and Wildlife Service et al. 2011, United States Fish and Wildlife Service et al. 2013).

Guarding and hazing involves using human presence to guard an area and then using pyrotechnics or other frightening devices to frighten wolves from the site if/when they arrive. Hazing can be used as an aversive technique, but requires that the technique be used consistently whenever the animal attempts to prey on the protected resource so they do not identify conditions when they can obtain prey without receiving a negative experience (Shivik 2004). If there are any radio-collared wolves in a pack which may pose a threat to livestock, nonlethal hazing efforts can be enhanced if the livestock producer or other personnel make use of a radio receiver to determine when wolves are near or approaching the livestock (Bangs et al. 2006). This requires diligent and persistent monitoring, but can make hazing much more effective.

Herders and/or range riders can assist in the guarding and hazing of livestock and in some areas are extensively used. Herders/range riders are people that live with and/or spend significant time/effort with the livestock, often moving them from area to area, monitoring for predators, assisting with implementation of nonlethal management techniques (e.g., carcass removal, relocation of sick/injured animals, frightening devices), and/or quickly discovering a depredation event before environmental factors degrade the scene and/or before additional predation occurs.

Frightening devices are methods that usually involve lights, sound and/or motion devices designed to deter wolves from a certain area. Strobes and flashing lights, propane exploders, sirens, and various combinations of these devices have all been used in attempts to reduce livestock losses, with wide-ranging degrees of effectiveness (Linhart 1984, Andelt 1987). Animal habituation (becoming accustomed) to the stimulus is one of the primary limiting factors for repellents. Essentially, anything new or different is likely to elicit avoidance behavior by canids, but this effect disappears over time. Moving the devices intermittently and randomly as well as alternating the stimuli (*e.g.*, a different type of noise or light) may extend the effective period of the system (Shivik and Martin 2001). The period of efficacy may also be extended by using systems which are motion-activated or only activated when a wolf wearing a transmitter collar comes into close proximity to the protected site. The Radio Activated Guard (RAG) is one such frightening device that employs this approach, and RAG devices have been field-tested in Idaho with some success (Breck et al. 2002). Use of the RAG in Idaho has been most effective in protecting livestock in small (≤ 40-60 acre), fenced-in areas.

Compensation for wolf damage does not reduce wolf conflicts, and does not preclude implementation of lethal actions, but can help offset some of the costs of wolf depredation and increase public support for wolf conservation. Under state statutes, the WGFD is required to compensate livestock producers for livestock killed by wolves and in some circumstances may compensate for livestock missing at the end of the grazing season. WS-Wyoming employees are often able to provide this confirmation as part of the initial investigation into complaints of wolf damage, but in some cases, the evidence remaining is insufficient to confirm that a wolf or wolves actually killed the animal.

3.4.1.2 Nonlethal Methods Available to Authorized Agencies and Individuals

Some nonlethal methods, research projects and population monitoring efforts involve capture and handling of wolves, which may not be conducted by the general public. Methods that require capture and handling of wolves would only be conducted by WGFD or tribal personnel, or agencies authorized by WGFD and the tribes including WS-Wyoming.

Foot-hold traps can be effectively used to live capture wolves, and are an extremely important tool in wolf management. When wolves are trapped, they are ordinarily physically restrained, chemically immobilized, radio-collared and released on site, or euthanized on site. Effective trap placement, pan-tension devices and the selection and placement of appropriate lures and baits by trained personnel contribute to selectivity of the foot-hold trap. WS policy requires that foot-hold traps used for wolf conflict management have offset or padded jaws to reduce foot injury to captured wolves (WS Directive 2.335). Traps may also be modified with small protrusions or "nubs" on the jaws to reduce the likelihood of the wolf's foot moving back and forth in the jaws, thereby reducing the potential for trap-related injury. Over the period of FY 07-16, foot-hold traps were the only live-capture method used by WS-Wyoming for wolves.

Disadvantages of traps include the difficulty of keeping them operational during rain, snow or freezing weather, and the fact that they cannot be 100% selective. Although pan-tension devices are effective in reducing the likelihood of unintentional capture of nontarget species smaller than wolves (*e.g.*, red foxes, coyotes), they cannot preclude the occasional capture of larger nontarget species such as mountain lions or black bears. They do, however allow for the option of releasing nontarget animals which may infrequently be captured. Whenever WS-Wyoming employees deploy traps for wolves, they post warning signs at access points into the area to alert people to the presence of traps.

Foot snares are devices consisting of a cable loop and a locking device that captures an animal around its foot or lower leg. The cable may be activated around the lower leg with a spring-powered throw-arm (Aldrich-type) or trap-type (Belisle) device. The foot snare can be modified with a stop on the cable to restrict the closure of the loop. Careful snare placement, pan-tension devices and the selection and placement of appropriate lures and baits by trained personnel contribute to the selectivity of this device. As with foot-hold traps, when foot snares are used as a live-capture device, wolves would ordinarily either be radio-collared and released on site, or euthanized. Foot snares are more often used for capture of mountain lions and black bears than for wolves.

Dart guns are capture tools that utilize a dart filled with tranquilizer drug, fired from a specially designed firearm. They would ordinarily only be used on wolves when conducting live-capture operations from a helicopter. Once tranquilized, the animal may be handled safely and processed for research or monitoring purposes. Use of dart guns would have no effect on nontarget species because positive target species identification is made before animals are darted. Thus, use of dart guns by WS-Wyoming personnel is expected to be 100% selective for target individuals and species, and would not pose a risk to nontarget species and individuals. All WS-Wyoming personnel who would dart wolves or deliver immobilizing drugs attend a minimum 2-day accredited training course and an online distance learning module on immobilizing wildlife, and pass all associated post-course tests. To maintain certification, WS-Wyoming employees are required to receive 16 hours of continuing education every 3-years and pass an online exam administered by the attending veterinarian at the USDA NWRC.

Snares can be used to live-capture animals around the neck with the use of a "stop" to prevent full closure of the loop, and improved methods for use are being developed for live-trapping wolves and other carnivores (Olson and Tischaefer 2004). Snares are ordinarily not affected by rain, snow and freezing weather to the extent that foot-hold

traps are. These devices offer a degree of selectivity based on the size of the cable loop and the height of the loop above ground level. They also offer a viable live-capture alternative to foot-hold traps during the winter months, when freezing temperatures combined with restricted blood circulation could result in damage to a captured wolf's foot. WS-Wyoming is working with NWRC on a pilot project using advanced break away snares to remotely attach radio collars for short term wolf monitoring purposes.

Capture and Relocation of problem wildlife species is a technique that is sometimes used to alleviate wildlife damage problems. The success of a relocation effort, however, depends on the potential for the problem individuals to be captured efficiently and the existence of an appropriate relocation site (Nielsen 1988). While relocation may be appropriate in some situations, especially when the species population was small, wolves are found in much of the suitable habitat in Wyoming and relocation is not necessary for the maintenance of viable populations (Section 1.4.5, (Mech et al. 1996, Linnel et al. 1997)). Identification of release sites and agreements with appropriate land owners/managers must be done before relocation efforts can be initiated.

Many predators that are relocated either return (even when displaced hundreds of miles), get into similar conflicts again, or die (Fritts et al. 1984, Linnel et al. 1997, Shivik 2001, Bradley et al. 2005). Relocated wolves, after being taken out of their element, often die, either slowly by starvation, brutally by another pack or killed on a highway (Shivik 2001), and some resume depredation at the relocation site (Bangs et al. 1995, Bradley et al. 2005). Fritts et al. (1984) who analyzed the fate of relocated wolves in Minnesota concluded that translocation was unsuccessful because all wolves traveled away from the release sites, some traveled through agriculture areas, and 42% of wolves with a known fate were recaptured at depredations sites. In the Northern Rockies, 27% of relocated wolves again caused depredations, and only 33% joined or formed new packs (Bradley et al. 2005). Relocated wolves also had lower survival rates than non-relocated wolves.

We understand that there may be isolated circumstances where relocation of wolves may be appropriate, and certain release practices may reduce some of the problems with relocation. However, given the limitations above and the current status and distribution of the wolf population in Wyoming, we expect capture and relocation to rarely be used. Any relocations would be conducted under the direction of the applicable state and tribal management agencies.

Radio-Tracking Collars and Satellite Tracking Collars: Tracking collars may be used to mark wolves for research, population monitoring, verification of packs involved in depredations, locating packs for optimal deployment of nonlethal WDM methods, and location of depredating packs for lethal removal of wolves. Tracking collars may be used by WGFD and tribal personnel. These entities may also authorize use of these methods by designated agents of the state and tribes such as WS-Wyoming, land management agencies, and research institutions.

3.4.1.3 Nonlethal Methods Which May Require Special Authorization from WGFD or Tribes

Some animal behavior modification systems involve capturing and fitting wolves with radio-transmitting collars to deliver or trigger repellent stimuli (*i.e.*, aversive conditioning). Other systems sometimes referred to as "less than lethal munitions," involve shooting wolves with projectiles such as rubber bullets or bean bag rounds.

These techniques involve intentionally using painful stimuli to modify wolf behavior. The WGFD or the tribes may require permits or other authorizations to use these methods and any other experimental wolf conflict management techniques. Methods that require capture and handling of wolves would be conducted only by personnel from WGFD, WS-Wyoming or the tribes or personnel authorized by WGFD and the tribes.

Aversive Stimuli are stimuli that cause discomfort, pain and/or an otherwise negative experience paired with specific behaviors to achieve conditioning against these behaviors. One example is the use of a dog training shock collar or similar device that is activated when wolves come into close proximity to a protected area, such as a livestock pen although in Schultz et al. (2005) there were problems with pack members of the collared wolf killing livestock (Shivik et al. 2003, Schultz et al. 2005). Rossler et al. (2012) determined that wolves with shock collars visited protected zones less and spent less time in treated zones than wolves without shock collars during 40-day shock periods and 40-day post-shock periods. Collared wolves remained away from shock zones for a greater number of days compared to control wolves and a smaller proportion of treatment pack members visited shock zones during shock and post-shock periods compared to packs that did not have members with shock collars. Additional development of the collar has helped to address concerns with animal safety, battery life and device performance (Hawley et al. 2013). As with some other frightening devices, the utility of this device in protecting large areas is limited.

Nonlethal Projectile use involves guarding an area and then using rubber bullets, bean bag rounds or other nonlethal projectiles to prevent a predation event. They can be used as an aversive conditioning technique, but require that the projectiles be used consistently whenever the predator attempts to prey on the protected resource, so it is less likely to identify conditions when it can obtain prey without receiving a negative experience (Shivik 2004). Methods which require around-the-clock presence of a person to guard the resource are most efficiently used when there are radio-collared wolves involved and the landowner/resource manager assists with the implementation. WGFD may agree to allow the use of these methods and allow WS-Wyoming to train private individuals to use such methods.

3.4.1.4 Lethal Methods

These methods are specifically designed to lethally remove wolves in certain situations to stabilize, reduce or eliminate conflicts. Use of lethal WDM methods to reduce damage by and conflicts with wolves as currently conducted and proposed by WS-Wyoming is intended as a short-term strategy to reduce depredations at the specific locations where the conflict occurs. The amount of removal necessary to achieve a reduction in wolf damage varies according to the effectiveness of other conflict management strategies, the conflict situation, and the level and likelihood of continual depredations. Under Alternative 1, WS-Wyoming would only use lethal WDM methods in the WTGMA at the direction of the WGFD. In the Predatory Animal Zone, WS-Wyoming would use the WS Decision Model (Slate et al. 1992) to determine when lethal management would be used. Under any of the alternatives, livestock and domestic animal owners, their employees or agents, may shoot a wolf in the act of attacking said animals (Wyoming Game and Fish Commission 2011). In the WTGMA, livestock and domestic animal owners may also be issued permits by WGFD to shoot wolves, in response to wolf conflicts (Wyoming Game

and Fish Commission (WGFC) Chapter 21, Regulation: Gray Wolf Management, Lethal Take Permits). WGFD may also establish provisions which allow livestock and domestic animal owners to also use traps to remove wolves in response to wolf conflicts. People in the Predatory Animal Zone may use lethal methods to take wolves without a permit. The lethal wolf management techniques that would be available to WS-Wyoming under Alternative 1 would include the use of foothold traps and snares, as described above under Section 3.4.2, followed by euthanasia, typically by gunshot to the brain (American Veterinary Medical Association 2007, Julien et al. 2010). Additional lethal methods used under Alternative 1 would include shooting, from the ground as well as from fixed-wing aircraft or helicopters.

Shooting from the ground is highly selective for the target species, and may be employed in conjunction with the use of auditory attractants (*e.g.*, sounds of prey animals in distress or imitations of wolf vocalizations). Removal of one or two specific animals by shooting in the problem area can sometimes provide immediate relief from a predation problem. Shooting is often attempted as one of the first lethal control options because it offers the potential of solving a problem more quickly and selectively than some other techniques, but it requires visually sighting the wolf within effective shooting distance. Shooting may sometimes be one of the only management options available if other factors preclude the setting of equipment (*i.e.*, traps or snares). During the 10-year period from FY 07 - FY 16, 18% of all wolves lethally removed by WS-Wyoming for WDM were taken by shooting from the ground.

Aerial Shooting typically involves visually locating depredating individuals or packs from either a small single-engine fixed-wing aircraft or a helicopter, and shooting them from the aircraft with a shotgun. Shooting typically results in a relatively quick death. Depredation problems can sometimes be resolved very quickly and effectively through aerial shooting (*e.g.*, by starting the aerial operation in the vicinity of a recent wolf kill, and catching the wolf or wolves when they return to feed on the livestock carcass.). Cain et al. (1972) rated aerial shooting as "very good" in effectiveness for problem solving, safety, and lack of adverse environmental impacts. Smith et al. (1986) cited cost-effectiveness and efficacy as benefits of aerial shooting. Aerial shooting can be particularly useful in remote areas and areas where limited or poor road access can increase ground transportation time and the labor involved in setting and checking land-based wolf removal methods.

Good visibility is required for effective and safe aerial shooting operations, and relatively clear and stable weather conditions are necessary. Summer conditions limit the effectiveness of aerial shooting because the increased vegetative cover makes finding the animals more difficult, and the higher ambient air temperatures reduce air density, which affects low-level flight safety.

In Wyoming, aerial shooting is one of the most effective methods of removing depredating wolves available, with more wolf damage problems resolved by aerial shooting than by any other method. During the 10-year period from FY 07 - FY 16, 73% of all wolves lethally removed by WS-Wyoming for WDM were taken by aerial shooting.

Neck snares may be used as lethal or live capture devices. This device may be used wherever a wolf moves through a restricted area (*i.e.*, crawl holes under fences, trails through vegetation, etc.). They are easier to keep operational during periods of inclement

weather than are foothold traps. During the 10-year period from FY 07-16, no wolves lethally removed by WS-Wyoming for WDM were taken by neck snares.

Foot-hold traps are described above in Section 3.4.2. Wolves capture in foot-hold traps can be euthanized via shooting or use of euthanasia drugs. Over the period of FY 07-16, an annual average of 9% of wolves lethally removed by WS-Wyoming for WDM were taken using this method.

Sodium Pentobarbital (Beuthanasia®-D) is a chemical euthanasia agent registered for domestic dogs, but may legally be used on other animals if said animals are not intended for human consumption. It is classified as a barbiturate. Barbiturates, by definition, depress the central nervous system, beginning with the cerebral cortex, progressively leading to unconsciousness and ultimately, death. The primary advantage of barbiturates is their speed of action. Barbiturates induce euthanasia smoothly, with minimal discomfort to the animal (American Veterinary Medical Association 2007). This method of euthanasia would likely only be used in the rare circumstance that an already sedated wolf was determined to have health issues such that it would be most appropriate to euthanize the animal. Carcasses of wolves killed using euthanasia chemicals would normally be given to the WGFD or tribe. Alternatively, they may be disposed of in a manner consistent with applicable state or tribal direction and WS immobilization and euthanasia and carcass disposal directives so that the carcass is not accessible to scavengers.

Public Harvest. States and tribes may establish wolf harvest seasons for a variety of reasons including to reduce wolf numbers in area's with a history of conflicts with wolves. WGFD takes a variety of factors into consideration when establishing wolf harvest seasons including conflicts with people and potential impacts of wolves on prey species (Wyoming Game and Fish Commission 2011). Research by DeCesare et al. (2018) provided evidence that wolf harvest seasons may result in a slight reduction in the number of depredation events in an area per year. WS does not have the authority to establish or manage harvest seasons. Furthermore, when WS-Wyoming uses lethal methods to resolve a conflict, WS-Wyoming makes every effort to target the specific wolves or pack involved in the depredation. WS-Wyoming would not engage in wolf removals intended to reduce the wolf population in a region of the state as may occur with harvest seasons. Nonetheless, this method is available to some landowners at the discretion of the WGFD or tribes.

3.4.2 Efficacy of WDM Methods

The integrated and adaptive approach currently employed by WS-Wyoming typically involves use or recommendation of both nonlethal and lethal measures to stop or reduce the likelihood of further wolf damage. Both nonlethal and lethal methods can be effective but also have limitations and no one method or strategy is universally effective or applicable for all situations. The following section reviews information on the efficacy of WDM methods. Additional information on individual methods is provided in the Section 3.4.1 discussion of individual methods.

Regardless of the method used, timing of response is a critical component in effective WDM Karlsson and Johansson (2009) reviewed data on livestock predation by brown bears, wolves and lynx on farms in Sweden and concluded that the risk of predation greatly increased during the first several weeks after an initial predation incident. They suggested that control efforts, whether lethal or nonlethal, would be most effective if applied during this period of time following an

initial depredation event. Nonlethal methods like frightening devices may be most effective if employed before depredation occurs and wolves learn to use livestock for food. Similarly, Bradley et al. (2015) completed a review of the impacts of lethal removal of wolves for WDM on local livestock depredations in Idaho, Montana and Wyoming over the period of 1989 to 2008. In their study, partial pack removals reduced the occurrence of subsequent depredations by 29% over a span of 5 years with greatest efficacy achieved if removals were conducted within 7 days of the depredation, reduced success if removals were conducted between 7 and 14 days of the depredation, and no difference in losses if partial pack removals were conducted more than 14 days after the depredation occurred.

Nonlethal Methods

One of the most effective nonlethal deterrents to wolf predation may be the presence of humans who remain near the livestock, or frequently check livestock, and are vigilant in trying to detect the presence of wolves so they can be consistently frightened away (Shivik 2004, Harper et al. 2008). These efforts can be rendered more effective if there are radio-collared wolves in the area and the livestock guardian personnel (e.g., herders and range riders) make use of radio-telemetry receivers to detect the nearby presence of wolves. The costs to provide 24/7 human presence around livestock may be cost-prohibitive for individual livestock producers, but in some situations, outside parties with an interest in wolf conservation have provided such assistance at no cost to livestock producers, in order to promote greater tolerance for wolves. Defenders of Wildlife has paid for such nonlethal methods in the Big Wood River drainage of central Idaho during several recent summer grazing seasons, and while, as with any WDM method, these efforts have not been 100% effective in eliminating wolf problems, they appear to have been effective in reducing the number of wolf attacks on sheep and livestock guarding dogs in this area (Stone et al. 2017). As with continual guarding of livestock, increased frequency of checking livestock has been correlated with reduced losses to wolf predation (Harper et al. 2008, Muhly et al. 2010b)

Impacts of other livestock husbandry practices in reducing wolf predation have been mixed. Bradley and Pletscher (2005) assessed multiple factors potentially related to wolf depredations on cattle in fenced pastures in Montana and Idaho. They concluded there was no relationship between depredations and carcass disposal methods, calving locations, calving times, breed of cattle, or the distance cattle were grazed from the forest edge. They did find that depredations were more prevalent in pastures where elk were more likely to occur, where the pastures were larger in size, had more cattle, and where cattle were grazed farther from residences than pastures without depredations. Mech et al. (2000) likewise concluded there were essentially no differences in husbandry practices between farms in Minnesota that suffered recurring wolf depredations, as compared to similar operations which experienced no depredations, and that farms with cattle farther from human habitation suffered more losses. Like Mech et al. (2000) , Treves et al. (2004), and Bradley and Pletscher (2005), Muhly et al. (2010b) found relationships between site characteristics and losses to wolf predation in Alberta, Canada, with losses to wolves higher in areas with greater elk density, areas farther from roads, sites closer to woodlands, and in areas with more level terrain. Unlike other authors, Muhly et al. (2010b) found that husbandry practices (frequency and seasonality of livestock checks, age class of herd) were more strongly correlated with losses to wolf predation than site characteristics (Section 3.4.1).

Stone et al. (2017) studied adaptive integrated use of nonlethal strategies for minimizing wolf depredation on sheep managed on open range grazing operations in Idaho (Wood River Wolf Project). Various nonlethal methods were applied and adapted in areas based on terrain, proximity to wolf den or rendezvous sites, and the need to avoid overexposure to harassment methods resulting in habituation. The methods used included increased human presence,

especially at night; increased numbers of livestock guarding dogs after wolf pups left the den, which avoided aggressive wolf behavior toward the dogs; use of high powered halogen spotlights at night; harassment devices activated by radio collars on wolves; fladry at the right height, including turbo fladry; penning sheep at night when wolves were suspected nearby; starter pistols firing blanks and loud air horns when wolves were present; intermittent bright flashing lights; and following wolves using radio telemetry. Trained field technicians worked closely with the shepherds, including camping at night near the sheep bedding grounds, working with the management agency to devise alternative grazing rotations to avoid encounters, alternating harassment methods to minimize habituation, helping determine the strategy of what methods, how many to use, and when to change methods, and ensuring that the nonlethal methods were implemented effectively. Although the project did not have a rigorous study design with randomized treatment and control sites that contrasted management strategies, it did provide evidence that nonlethal strategies can be a valuable tool in WDM. Given the lack of randomized treatment and control sites, the authors recommend that the results should be interpreted cautiously. There could be inherent differences in predation rates from the area in which their case study occurred that are not accounted for in their study design. Furthermore, as pointed out in the paper, they did not consider regulated hunting and trapping and administrative removal of entire wolf packs that was ongoing in the area, which could have impacted their results in unknown ways. The authors recommend a combined approach incorporating consistent human presence at night, wolf monitoring with radio collars to determine and predict pack movements, and appropriate deterrents carefully applied. Estimated costs to protect a cluster of grazing areas for 4 livestock producers ranged from $22,000 to $48,000 annually, with technician labor and field transportation representing more than 85% of the total annual costs. An unquantified but significant amount of labor was provided as volunteer help, which was not included in the calculated costs. The applicability of this study to other systems is unknown, for example, with cattle in open range grazing situations. The conclusion that increased human presence and the use of nonlethal tools in an adaptive fashion could apply as recommendations for livestock producers when conditions as outlined in this paper warrant this strategy. Those conditions include sheep grazing in open rangeland grazing systems, resources to improve ability to monitor sheep and wolves particularly at night, and cooperation from natural resource agencies responsible for managing grazing on public lands.

Fladry has also been used to deter wolves for up to 60 days before some wolves crossed the barrier and killed livestock (Musiani et al. 2003). In the tests by Musiani et al. (2003), wolves shifted to alternative livestock when excluded from one herd, which has ramifications for use of the method in areas where multiple herds are in relatively close proximity. Davidson-Nelson and Gehring (2010) reported that if maintained, fladry can exclude wolves from livestock for up to 75 days. Electric fencing can help protect livestock from wolves especially when used in combination with fladry (i.e., turbo fladry). Turbo-Fladry substitutes the cord in regular fladry with electrified wire and can increase the amount of time fladry barriers may remain effective (Lance et al. 2010). Fladry and other types of fencing may not be permitted or effective for livestock grazing on large public land allotments. For livestock grazing on open range, temporary fences may be better suited to protecting sheep than cattle because sheep are routinely gathered to bed grounds which lends to being more readily protected this way. Fences may also be better suited for small areas with limited livestock. When temporary fencing is used, if the area to be protected is too large, it may not be cost-effective or too time consuming to keep installing and moving fencing to keep up with livestock needs for forage. This limitation precluded long-term adoption of turbo fladry in a recent demonstration project in Wyoming (M. Foster, WS-Wyoming, pers. comm.).

Like lethal methods, many nonlethal methods are often only temporarily effective, but they may offer protection for a long enough period of time to protect a resource when it is most vulnerable. An example is the use of the RAG in small calving pastures. Breck et al. (2002) reported that this frightening device, activated by the radio signal from an approaching radio-collared wolf, was effective in keeping a radio-collared wolf pack away from several small calving pastures in central Idaho for 60 days. However, this device is only useful in those cases where at least one and preferably multiple wolves in the pack are radio-collared, and it is only useful for protecting relatively small areas.

Bangs and Shivik (2001) reported that while some nonlethal methods may be temporarily effective, many are expensive for individual producers to implement and none available at the time of their report were widely effective. However, new research is identifying ways to improve some methods. For example, use of guard dogs has been tried against wolves in Minnesota with only limited success (Fritts et al. 1992). Coppinger and Coppinger (1996) showed the dominance of wolves over livestock guarding dogs in direct confrontations. Coppinger and Coppinger (1996) and Bangs et al. (1998) also reported that wolves have killed livestock guarding dogs. However, recent research by the NWRC indicates that some breeds of dogs may be more effective in reducing conflicts with wolves than others. This research is still underway and WS is assisting in these projects (Marlow 2016).

Early testing of aversive conditioning, such as the use of shock collars (Gustavson and Nicolaus 1987, Shivik and Martin 2001, Shivik et al. 2003), was not promising when used with wild wolves (Fritts et al. 1992). However, in case studies by Schultz et al. (2005), a wolf collared prior to any depredations did not engage in depredations that year, but did kill livestock the subsequent year when only a beeper but no shock was used. A second wolf was captured in 2001 after depredations began, and although it was kept off the farm, other pack members caused further depredation and were removed from the farm. Subsequent testing has refined the use of the method and indicates that shock collars, although a labor-intensive and expensive management tool, may have utility in addressing wolf depredations in some situations, especially when lethal methods are not an option (Rossler et al. 2012, Hawley et al. 2013).

Conclusions

Nonlethal methods can be beneficial in helping to alleviate or prevent depredation by wolves, but not all methods are practical and effective for every situation. Protection of cattle dispersed throughout large (thousands of acres) pastures and range allotments is particularly challenging. In contrast, herders are commonly used with sheep grazed in large pastures and range allotments, and sheep are commonly gathered to bed grounds in the evenings, making it easier to implement a wider range of nonlethal methods. Producer-reported implementation of nonlethal methods reflect this difference. Like lethal methods, the duration of efficacy of some methods is relatively short although careful application of methods like frightening devices can extend the period of efficacy for some methods. Some nonlethal methods may require ongoing implementation or repeat application.

Lethal Methods

Use of lethal WDM methods to reduce damage by and conflicts with wolves as currently conducted and proposed by WS-Wyoming is intended as a short-term strategy to reduce depredations *at the specific locations* where the conflict occurs. Given wolf behavior and the targeted nature of the management effort, these removals are not intended or expected to have regional-level impacts on livestock losses, and studies conducted to assess the efficacy of lethal removals at the regional level have not detected reductions in losses at this scale. Bangs et al. (2009) noted that lethal management of problem wolves had a role in reducing conflict because it:

1) enhanced effectiveness of nonlethal control measures, 2) interrupted use of livestock as food by surviving wolves, 3) removed offending individuals, 4) reduced wolf density in conflict areas, 5) eliminated packs where recurring livestock depredations had been occurring, 6) helped to keep wolf packs out of unsuitable habitat, 7) made surviving pack members temporarily avoid or be more wary of people and/or areas with livestock, 8) reduced the pack's overall need for food, 9) made it more difficult for the fewer remaining pack members to kill larger prey like adult cattle or attack calves protected by cows, 10) increased the detection rate of subsequent depredations because livestock carcasses were consumed more slowly (so additional control could be applied more rapidly), 11) reduced compensation and control costs, and 12) moderated some of the public anger over wolf predation on livestock.

WS-Wyoming aims to stop depredations following verified damage and most of the time, WS-Wyoming's efforts stop further depredations from occurring that year. Because of high wolf densities, wolf pack territories are frequently re-colonized by wolves the following year, which may result in subsequent depredations. However, only a small proportion of properties (3% in Predatory Animal Zone, 8% in WTGMA) have recurring predation issues (defined as requesting WS assistance in 3 or more years over the period of FY13 to FY18). Conversely, 80% of cooperators in the WTGMA and 70% of cooperators in the Predatory Animal Zone only requested WS-Wyoming assistance one year during the 6-year period of FY 2013-2018.

Musiani et al. (2003) observed that, in the western United States over the period of 1987-2001, the number of wolves killed by government authorities and the occurrences of wolf depredations were increasing and that these trends were related to concurrent increases in the wolf population. In Alberta, Canada, wolf take for depredation management increased and decreased in a pattern parallel to the number of domestic animals killed. Wolf take by government agents for depredation management only occurred in these areas when losses were confirmed and increase in take was the result, not cause, of increases in verified depredation. If take of wolves were to result in increases in depredation in subsequent years as proposed in Wielgus and Peebles (2014), discussed below, then data from Canada would have shown an increase in livestock losses the year after an increase in wolf take. However, this was not the case. Livestock losses to wolf predation showed increases and decreases throughout the study period and, in almost all years, take of wolves followed the same pattern as the number of domestic animals killed in the same year, illustrating the connection between reported losses of domestic animals and resultant corrective use of lethal WDM.

Musiani et al. (2005) concluded from a regional study conducted in Alberta Canada, and several northern Rocky Mountain states, that wolf depredation events follow predictable seasonal patterns that can be used to help plan efforts to reduce livestock depredation. The authors further state that in both the United States and in Canada, rapid responses to specific wolf depredation events were being used to control livestock losses, but not for wolf population management or regional depredation control. Musiani et al. (2005), did not detect regional-level decreases in livestock depredation in Montana, Idaho, Wyoming and portions of Alberta, Canada over the period of 1987- 2003, but noted the removals were not intended or expected to have regional-level impacts. Finally, the authors conclude that all methods described, including lethal methods along with nonlethal ones, could be employed without conflicting with wolf conservation objectives in either country.

Muhly et al. (2010b) identified a positive correlation between livestock losses to wolf predation and wolf removals for depredation management. The authors concluded that the patterns observed in their study, like Musiani et al. (2003) and Musiani et al. (2005), indicated that wolf removals were corrective (i.e., conducted in response to depredation events), not preventive, and

therefore their findings could not be interpreted to suggest increasing or decreasing levels of wolf removals for livestock protection. Like other authors, they did indicate that there was no evidence that wolf removals provided a long-term solution to wolf conflicts.

Harper et al. (2008) found that removing wolves at depredation sites in Minnesota did not impact depredations the following year at the state or local level. In a review of 2 localized farm clusters, Harper et al. (2008) showed that as more wolves were killed one year, the depredations increased the following year. These findings were not necessarily interpreted as indicating that WDM failed to resolve immediate wolf depredation problems. In fact, when Harper et al. (2008) looked at re-depredation rates within the same year and at the local level, trapping and killing adult males reduced re-depredation rates and removing wolves was generally effective at sheep farms. At the individual farm level and within 2.5 miles of the target farm, targeting adult males and continuing to trap if they are believed to be present may improve control effectiveness. Even attempting to trap without capturing wolves, appeared to reduce re-depredation rates over not attempting to trap, indicating that the increase in activity near depredation sites associated with setting and monitoring traps (daily) also aided in reducing losses. Harper et al. (2008) noted that while it was conceivable that reductions in depredation rates might be attributable solely to increased human activity, it would not explain why killing adult males in certain cases was most effective. Harper et al. (2008) provided 2 hypothesis for the observed pattern in: 1) the farms where more wolves were captured may have been areas where more wolves lived; or 2) wolves remaining after trapping may have learned to prey on livestock and might have become more dependent on livestock once pack mates were removed. An alternative likely hypothesis is that her study occurred during a period when the state wolf population was rapidly increasing (study used data from 1979-1998) so increases in depredations in subsequent years may indicate that as wolf populations in agricultural areas increased wolf damage increased (Harper et al. 2005). With the possible exception of adult males, age and sex of wolves removed did not impact re-depredation rates. Total number of animals removed did not appear to affect re-depredation rates. Considering the findings of Bradley et al. (2015) this may be due to the fact that it is not the number of wolves removed that matters, but whether all or only a portion of the pack was removed. Based on these findings, we conclude that at least some of the observed reductions in re-depredation rates were likely attributable to lethal removal of wolves and that impacts of lethal removals are restricted to the local level.

Fritts et al. (1992) evaluated Minnesota data from 1979 to 1986, and concluded that while use of lethal methods did not reduce depredations range-wide, it may have reduced depredations at specific farms. The amount of removal necessary to achieve a reduction in wolf damage varies according to the effectiveness of other damage management strategies, the damage situation, and the level and likelihood of continued depredations.

Bradley et al (2015) reported that lethal removal of wolves from depredation situations in the western U.S. resulted in a longer time to recurrent depredations than no lethal removal. In their study, median time between recurrent depredations was 19 days following no removal of wolves, 64 days following removal of some individuals within the depredating pack (partial pack removal) and 730 days following removal of entire packs. Partial pack removals reduced the occurrence of subsequent depredations by 29% over a span of 5 years. Complete removal of packs reduced occurrence of subsequent depredations 79% over 5 years. Timing of removal was especially important for partial pack removals, with greatest efficacy achieved if removals were conducted within 7 days of the depredation, reduced success if removals were conducted between 7 and 14 days of the depredation, and no difference in losses if partial pack removals were conducted more than 14 days after the depredation occurred.

Wielgus and Peebles (2014) reviewed the effects of wolf mortality on reducing livestock depredations from 1987 to 2012 in Idaho, Montana and Wyoming and concluded that the odds of livestock depredations the year after WDM removals were conducted was positively correlated with the number of wolves removed up and until wolf mortality exceeded the mean intrinsic growth rate of wolves at 25%. But the authors also acknowledge that lethal control of individual depredating wolves may sometimes be necessary to stop depredations in the near-term. Findings of the study have been interpreted by some to indicate that lethal removal of wolves makes depredation problems worse instead of better. However, subsequent review of the methods and conclusions has identified several critical flaws in the methods used in the analysis which render this analysis unsuitable for use in evaluating the efficacy of WDM methods. The conclusions of this review are provided in Appendix C.

Santiago-Avila et al. (2018) evaluated wolf population-level responses at three spatial scales to lethal and nonlethal wolf damage management on Michigan's Upper Peninsula in terms of post WDM likelihood of further livestock losses. The authors report that lethal WDM resulted in an insignificant reduction (27%) in the risk for repeated livestock depredation at WDM sites, and an insignificant increase (22%) in the risk for livestock depredation at sites up to 5.42 km from the WDM sites. Santiago-Avila et al. (2018) indicate that the results of their analysis are largely inconclusive, and suggest that agency record-keeping, bias in study site-selection, and the integrity of reporting are problematic for gaining a full understanding of differences between lethal and nonlethal approaches. After review of the analysis, we concur that the findings of the study were inconclusive and that modifications to study protocol may provide greater clarity. Concerns regarding enrollment bias and data collection likely reflect the difficulties in using records from a system intended to record operational activities for research purposes. WS-Wyoming remains open to the consideration of all peer-reviewed literature on the effectiveness of methods used for wildlife damage management. However, it is our opinion that the suspension of lethal WDM is not supported by Santiago-Avila et al. (2018).

Research by DeCesare et al. (2018), conducted in Montana between 2005-2015, provided evidence that wolf harvest seasons may result in a slight reduction in the number of depredation events in an area per year, but were less effective than targeted removals as proposed by WS-Wyoming under Alternative 1. They also reported increasing levels of targeted lethal removal reduced the probability that a depredation event would occur, but did not reduce the frequency of depredation events in places where depredations did occur. The study was correlational in nature, and provided information on relationships between WDM efforts and livestock losses, but did not definitively address the causes for the relationships observed. WS-Wyoming does not have the authority to establish or manage harvest seasons and would not engage in wolf removals intended to reduce the wolf population in a region of the state as may occur with harvest seasons. Nonetheless, this method is available to some landowners at the discretion of the WGFD or tribes, and, if effective, could reduce requests for WDM assistance from WS-Wyoming.

Potential for Lethal Removal to Disrupt Pack Social Structure and Inadvertently Increase Predation on Livestock.

Concerns have been expressed that lethal removal of wolves may remove older or dominant individuals that may be more experienced in capturing large prey such as elk. There have also been concerns expressed that the reduction in pack size associated with partial pack removal might also adversely impact the ability of a pack to obtain large prey and make them more likely to prey on livestock.

The success rate of wolf packs preying on elk appears to plateau at relatively low levels (2-6 wolves) with some individuals in larger packs, primarily nonbreeding adults with no dependent

offspring, withholding participation in predation events (MacNulty et al. 2012). Pack size does appear to play a greater role in the success of foraging on higher risk species (bison) with predation success rates plateauing for packs with 9-13 wolves and evidence of additional improvements for even larger packs (MacNulty et al. 2014). Even in YNP, where there is no wolf hunting or removals for WDM and pack sizes are larger, wolves preferentially take less abundant but relatively safer species (elk) than more abundant but higher-risk/effort bison (MacNulty et al. 2014, Tallian et al. 2017). Pack size in YNP for a pack that primarily foraged on bison in the winter when elk moved out of the packs' territory was in the optimal range for foraging on bison, but even this pack left Pelican Valley periodically in winter to forage on elk in Northern Yellowstone. The Jackson bison herd spends much of the summer and fall in Grand Teton National Park, until winter weather forces them to migrate out of the park and predominately to the National Elk Refuge and Bridger-Teton National forest. The 3-year mid-winter trend average (2015-2017) count for the herd was 593 individual bison (WGFD 2017). WS-WY could conduct wolf damage management activities in Bridger-Teton National Forest and any nearby private lands at the request of WGFD, given this area is part of the WTGMA. Bison do not occupy other areas of the state where WS-WY conducts wolf damage management activities.

Bradley et al. (2015) completed a review of the impacts of lethal removal of wolves for WDM on local livestock depredations in Idaho, Montana and Wyoming over the period of 1989 to 2008. There were no differences in depredation recurrence if breeding females or males >1 year of age were removed during partial pack removal. For partial pack removal, probability of recurrence of depredation events increased 7% for each animal left in the pack after the management response. However, the number of animals left in the pack was also directly related to the likelihood that a pack would meet criteria as a breeding pair the subsequent year, which is important for population restoration.

MacNulty et al. (2009) discussed evidence from observations of YNP wolves and suggested that as wolves age, their ability to kill elk declines due to physiological deterioration. The authors' data suggested that 2-3 year old wolves were in the best physical condition to attack and kill prey, and the higher the proportion of wolves over age 3 in the population, the lower the rate at which they kill elk.

Based on the above information, we do not believe there is sufficient evidence to indicate that wolf removals for damage management would lead to an increased likelihood of depredation. Further evidence of this conclusion is provided by the relatively low rate of repeat requests for lethal WDM assistance from WS-Wyoming, with only 3% of cooperators in the Predatory Animal Zone, and 8% of cooperators in WTGMA requesting assistance from WS in 3 or more years over the 6-year period of FY 2013-2018.

Conclusions

Lethal removal of depredating wolves can be an effective tool in addressing wolf depredations. However, like nonlethal methods, lethal removal may not be effective or appropriate for all situations and benefits may be short-term and are highly localized. Bradley et al. (2015) determined that removal of the entire depredating pack following verified depredations had the longest time until additional losses were verified, longer than partial pack or no wolf removal and should also be considered in the discussion on the efficacy of lethal wolf removal on recurring wolf depredations. WS-Wyoming has had relatively low rates of repeat depredation with only a small proportion of properties (3% in Predatory Animal Zone, 8% in WTGMA) having recurring predation issues (defined as requesting WS assistance in 3 or more years over the period of FY13 to FY18). Eighty percent of cooperators in the WTGMA and 70% of cooperators in the

Predatory Animal Zone only requested WS-Wyoming assistance one year during the 6-year period of FY 2013-2018.

3.4.3 Protective Measures Used During Wildlife Damage Management

Protective measures improve the safety, selectivity and efficacy of wildlife conflict management techniques. The following measures apply to some or all of the Alternatives (Table 3-1). This list only describes actions by WS-Wyoming and does not include actions by the WGFD or WDA. In some cases, if an action is not taken by WS-Wyoming, it may be implemented or required by the WGFD or WDA, the tribes or a land management agency.

Table 3-1. USDA, APHIS, Wildlife Services WDM protective measures included in each alternative. Alternative 1 - Continue the Current Wolf Conflict Management Activities (No Action/Proposed Action). Alternative 2 - WS-Wyoming Nonlethal Wolf Conflict Management Only. Alternative 3 – No Wolf Damage Management by WS in Wyoming

Protective Measures in Alternatives	**Alternative 1[a]**	**Alternative 2[b]**	**Alternative 3[c]**
General Procedures and Conditions for Conducting Wolf Damage Management			
WS-Wyoming wolf conflict management activities would follow guidelines as specified and agreed upon in established guidelines and rules, and as authorized by the WGFD, WDA and tribes.	X		
WS-Wyoming would conduct wolf conflict management only when and where a need exists.	X	X	
Nonlethal methods would be used when practical and effective, but lethal methods could also be applied alone or in combination with nonlethal methods in some cases to most effectively resolve a damage problem.	X		
WS-Wyoming could use lethal methods to remove wolves in cases of threats to human safety.	X		
WS-Wyoming would not initiate use of lethal wolf conflict management methods for protection of livestock until an authorizing agreement has been signed by the producer.	X		
Lethal depredation management activities would occur within specific areas as authorized by the WGFD, WDA or tribes.	X		
All wolf mortalities, while conducting wolf conflict management and wolf population monitoring, would be reported to the WGFD, WDA or tribes.	X	X	
Samples and other data needed by WGFD for monitoring wolf population genetics and population health would be provided to WGFD.	X	X	
Wolves or wolf parts taken during wolf conflict management may be transferred to Native Americans for cultural purposes, educational use, or scientific research purposes when coordinated with and approved by WGFD, WDA or tribes. Specimens not suitable, or not needed, for such use would be disposed of as directed by WGFD, WDA and the tribes.	X		

Protective Measures in Alternatives	**Alternative 1[a]**	**Alternative 2[b]**	**Alternative 3[c]**
Animal Welfare and Humaneness of Methods Used by WS			
Nonlethal wolf conflict management methods such as guard dogs, scare devices, fladry and other methods, would be recommended and implemented, when appropriate.	X	X	
WS-Wyoming could provide training to landowners and resource managers in the safe and effective use of nonlethal projectiles when authorized by the WGFD or WDA, as appropriate.	X	X	
Wolf capture, handling, and euthanizing (if permitted) would be carried out as humanely as practically possible.	X		
Traps and snares would be checked consistent with WGFD rules and WS policy.	X	X	
Research would continue to improve the selectivity and humaneness of management devices and findings would be incorporated in WS-Wyoming activities as appropriate.	X	X	
Foot-hold traps would be equipped with pan-tension devices to reduce the incidence of smaller nontarget animal captures.	X	X	
All WS-Wyoming Specialists dealing with wolf complaints would be trained in the capture, chemical immobilization, and medical handling of wolves to minimize accidental injury and death.	X	X	
Nonlethal projectiles (*e.g*., rubber bullets and bean bag projectiles) may be used if authorized by WGFD.	X	X	
Nonlethal projectiles would be used in a manner which would be unlikely to result in any permanent physical damage or death to a wolf.	X	X	
Personnel would be trained in the safe and appropriate use of wolf conflict management techniques and equipment.	X	X	
Safety Concerns Regarding Use of Capture Devices			
The WS' Decision Model, designed to identify the appropriate wolf conflict management strategies and their impacts, is used.	X	X	
WS-Wyoming would place traps and snares so that captured animals would not be readily visible from publicly used travel routes.	X	X	
Warning signs would be posted on main roads and/or trails leading into any areas where traps or snares were being used. These signs would be removed at the end of the conflict management activities.	X	X	
No traps or snares would be used by WS-Wyoming within ¼ miles of any residence, community, or developed recreation site, unless granted permission from the owner of a privately-owned property or an official from the appropriate public land management agency.	X	X	

Protective Measures in Alternatives	**Alternative 1[a]**	**Alternative 2[b]**	**Alternative 3[c]**
During work plan meetings and other project-specific discussions, land management agencies will inform WS-Wyoming of any human safety concerns so that they may be addressed in site-specific management strategies developed using the WS Decision Model.	X	X	
Concerns About Impacts of Wolf Conflict Management Activities on T/E Species, Other Species of Special Concern, and Cumulative Effects.			
WS-Wyoming consulted with the USFWS on the impacts of wolf conflict management activities to federally listed T/E species found in Wyoming and will implement reasonable and prudent measures or alternatives established by the USFWS for the protection of T&E species.	X	X	
WS-Wyoming personnel would attempt to resolve depredation problems by taking action against individual problem animals, or local populations or groups.	X	X	
WS-Wyoming foot-hold traps or spring activated foot snares set for wolves would incorporate tension devices to reduce the likelihood of capturing smaller nontarget species.	X	X	
WS-Wyoming would not set foot-hold traps or snares for wolves within 30 feet of any exposed bait or animal carcass to reduce the likelihood of capturing nontarget species.	X	X	
The WGFD, or the appropriate land manager, would be notified as soon as possible, if a state or federally listed T/E species is caught or killed.	X	X	
During work plan meetings and other project-specific discussions, land management agencies will inform WS-Wyoming of mitigation measures needed to protect threatened, endangered and sensitive species, water quality and other resource values of concern.	X	X	
Cultural Resources/Native American Concerns.			
This EA has been provided to Native American Tribes for comment to determine if cultural issues have been addressed.	X	X	X
On private lands within recognized tribal reservation boundaries, WS-Wyoming will ask the affected landowner if the appropriate reservation personnel can co-investigate any complaint with WS-Wyoming. If allowed by the landowner, the tribe may co-investigate the complaint. WS-Wyoming and the tribe will consult regarding a course of action to address or resolve verified wolf complaints on these lands.	X	X	
WS-Wyoming will comply with requirements for notifying tribes as requested by the tribes.	X	X	
Public Land Issues			
On public lands, vehicle use would be limited to existing roads unless otherwise authorized by the land management agency.	X	X	

Protective Measures in Alternatives	Alternative 1[a]	Alternative 2[b]	Alternative 3[c]
WS-Wyoming will meet annually with the land management agency to develop Work Plans which include delineation of areas where certain methods may not be used, for all or part of the year.	X	X	
Public land agencies will review work plans for consistency with land and resource management plans.	X	X	
During annual work plan meetings, public land management agencies aid WS in minimizing environmental risks by providing information on mitigation measures needed to protect public safety; threatened, endangered, and sensitive species; and other resource values."	X	X	
If wolf conflict management were ever requested to take place in Wilderness Areas or Wilderness Study Areas, it would only be conducted in coordination with the responsible land management agency and under applicable guidelines.	X	X	

3.5 ALTERNATIVES CONSIDERED BUT NOT IN DETAIL, WITH RATIONALE

3.5.1 Bounties

Bounties, which are payments of funds for killing wildlife suspected of causing economic losses, are not considered effective for reducing wolf damage. This alternative will not be considered in detail because:

- Neither the WGFD nor tribes have authorized a bounty program for wolves and are highly unlikely to do so.
- Bounties are generally not effective in reducing damage because depredating individuals/local populations are not specifically targeted
- No effective process exists to prevent taking of animals from outside the damage management area for compensation purposes
- Fraudulent claims can occur (Waller and Errington 1961)

3.5.2 Eradication and Suppression

An Eradication Alternative would direct all WS-Wyoming efforts toward planned, total elimination of wolves. This Alternative will not be considered in detail because:

- The attempted eradication of established wolf populations is contrary to state, federal and tribal efforts to protect and conserve wildlife and native ecosystems
- Eradication of wolves is generally not acceptable to the public
- It is not realistic, practical, or allowable under present WS policy to consider large-scale population suppression for native wildlife.

3.5.3 Agencies Exhaust All Nonlethal Methods Before Attempting Lethal Methods

Under this alternative, all nonlethal methods would have to be attempted and proven ineffective prior to using lethal wolf conflict management methods. The primary reason this alternative was not considered in detail was because it would require agencies, and livestock producers to expend resources implementing WDM methods even though the professional judgment of WS-Wyoming, the WGFD or tribal personnel indicates the method is impractical (e.g., would incur costs in excess of the value of resources protected), inappropriate (e.g., use of a light siren device in areas near human residences or wilderness areas), or is likely to be ineffective for the given situation (e.g., where the predator appears to have habituated). Livestock producers faced with such impractical requirements, may be more inclined to seek assistance from alternate sources with impacts similar to those discussed for Alternative 3. Additionally, all operational expenses associated with WDM services provided by WS-Wyoming are paid by the WGFD and the ADMB and they are likewise unlikely to seek WS-Wyoming's assistance if they are required to fund nonlethal methods known by the agencies to be ineffective prior to utilizing lethal methods.

3.5.4 Only Use Lethal WDM Methods

Under this Alternative WS-Wyoming would only provide technical and operational assistance with lethal damage management techniques. Prohibiting WS-Wyoming from using or providing technical assistance on effective and practical nonlethal wolf conflict management methods is not in the best interest of the continued recovery of the species, is contrary to agency policy and directives (WS Directive 2.101), and will not be analyzed further. In certain situations, nonlethal methods may provide a more effective short-term or long-term solution to wolf conflict problems than lethal methods.

3.5.5 Technical Assistance Only

Under this Alternative, WS-Wyoming would not conduct operational wolf conflict management in Wyoming but could provide information to requesters about methods or techniques they could use to reduce wolf conflicts. WS-Wyoming would also be able to conduct investigations of potential wolf depredation sites as required to administer the WGFD wolf damage compensation program. Because WGFD and the tribes could still use and authorize others to use nonlethal and lethal wolf conflict management techniques, the environmental impacts of this Alternative are encompassed in the evaluation of Alternatives 1, 2, 3, and 4 of this EA. Detailed analysis of this alternative would not contribute substantive additional information to the understanding of the environmental impacts of the alternatives, so this Alternative will not be analyzed in detail.

3.5.6 Wolf Damage Management Conducted by Licensed/Permitted Hunters and Trappers

The premise for this alternative is that individuals who enjoy the challenge of hunting or trapping wolves would be willing to provide this service for free or at a very low cost. The primary challenge with this approach is that private hunters and trappers (as opposed to private wildlife damage management contractors as discussed in Alternatives 2 and 3), would not always have the time, resources, or training to promptly and effectively respond to site-specific damage problems. The salvage of wolf hides obtained through private depredation control activities could conceivably be authorized as an incentive to promote this approach, but the majority of wolf damage problems occur between April and September, when pelts would not be in prime condition for salvage and are of little value. Now that wolves are delisted, WGFD can focus hunter harvest of wolves in areas of chronic wolf depredation problems through the establishment of targeted harvest seasons and quotas. Recent data indicates that use of licensed hunting and trapping can help to reduce conflicts but was not as effective as a targeted removals for WDM (DeCesare et al. 2018). To the extent WGFD might be able to facilitate this, the cumulative

impacts of this approach are already encompassed to a degree within the evaluations of Alternatives 2 and 3.

3.5.7 Ongoing Nonlethal Before Lethal

In predator damage management EAs prepared for nearby states and in comments provided on this EA, commenters proposed consideration of a variation to the "Exhaust All Nonlethal Methods Before Lethal" alternative discussed in Section 3.5.3. This alternative has sometimes been referred to as the Natural Resources Defense Council (NRDC) Alternative. This alternative would specifically require that: 1) cooperators show evidence of sustained and ongoing use of nonlethal/husbandry techniques aimed at preventing or reducing predation prior to receiving services from WS-Wyoming, 2) WS-Wyoming would use or recommend, as a priority, nonlethal techniques in response to a confirmed damage situation, and 3) lethal techniques would only be used when the use of nonlethal methods failed to keep damages below an acceptable level.

This alternative is similar to the proposal in Section 3.5.3, but would require use of nonlethal methods on a more limited scale in terms of the diversity of nonlethal methods that would need to be deployed prior to receiving WS-Wyoming operational assistance with lethal WDM methods. It would further restrict WS-Wyoming from implementing lethal methods unless use of nonlethal methods failed to keep wolf damage below a certain level determined to be acceptable. This alternative is not considered in detail for the following reasons:

In Section 4.3.1.1 of the EA, we explain how most instances of wolf predation on livestock occur in spite of livestock producers' use of nonlethal methods including herders and livestock guarding dogs to help protect the animals from predation. Therefore, the current situation for many wolf-caused livestock depredation problems is that the producers have and/or are currently already implementing one or more nonlethal strategies prior to receiving WS-Wyoming or other agency assistance.

WS does not have regulatory authority for wildlife damage management. Instead, management alternatives implemented by WS-Wyoming must be consistent with policies and regulations of the applicable state, federal and tribal agencies. The primary decision-makers for determining how wolf depredation situations are to be resolved (*i.e.*, WGFD, WDA, the ADMB and County Predatory Animal District Boards) have not established any requirement for producers to use prescribed nonlethal methods or strategies prior to receiving wolf conflict management assistance. Because WS-Wyoming acts as an agent of either the WGFD or the ADMB for wolf conflict management in Wyoming, we do not consider it appropriate for WS-Wyoming to establish these types of conditions before providing service. This is especially true in the WTGMA where WGFD makes the determination as to what methods will be used to resolve a conflict and WS-Wyoming only provides operational assistance after WGFD has determined the action to be taken and requested assistance. The ADMB has indicated that funds provided for WDM assistance from WS-Wyoming are intended to focus on operational WDM actions by WS-Wyoming with some funds set aside for research and demonstration projects at the discretion of the ADMB (Albert 2018). Funds are not available to help individual producers pay for WDM materials or livestock guarding animals.

There are a number of factors that must be considered when selecting among nonlethal methods for use in WDM. Depending on site-specific circumstances, some methods that would likely need to be implemented under this Alternative would be impractical, inappropriate, or have a low efficacy for a variety of reasons. For example, methods such as wolf-proof or wolf-resistant fencing for pastures that may be 1,000s of acres in size could cost more than the value of

resources protected, and may have unacceptable impacts on movements and land use by other wildlife, and would not be an appropriate solution for livestock on public land; noise-producing scaring devices require sustained use over a period of days or weeks and could disturb recreational users of public land grazing areas or nearby human residents; guard dogs might present human safety risks to recreational users of a public land grazing area; visual or auditory scaring devices may be ineffective in situations where wolves have habituated to such strategies already. Fladry has been proven effective in reducing wolf predation on livestock in several states. However, it is best suited to relatively small pastures and sheep production where it may be possible to gather animals in a relatively small area at night when risk of predation is greatest (e.g., sheep bedgrounds). When this method was attempted in a demonstration project involving cattle production in Wyoming, the amount of area needed to sustain the herd of cattle over time was so high that it rendered the method impractical. Even though the project used smaller areas with the plan of rotating cattle to a new area as needed to preserve grazing resources, the amount of area that had to be fenced and the frequency with which it was necessary to move cattle made the project impractical. The potential for additional losses to occur while having to take the time to experiment with nonlethal methods may be unacceptable to some, which would likely result in an increase in the number of individuals attempting to solve their own problems instead of working with WS-Wyoming or WGFD personnel. In the rare event of a wolf-related threat to human safety, experimenting with nonlethal approaches may present too great a risk of failure at preventing human injury or fatality to be deemed appropriate by local government jurisdictions.

With respect to element two (2) in the NRDC proposed Alternative, WS-Wyoming already gives preference to using or recommending nonlethal methods when practical and effective as part of the Proposed Action Alternative (WS Directive 2.101) to the extent that it is allowed by the WGFD, ADMB and County Predatory Animal Districts when those agencies make decisions about how to resolve wolf damage situations. The practicality of a particular husbandry or other nonlethal method can vary substantially among producers and among depredation situations. Therefore, it is difficult, and many times impractical, to determine appropriate and reasonable criteria to dictate ahead of time which particular husbandry or other nonlethal methods should be required in given situations.

With respect to element three (3) in the proposed Alternative, it is difficult to determine an “acceptable level” of loss for individual livestock producers. In our experience, whether a given rate of loss is “acceptable” or not varies substantially among individual livestock producers and the nature of livestock produced. Some producers have lower costs of doing business -- for example, one producer might have no cost of financing or purchasing his ranch property while the next could be carrying a substantial mortgage with considerable interest costs. What might be an economically tolerable or “acceptable” level of loss to one rancher could be economically unacceptable, or even financially devastating, to another. Additionally, there may be delays between when a method is recommended and when it effectively works to address damage (e.g., time to acquire supplies and install devices, time needed to capture animals). If wolf conflict management methods are delayed until damage has increased to a certain predetermined level, conflicts may escalate to an excessive level before the problem can be resolved. Therefore, we believe it would be impractical to establish a standard or threshold of "acceptable losses" for providing assistance.

One purpose of having effective conflict management assistance available to livestock producers is to foster support for, or to at least minimize or reduce the amount of opposition to, wolf recovery. As stated in Section 1.4, prompt, professional management of conflicts with wolves is an important component of wolf recovery because it facilitates local public acceptance and tolerance of wolves (Fritts et al. 1992, Fritts 1993, Mech 1995). To establish an arbitrary

threshold of "acceptable loss" before any wolf removals would occur would, in our view, be counterproductive to promoting acceptance of wolf recovery by the livestock industry. This is because we would expect that some, or perhaps many, producers experiencing losses to wolves would cease to request assistance from WS-Wyoming if the conditions for receiving such assistance were perceived too burdensome. Greater incidence of illegal wolf killings would likely result; additionally, increased political efforts to get laws changed by Congress would likely occur, as evidenced by recent legislation introduced to prevent wolves from being listed under the ESA.

The Alternatives selected for detailed analysis in this EA encompass a reasonable range as required by NEPA and include some of the suggestions in the NRDC proposal. Given the limits to WS-Wyoming decision-making in the WTGMA and use of funds in the WTGMA, the fact that WS-Wyoming already gives preference to practical and effective WDM methods when selecting alternatives for use in the Predatory Animal Zone, and the fact that most cooperators have already attempted or are still using nonlethal methods at the time they request assistance from WS-Wyoming, we do not believe that this alternative would yield results substantially different from Alternative 1.

3.5.8 Address All Conflicts with Compensation

Compensation programs are usually established by state or private entities, which determine the nature of the compensation program and the types of losses that will be covered. WS-Wyoming involvement is limited to providing assistance, if requested, in verifying the cause of livestock losses in the WTGMA with WGFD responding to most complaints of wolf depredations on livestock. In the WTGMA, WGFD pays for confirmed and probable losses to wolf predation and a 7:1 compensation multiplier in certain circumstances (WGFD Regulations, Chapter 28, Regulations Governing Big or Trophy Game Animal or Game Bird Damage Claims), designed to compensate for losses not found. In the Predatory Animal Zone, there is no state compensation for livestock losses. However, wolves have been reintroduced to Wyoming as a result of federal action. Consequently, livestock producers have been eligible for compensation through the federal Livestock Indemnity Program in the 2014 farm bill (79 FR 20196-21118). However, the program only covers 75% of the value of the animal lost to predation. Animals kept for recreational purposes, such as hunting animals, animals used for roping practice, pets, livestock guarding animals and show animals are ineligible for compensation under the Livestock Indemnity Program. Producers who receive state compensation payments are not eligible for the federal program.

The compensation programs listed above are indicative of some of the challenges associated with compensation for wildlife damage. While the state program is unusual in that it provides an allowance for animals lost to wolf predation but not located, most compensation programs, like the federal program, only pay for a portion of all losses caused by wolves. Where verification of loss is required, compensation may underestimate total losses because cause of death cannot be conclusively determined due to lack of evidence. This can occur when wolves may have completely consumed the lost livestock or removed it from the site, when carcass remains have been scavenged by other species destroying evidence of wolf damage, or when weather conditions destroy predator sign and other factors. Consequently, producers are not compensated for all livestock deaths caused by wolves. Livestock producers also do not receive any compensation for costs of treating livestock and pets injured by wolves, adverse impacts on livestock health and weight losses resulting from harassment by wolves, repairs needed after wolves chase livestock through fences, need to re-sort livestock dispersed by wolves, or cost of feed used because livestock are removed from grazing pastures to minimize risks from wolves.

Additionally, as noted for the federal Livestock Indemnity Program, not all animal losses to predation are covered by compensation programs.

Although compensation programs can be an effective and important component of an integrated WDM program (Section 2.4.1) they are not suitable for exclusive use in resolving conflicts with wolves. As noted above, there are problems with compensation programs failing to cover all losses, and compensation programs are not an appropriate solution to threats to human safety. Multiple studies, some referenced below, have considered compensation as a mechanism for addressing conflicts with wildlife. These studies have noted the following disadvantages of utilizing compensation programs that also preclude their exclusive use as a response to conflicts with wolves.

- Compensation programs require large expenditures of money and labor to investigate and validate all losses to determine and administer appropriate compensation. In Wyoming, even with compensation for only some of the damage caused by wolves and active WDM assistance in place, compensation payments have been as high as $330,667 in a single year (CY 2015) (U.S. Fish and Wildlife Service et al. 2017) and have averaged $197,192.68 over the period of 2008 – 2017 (Jimenez et al. 2009, Jimenez et al. 2010b, Jimenez et al. 2011, Jimenez et al. 2012, Wyoming Game and Fish Department et al. 2013, Wyoming Game and Fish Department et al. 2014, Wyoming Game and Fish Department et al. 2015, Jimenez and Johnson 2016, U.S. Fish and Wildlife Service et al. 2017, Wyoming Game and Fish Department et al. 2018). In the absence of effective WDM assistance by WS-Wyoming, the WGFD, WDA or tribes, compensation costs are expected to be higher.
- Compensation programs for recovering wildlife species, such as wolves, can, in some cases, increase to the point where funds needed for compensation undermine budgets for conserving other species (Treves et al. 2009).
- It is not always possible to verify the predator responsible for damage and not all carcasses of animals taken by wolves are located (Section 1.2.1). Consequently, compensation programs will likely not pay for all losses to wolf predation. Incomplete payments and frustration with the lack of access to operational assistance with WDM could result in increased poaching as individuals seek their own remedies to conflicts with wolves.
- Compensation would most likely be below full market value.
- 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 livestock producers would rely completely on a compensation program and WDM activities, including lethal control, would likely continue as permitted by state law.
- 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).

3.5.9 Consider the successful predator damage management assistance program in Marin County, California. Marin County redirected funds toward nonlethal measures. Funds were allocated for tools such as night corrals, fencing, lamb sheds, noise- and light-generating devices, and compensation to farmers for livestock losses.

Following public controversy over the use of lethal methods to control coyote predation, the Marin County, California Board of Supervisors replaced a cooperative program with the California Department of Food and Agriculture and WS-California with a county-administered, nonlethal program (Fox 2008). As noted by the commenter, the Marin County Program provides

qualified ranchers with funding to assist in the implementation of nonlethal management methods to reduce depredation (e.g., through new fence construction or improvements to existing fences, guard animals, scare devices or changes in animal husbandry (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 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. All compensation was eventually discontinued, and by 2014, when a query was sent to the Marin County Department of Agriculture, the county indicated the Livestock Protection Program was only a cost share program to provide limited funds for purchasing fencing materials and guard animals.

Producers are not required to participate in the Marin County program and the county does not prohibit livestock producers from using lethal methods or contracting for assistance with implementation of lethal methods. 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 nontarget populations nor evaluate the environmental impacts of such take. However, a review of the program by Larson (2006) indicated that more coyotes may be killed in the county under the new program than by the prior cooperative program.

There are fundamental differences between the types of predators and nature of livestock production in Marin County compared to Wyoming. The Marin County program primarily addresses conflicts with coyotes and most livestock is kept in relatively small fenced pastures well suited to the installation of predator proof fencing and the use of livestock guarding animals. However, the majority of WS-Wyoming's WDM assistance involves requests from cattle producers on open range or very large (sometimes 1,000s of acres) fenced pastures. In these situations, cattle are dispersed across a wide area, which limits the utility of livestock guarding animals and frightening devices which are better suited to protecting smaller pastures or clusters of animals such as flocks of sheep.

There are no federal funds for operational WDM in Wyoming. In the WTGMA the decisions to implement this type of program would need to be made by the WGFD, because WGFD determines the methods to be used in all verified cases of conflicts with wolves. In the Predatory Animal Zone, the decision to reallocate operational funds to a project like the one in Marin County must be made by the WDA and County Predatory Animal Districts. At present, none of the entities have expressed interest in a transition to this type of program (Wyoming Game and Fish Commission 2011;2012). Based on the limitations of the Marin County program noted above and the similarity to the nonlethal only alternative (Alternative 2) analyzed in detail, we have 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.

3.5.10 Agencies Exhaust All Reasonable Nonlethal Methods Before Attempting Lethal Methods

This alternative is more practical than the "Exhaust All Nonlethal Methods Before Attempting Lethal Methods Alternative" (Section 3.5.3), and is similar to the "Ongoing Nonlethal before Lethal Alternative" addressed in Section 3.5.7. By restricting the methods to be tried to those deemed, in the professional opinion of trained specialists, to be reasonable for the given site, this alternative avoids some of the pitfalls in the Ongoing Nonlethal before Lethal and "Exhaust all Nonlethal Methods" alternatives. As with the "Ongoing Nonlethal Before Lethal Alternative",

we do not consider it appropriate for WS-Wyoming to establish these types of conditions before providing service, especially in the WTGMA where WGFD makes the determination as to what methods will be used to resolve a conflict and WS-Wyoming only provides operational assistance after WGFD has determined the action to be taken and requested assistance. The State of Wyoming has determined that the Predatory Animal Zone is poor quality habitat for wolf populations and established a system by which wolves may be taken at any time without a permit.

However, it is unlikely that a state agency would support or impose restrictions on WDM assistance in an area where they have purposefully chosen to eliminate restrictions. The ADMB has indicated that funds provided for WDM assistance are intended to focus on operational WDM actions by WS-Wyoming with some funds set aside for research and demonstration projects at the discretion of the ADMB (Albert 2018). Funds are not available to help individual producers pay for WDM materials or livestock guarding animals. It should be noted that, should the ADMB, WGFD or an individual County Predatory Animal District Board choose to impose conditions under which lethal WDM methods could be used, this decision could be accommodated within the framework of Alternative 1. Although Alternative 1, gives WS-Wyoming full access to all legally available nonlethal and lethal WDM methods, cooperating agencies, the tribes and individual livestock producers can self-impose restrictions on the methods they want used on lands under their jurisdiction. Additionally, as noted previously, data from (Bradley et al. 2015) indicates that partial pack removal can help to reduce livestock losses to wolf predation, but only if implemented soon after losses start. Based on the information above, we have not selected this alternative for detailed analysis.

3.5.11 No WDM in any Designated Wilderness Areas (WAs) or Wilderness Study Areas (WSAs)

WS-Wyoming occasionally conducts WDM in Wilderness Areas (WAs) or Wilderness Study Areas (WSAs). Future requests for WDM in these areas are anticipated to be rare to a medium chance at most (Appendix E). The amount of WDM activities that is expected to occur in designated WAs, proposed WAs, and WSAs is either none, or so minor that the effects of any of the alternatives that involve no WS-Wyoming lethal work would not likely be significantly different from the effects of a "No Control in Wilderness Areas" alternative. Some WAs, proposed WAs and WSAs in Wyoming have historic grazing allotments. The minor amount of WDM activities that could be conducted by WS-Wyoming in WAs, proposed WAs, or WSAs conforms to legislative guidelines, and MOUs between APHIS-WS and the responsible land management agencies. WS-Wyoming and the land management agency coordinate annually to review and update work plans which delineate what, when, why, where, and how WDM would be conducted. WS-Wyoming would use the minimum lethal management necessary when conducting WDM activities in WAs and WSAs per BLM and FS policy.

3.5.12 Greater Yellowstone Coalition Alternative

This alternative involves 1) Completing adequate consultation with all land management agencies to determine where WDM methods may and may not be permitted and working to get preventive nonlethal methods included in grazing plans; 2) Establishing a detailed structure for adaptive management, including describing scenarios when nonlethal methods would be applied and lethal methods may only be used once preventive measures have been exhausted. 3) Investing in novel solutions in areas with chronic conflict and ensuring that livestock producers fully understand the full suite of nonlethal preventive methods available to reduce losses to acceptable levels. 4) Working to develop community-based conflict resolution including educating agricultural communities and predator management boards on available tools like WS-Montana has by hosting workshops around the state.5) Ensuring that lethal methods are conducted in a manner

that reduces risks to grizzly bears, lynx and other nontarget animals, including eliminating use of always-lethal methods like neck snares and M-44s. 6) Developing a statewide approach that maintains consistency in managing wolf conflicts regardless of state classification of wolves (predator vs. trophy game) and only utilizing lethal control actions in response to verified wolf depredations statewide. 7) Recognize the important economic and ecological benefits of wolves and structure control efforts around these two benefits spatially. The economic benefits of wolf watching typically accrue to people in different areas than where livestock losses occur. This means that WS actions potentially could be structured so that benefits to wolf-watching businesses are minimally impacted by control actions taken for the benefit of livestock operators.

Many facets of this alternative were in Alternative 1 or have been included in the proposed action in response to public comments. WS-Wyoming has completed consultation with land management agencies on this EA including additional consultation with Bridger-Teton National Forest. WS-Wyoming prepares annual work plans with cooperating agencies to ensure that management actions are consistent with agency policies, goals and land management plans (Item 1 above). When resources and collaborative partnerships are available, WS-Wyoming has and can work with individual producers, NGOs and agency partners to implement nonlethal WDM methods. One example is the 2017 fladry demonstration project (Item 3 above). Educational activities may be conducted under Alternatives 1 and 2. See also Chapter 5 Responses 42 and 52 for additional information regarding WS-Wyoming involvement in educational programs and community –based conflict management. M-44s are not registered for use in WDM or proposed for use in this EA (Item 5 above). WS-Wyoming has consulted with the USFWS on strategies to reduce risks to federally-listed species, protective measures used to help reduce risks to nontarget species are listed in Section 3.4.3, and impacts on nontarget species are addressed for each of the alternatives considered in detail in Chapter 4 (Item 5 above). Snares have not been used to date for WDM except experimental use of specially-modified break-away snare systems for radio-collaring wolves (Item 5 above). WS has committed to using lethal methods only in response to verified damage by wolves (Item 6) which provides a degree of consistency in WS WDM efforts across the state. WDM actions are determined on a case-by-case basis in the WTGMA by WGFD who also make the determination of whether or not to request WS-Wyoming assistance, which limits the extent to which WS operations are completely consistent across the two management zones (Item 6). Using lethal WDM methods only in response to verified conflicts with wolves reduces the extent to which WDM activities may impact wolf watching and calling opportunities and associated impacts when these events are conducted in separate areas as noted for Item 7.

Item 2 appears to refer to a management strategy similar to those addressed in detail in Sections 3.5.7 and 3.5.10 above. For reasons noted in those sections, we will not be addressing the proposal in Item 2 in detail. Given that some portions of this proposal have been identified as not being viable for detailed consideration and that other program components are included in existing alternatives that have been addressed in detail, analysis of this alternative in detail is not warranted.

3.5.13 No WS-Wyoming Lethal WDM on Public Land.

This alternative would be a mix between impacts of Alternative 1 and Alternative 2. It was proposed as a means of placing priority on public resources on public lands instead of allowing removal of a public resource to protect private interests.

WS-Wyoming's access to lethal methods for WDM on federal public lands is determined by state regulations and the management plans and policies of the respective federal agency. As

outlined in the descriptions of Alternatives 1 and 2 (Section 3.2), producers leasing grazing allotments 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. All funds for WDM field work by WS-Wyoming come from either the WGFD or the ADMB. There are more private pilots, gunners and aircraft licensed to conduct aerial operations in Wyoming than for WS-Wyoming. Mechanisms are in place by which the WGFD, County Predatory Animal District Boards or ADMB could apply for permits to conduct aerial operations on public land. If permits for aerial operations are not as readily available to non-WS entities, then we would anticipate an increase in use of alternative methods such as traps and snares and associated increases in potential risks to nontarget species and pets.

In general, impacts of this alternative would be split between impacts analyzed for Alternative 1 on private lands and impacts of Alternative 2 on public lands. Given the current funding and regulatory situation in Wyoming, selection of this alternative would not resolve concerns regarding take of public resources for the protection of private property and might result in slightly greater take of wolves and increased risks to nontarget species and pets as described for Alternative 2. We will not analyze this alternative in detail because it would not provide substantial new information and is unlikely to resolve the concerns it is intended to address.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Chapter 4 provides information needed for making informed decisions concerning alternatives for meeting the need for action and objectives established in Chapter 1 in context of the issues discussed in Chapter 2. This chapter consists of 1) review of the ability of the alternatives to achieve management objectives and the efficacy of management methods; 2) analysis of environmental consequences of the alternatives for each of the issues considered in detail, and 3) summary of impacts.

Alternative 1 continues WS-Wyoming current WDM activities and is defined as the No Action alternative in accordance with CEQ guidance which states that the "No Action" alternative can be defined as being the continuation of current management practices (Council on Environmental Quality 1981). As such, the descriptions of Alternative 1 represent the environmental baseline for the analysis. Impacts of Alternatives 2 and 3 are compared to Alternative 1, as the "No Action" baseline to determine if the real or potential adverse effects of the alternatives are greater, lesser or the same (Table 4-4).

4.2 EVALUATION OF SIGNIFICANCE OF CUMULATIVE AND UNAVOIDABLE IMPACTS

The issues analyzed in detail are evaluated for each alternative including consideration of 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. The following factors were used to evaluate the significance of impacts in this EA that relate to context and intensity for this proposal:

4.2.1 Magnitude of the Impact (size, number, or relative amount of impact)

Magnitude is defined as a measure of the number of animals killed in relation to their abundance, and may be determined either quantitatively or qualitatively. Cumulative impacts to Wyoming's wolf population would include the legal wolf removals conducted by WS-Wyoming, the WGFD, the tribes, or other agency personnel, and livestock producers for damage management; hunter harvest (when allowed); natural mortalities; illegal killing of wolves; and any other sources of direct mortality. It also includes indirect impacts that might result from wolf removals such as impacts on pack structure or the relatedness of individuals within packs. The cumulative impact on Wyoming's wolf population will be considered in the context of the applicable federal, state and tribal wolf management objectives.

4.2.2 Duration and Frequency of the Impact

Duration and frequency of WDM in Wyoming may be highly variable. Biotic and abiotic factors affecting wolf and other wildlife behavior influence the duration and frequency of WDM activities conducted by WS-Wyoming. Statewide, WDM is usually seasonal, but the frequency and duration of individual actions would be highly variable depending upon any number of factors affecting the behavior of the animals that are causing damage and the location of the potential damage. Wolf damage management would only be conducted by WS-Wyoming when a request for assistance is received, the need for action is verified, and applicable authorizations or permits are issued by the state or tribes, as appropriate. Depending on the status of wolves, duration and frequency of WDM actions at individual sites may also be limited by applicable state and tribal management plans and rules.

4.2.3 Geographic Extent

WDM can occur anywhere in Wyoming where wolf damage occurs, assistance has been requested, and agreements for WDM are in place. In the WTGMA, the need for action and actions to be taken are determined by the WGFD. In the Predatory Animal Zone, the need for action is verified by WS-Wyoming after reviewing the site information as directed in the WS Decision Model (Slate et al. 1992). WDM would be limited to areas where a wolf conflict has been verified. WS-Wyoming will not conduct lethal preventive WDM.

4.2.4 Direct, Indirect and Cumulative Impacts.

Chapter 4 examines the direct, indirect, and cumulative impacts of each of the alternatives on the biological, physical, and sociocultural aspects of the human environment (issues). Direct effects are caused by the action and occur at the same time and place. Indirect effects, which are caused by the action and are later in time and farther removed in distance (40 CFR §1508.8). A cumulative impact results from the incremental impact of the action when added to other past, present, and reasonably future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR §1508.7).

The consideration of past actions may be considered in a cumulative impact analysis as the baseline to which the impact associated with the proposed action or alternative is compared and contrasted. It may also provide a context of the trends over time related to direct or indirect effects associated with the proposed action or alternatives or may illuminate or predict future direct or indirect effects of the proposed action based on past experience with similar types of proposed actions (Council on Environmental Quality 2005). Thus, the baseline impacts are those for Alternative 1, the proposed action/no action alternative.

4.3 ENVIRONMENTAL IMPACTS

4.3.1 Alternative 1 - Continue Current Wolf Conflict Management Activities (No Action/Proposed Action)

Under this and all the other alternatives, WDM in Wyoming is oriented toward reducing conflicts when and where they occur while maintaining wolf population recovery goals (Wyoming Game and Fish Commission 2011;2012). WDM actions would be conducted in accordance with applicable state and tribal regulations and wolf management plans. WS-Wyoming involvement is not required for implementation of any of the processes stipulated in the state or tribal plans and action may be conducted by the individual landowner/manager or permittee on grazing allotments, or agency and tribal personnel, without WS-Wyoming assistance provided that applicable authorizations have been obtained.

The WGFD management goal is to ensure the long-term viability of the gray wolf population. In order to ensure the population goal is achieved, the agency is expected to maintain at least 10 breeding pairs and at least 100 wolves in the WYO (outside YNP and the WRR) to demonstrate recovery. Additional wolf packs and breeding pairs are expected in YNP and the WRR and will be tabulated during annual reporting processes(Wyoming Game and Fish Department et al. 2018). The WGFD will also maintain balanced wolf and prey populations, ensure genetic transfer among states through maintenance of connectivity and functional metapopulation processes, and manage wolves to minimize conflict with humans and domestic animals. Although WS-Wyoming would not be involved in WDM for the protection of ungulates, this type of action could be conducted by the WGFD in accordance with state wolf and ungulate management plans. The long-term WGFD objective is to maintain a viable wolf population in Wyoming, achieve short-term harvest goals to reduce conflicts, provide annual harvest opportunity, and provide for non-consumptive benefits (i.e., aesthetics of wolves in the environment) as well (Wyoming Game and Fish Commission 2011). Future population goals will incorporate knowledge acquired from year to year. The Wyoming wolf management plan primarily applies to wolf management in the WTGMA, with the exception of including wolves from the Predatory Animal Zone in evaluations of the size and health of the state wolf population, and genetic monitoring of the population.

Wolves in the Predatory Animal Zone are under the management of the Wyoming Department of Agriculture and are addressed in the same way as other predatory animals such as coyotes. Because of the high potential for conflicts with humans in the Predatory Animal Zone, there is no set management objective for wolves in this portion of the state. Wolf collaring and pack monitoring is not conducted in the Predatory Animal Zone with the same intensity as in the WTGMA. At the time of this report, the state did not commit resources to systematic surveys for wolves or determining the breeding pair status of packs in the Predatory Animal Zone. Consequently, wolf population estimates from within the Predatory Animal Zone are less robust than from other parts of the state, and conclusions drawn from these should be considered in that light. There are no state restriction on take of wolves in this portion of the state, although WS-Wyoming has a self-imposed restriction of only providing lethal WDM assistance in response to verified conflicts with wolves. All take of wolves in the Predatory Animal Zone must be reported to WGFD within 10 days.

4.3.1.1 Ability of alternative to meet management objectives and efficacy of methods

This section reviews each alternative to determine if the alternative could be successful in meeting the overall goal of conserving wolf populations while protecting livestock,

domestic animals and human health and safety in Wyoming and the objectives listed below as established in Section 1.9. This evaluation is distinct from the environmental impact analysis, and is intended to aid the decision-maker in making a well-informed decision that considers both the ability of the alternative to meet the management objectives and the environmental consequences of the PDM alternatives. The objectives for WS-Wyoming WDM are:

- The proposed action must not jeopardize the recovery of the state or regional wolf population.

- Management actions should not have significant adverse effects on nontarget species populations.

- Wolf damage management activities must be conducted in accordance with authorities provided by the WGFD, tribes and applicable federal, state, tribal and local regulations.

- Wolf conflict management strategies should include a range of damage management techniques that allow for development of site-specific plans to effectively reduce damage and conflicts with wolves, meet landowner/manager objectives for site use, and minimize potential for adverse environmental impacts.

- WDM assistance should be provided by personnel trained and qualified in wolf damage management.

- There should be a system for monitoring the effect of management actions and cumulative impacts on the wolf population.

In the WTGMA, the WGFD would request WS-Wyoming assistance in WDM on a case by case basis after evaluating the details of the conflict and developing a management strategy that places emphasis on preventing or minimizing wolf conflicts by incorporating wolf conflict prevention into WGFD's information and education program. In the Predatory Animal Zone and the WRR, WS-Wyoming, at the direction of the WDA, or tribe, would apply an IWDM approach where approved nonlethal and lethal methods are considered, with preference given to the former. The evaluation, selection and eventual application of methods considers 1) overall effectiveness of the method to resolve the problem, 2) specific type and magnitude of damage, 3) geographic extent of the damage, 4) duration, frequency and likelihood of recurring damage, 5) nontarget species vulnerability, 6) environmental condition and impacts, 7) social and legal factors, and 8) costs to the individual livestock producer.

Ability of Alternative to Meet Management Objectives

This alternative would provide access to the full range of legally available WDM methods. No one method or class of methods is likely to resolve all conflicts with wolves. Access to the full range of WDM methods maximizes the likelihood that the WS-Wyoming will be able to work with cooperators to develop effective site-specific management strategies to address damage by and conflicts with wolves in Wyoming. Based on review in Section 4.3.1.2, WS-Wyoming involvement in WDM would not have individual or cumulative adverse impacts that would jeopardize the recovery of the state or regional gray wolf population.

Analysis in Section 4.3.1.6 indicates that, despite established protective measures to minimize risk of adverse impacts, the proposed action has the potential to result in injury or death of a limited number of individual nontarget animals. However, these losses would not be of sufficient magnitude or scope to adversely affect nontarget species populations. Consultation with the USFWS indicates that this alternative would have no effect on or be unlikely to adversely affect T&E species in the state and may affect, but would not result in jeopardy to Canada Lynx populations. Now that wolves are removed from the federal list of T&E species, there will be an increase in WDM actions conducted by entities other than WS. Some of these entities may not consult with the USFWS regarding measures to reduce risks to T&E species, so risks associated with their actions may be greater than for WS activities. However, when provided access to prompt professional agency WDM assistance, many individuals will use the agency assistance. Consequently, risks to T&E species from non-WS entities are likely lowest for this alternative.

All WS-Wyoming WDM activities are conducted in accordance with authorities provided by the WGFD, WDA, tribes and applicable federal, state and local regulations. WS personnel are trained in safe and effective WDM practices and conduct WDM in accordance with applicable protective measures listed in this EA and WS Directives to improve project efficacy and reduce risks of adverse impacts on the human environment. WS-Wyoming reports the impact of management actions to the applicable state, and tribal agencies to facilitate coordination of management efforts, agency management of cumulative impacts on wildlife populations and review of environmental impacts of WDM activities. WS-Wyoming would also monitor WDM activities and impacts to ensure that they remain within the parameters analyzed in this EA, and would update the analsis as needed in accordance with CEQ, USDA and APHIS NEPA implementation regulations and procedures.

WDM may be conducted by entities other than WS-Wyoming, especially in the Predatory Animal Zone where wolves may be taken at any time, with or without evidence of depredations. The training and skill level of these entities is variable and in some instances WDM is likely to be conducted by individuals with less access to training and WDM tools than WS. Private entities may also not provide the same level of information to federal, state and tribal agencies on the impacts of their actions on wolves and nontarget species. However, when prompt, effetive agency WDM assistance is available, as would occur under this alternative, many individuals will seek agency assistance with WDM. Consequently, reporting and project monitoring are likely to be the most extensive under this alternative.

4.3.1.2 Effects on the wolf population in Wyoming

Status of the NRM Wolf Population

United States Fish and Wildlife Service (1987) initially specified a recovery criterion of a minimum of 10 breeding pairs of wolves for a minimum of 3 successive years in each of 3 core recovery areas. U.S. Fish and Wildlife Service (1994) subsequently revised wolf recovery parameters in the NRM to stipulate that "Thirty or more breeding pairs comprising some 300+ wolves in a metapopulation, with genetic exchange between subpopulations, should have a high probability of long-term persistence." In addition, the metapopulation configuration and distribution throughout secure suitable habitat (e.g.,

YNP, NW Montana and central Idaho) would ensure that each core recovery area would provide a recovered population that would be distributed over a large enough area to provide resilience to natural or human-caused events that might temporarily affect one core recovery area. U.S. Fish and Wildlife Service (1994) further determined that a metapopulation of this size distributed among the three core recovery areas within the identified NRM DPS would result in a wolf population that would fully meet recovery objectives.

The USFWS conducted another review of what constitutes a recovered wolf population (United States Fish and Wildlife Service et al. 2002, United States Fish and Wildlife Service et al. 2003) to re-evaluate and update U.S. Fish and Wildlife Service (1994). A majority (78%) of a panel of wolf experts supported U.S. Fish and Wildlife Service (1994) conclusions and agreed that wolf population viability was enhanced by higher (500 or more wolves) rather than lower population levels (300) and longer (more than 3 years) rather than shorter demonstrated time frames. The USFWS also determined that an essential part of achieving recovery is an equitable distribution of wolf breeding pairs and individual wolves in Idaho, Montana and Wyoming and the three core recovery areas, and concluded that NRM wolf recovery and long-term wolf population viability is dependent on its distribution as well as maintaining the minimum numbers of breeding pairs and wolves.

Minimum recovery goals have been exceeded in the NRM DPS every year since 2002 (United States Fish and Wildlife Service et al. 2011). At the time of the most recent wolf population report by the USFWS for the NRM DPS, there were at least 1,704 wolves including 282 packs of which at least 92 met the criteria for breeding pairs in the core states of Idaho, Montana and Wyoming (U.S. Fish and Wildlife Service et al. 2016). When Washington and Oregon wolves were included, there were at least 1,904 wolves, 316 packs and 114 breeding pairs. Although wolf hunting seasons and wolf removals for damage management occur in Idaho, Montana and Wyoming, the wolf populations in these states remain well above thresholds for delisting and the gray wolf population in the western United States continues to expand into new states and regions, with breeding packs now in Washington (Washington Department of Fish and Wildlife et al. 2018), and Oregon and California (Oregon Department of Fish and Wildlife 2018).

Resident packs have saturated much of the suitable habitat in the core recovery areas despite licensed harvest, removals for depredation management and other causes of mortality in Idaho, Montana and Wyoming (Jimenez 2013;2014;2016). There appears to be enough habitat connectivity between occupied wolf habitat in Canada, northwestern Montana, Idaho and the GYA to ensure exchange of sufficient numbers of dispersing wolves to maintain demographic and genetic diversity in the wolf population (Carroll et al. 2006, Oakleaf et al. 2006, von Holdt 2008, von Holdt et al. 2010). Wolf movements between Canada and northwestern Montana have been documented from radio-telemetry monitoring (Pletscher et al. 1991, Pletscher et al. 1997, Boyd and Pletscher 1999, Sime et al. 2007), wolf movement between Idaho, Montana and Wyoming has been confirmed. (71 FR 6634). In addition, USFWS-approved state wolf management plans in Montana (Montana Fish Wildlife and Parks 2003), Idaho (Idaho Legislative Wolf Oversight Committee 2002, Idaho Department of Fish and Game 2008), and an interagency MOU (Wyoming Game and Fish Department et al. 2012) commit to maintaining the metapopulation structure as well as sufficient genetic diversity utilizing various methods including relocation, if necessary, to ensure the long-term viability of the wolf population.

USFWS reviews of the status of the wolf population made in conjunction with delisting indicate that sufficient secure wolf habitat and prey will remain available into the future (Section 2.2.1). The vast majority of suitable wolf habitat and the current wolf population are secure in mountainous forested federal public land that will not be legally available for or suitable to intensive human development. The core recovery areas in the NRM have long been recognized as the most likely areas for maintenance of successful metapopulations, with dispersal between subpopulations (71 FR 6634)(United States Fish and Wildlife Service 1980;1987, U.S. Fish and Wildlife Service 1994, Wyoming Game and Fish Commission 2011). Consequently, human development will not occur on a scale that could possibly affect the overall suitability of Wyoming or the GYA for wolves, and no foreseeable habitat-related threats will prevent these areas from supporting a wolf population that is capable of substantially exceeding recovery levels (76 FR 61782).

The USFWS 2015 post-delisting review of the Northern Rocky Mountain gray wolf population indicated that none of the factors that would trigger a status review had been met and that the NRM wolf population continued to exceed recovery goals (Jimenez 2016). Documented dispersal of radio-collared wolves and genetic analysis indicated that the genetic metapopulation structure was being maintained solely through natural dispersal. The USFWS also reviewed potential threats to the population including 1) the presence or threatened destruction, modification or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific or educational purposes; 3) Disease or predation; 4) Inadequacy of existing regulatory mechanisms; and 5) and other natural or man-made factors affecting the continued existence of wolves including (public attitudes, genetic considerations, climate change, catastrophic events and impacts to wolf social structure) and determined that there were no threats to the population that would warrant reconsideration of ESA protections for wolves. The USFWS reached similar conclusions during the reviews for 2012 (Jimenez 2013;2014) and 2013 (Jimenez 2014) when wolves were delisted and licensed hunting was permitted in Idaho, Montana, and Wyoming.

Status of the State Wolf Population

Alternative 1 has been implemented by the USFWS and WGFD either under section 4(d) provisions of the ESA, section 10 permits from the USFWS, or authority granted to WGFD by the USFWS. WS-Wyoming has been an agent of the USFWS, WGFD, WDA or tribes for purposes of resolving and reducing livestock and domestic animal losses caused by wolves (from letters to R. Krischke, WS from M. Jimenez, USFWS, Wyoming Wolf Recovery Project Leader, March 1, 2009, October 22, 2014; and R. Krischke, WS from B. Nesvik, Chief Wildlife Division, WGFD October 4, 2011). WS-Wyoming involvement in implementation and use of IWDM strategies and methods in the WTGMA under this alternative would continue as directed by WGFD for delisted wolves (2012-2014 and 2017-present). Consistent with USFWS management, Wyoming's goal is to ensure the long-term viability of the state gray wolf population (Wyoming Game and Fish Commission 2011;2012). WGFD is expected to maintain at least 10 breeding pairs and 100 wolves in the WYO as required for delisting plus additional breeding pairs and wolves to help ensure that the population does not go below the minimum even with natural fluctuations in population size (Wyoming Game and Fish Commission 2012). Additional wolves, packs and breeding pairs above the minimum needed in the state for delisting are expected in YNP and the WRR. At the end of 2017, the gray wolf population in Wyoming remained above minimum delisting criteria with at least 347

wolves, and 53 packs including at least 23 breeding pairs (Fig. 4-1), making 2017 the 16th consecutive year Wyoming has exceeded the numerical (breeding pairs and total wolves), distributional, and temporal delisting criteria established by the USFWS (Wyoming Game and Fish Department et al. 2018). The WYO wolf population generally increased after wolf reintroduction until 2012 when wolves were delisted, at which point there was a decline consistent with WGFD management objectives (Figure 4-1). A similar increase while listed, followed by a managed decrease after delisting occurred over the period of 2014 to present (see "***Regulated Public Harvest"*** below). The wolf population in Wyoming is distributed throughout all of the available high quality habitat in the WYO (U.S. Fish and Wildlife Service et al. 2014).

One of the goals of the Wyoming wolf management plan is to quickly and efficiently resolve localized wolf conflicts while maintaining healthy wolf populations (Wyoming Game and Fish Commission 2011;2012). While federally protected under the ESA, the U.S. Fish and Wildlife Service (1994) focused on resolving specific conflicts at specific sites (*i.e.*, livestock depredations and threats to human safety). The WGFD places similar emphasis on reduction of conflicts, but also employs public hunting of wolves to the extent possible in attempting to reduce those conflicts. The different forms of wolf take for conflict management (*e.g.*, take by WS-Wyoming and take by land/property owners under permits) are interrelated. Take by one of these entities is likely to reduce the number of wolves that will be taken by another entity. For example, if lethal WDM by WS-Wyoming successfully resolves a problem, there may be no need for a landowner to take wolves, so take under permits would decline. Conversely, landowner removal of a wolf caught in the act of depredation may reduce or eliminate the need for additional wolf removal by WS-Wyoming. Similarly, now that wolves are delisted, and where regulated harvest can help reduce the number of wolves and incidents of wolf predation on livestock, there would likely be fewer wolves taken by WS-Wyoming and private property owners during control actions.

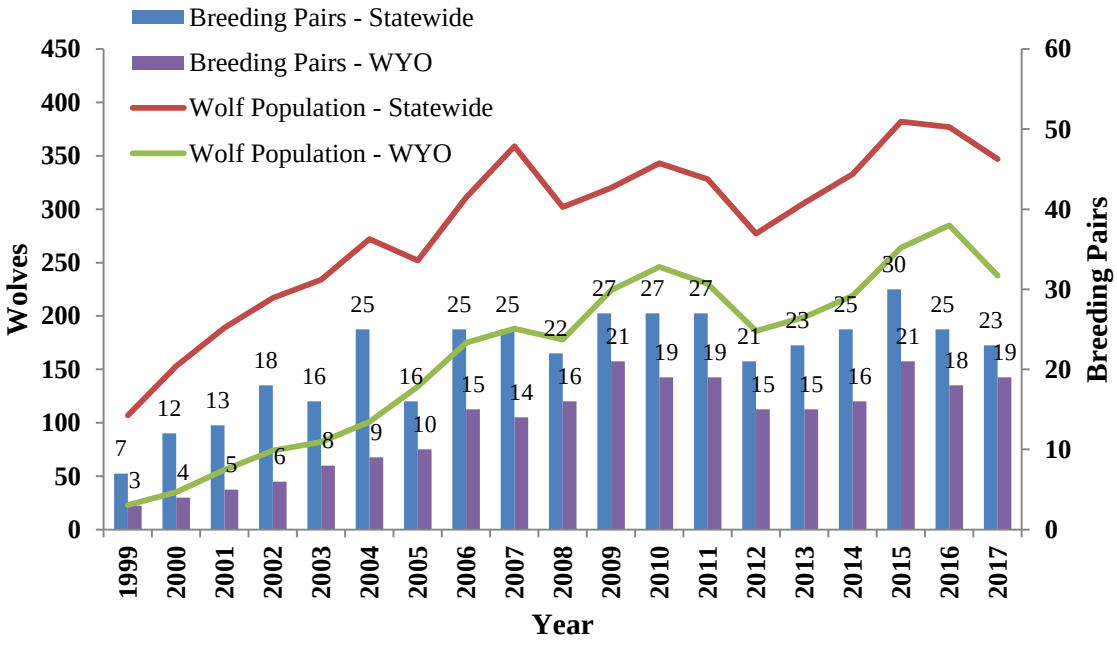


Figure 4-1. Statewide trend in wolf population and breeding pairs in Wyoming and in the WYO portion of Wyoming (area outside Yellowstone National Park and the Wind River Reservation), 1999-2017. Wolves were delisted from 2012-2014 and 2017 to present. (United States Fish and Wildlife Service et al. 2000, United States Fish and Wildlife Service et al. 2001, United States Fish and Wildlife Service et al. 2002, United States Fish and Wildlife Service et al. 2003, United States Fish and Wildlife Service et al. 2004, United States Fish and Wildlife Service et al. 2005, United States Fish and Wildlife Service et al. 2006, Jimenez et al. 2007, Jimenez et al. 2008, Jimenez et al. 2009, Jimenez et al. 2010b, Jimenez et al. 2011, Wyoming Game and Fish Commission 2011, Jimenez et al. 2012, Wyoming Game and Fish Department et al. 2013, U.S. Fish and Wildlife Service et al. 2014, United States Fish and Wildlife Service et al. 2015, Jimenez and Johnson 2016, U.S. Fish and Wildlife Service et al. 2017, Wyoming Game and Fish Department et al. 2018).

During 2014-2017, the proportion of packs in Wyoming involved in at least one livestock depredation per year has averaged 52% of the known packs in the state (range 48-56%) (Wyoming Game and Fish Department et al. 2013, U.S. Fish and Wildlife Service et al. 2014, Wyoming Game and Fish Department et al. 2014, United States Fish and Wildlife Service et al. 2015, Wyoming Game and Fish Department et al. 2015, Jimenez and Johnson 2016, U.S. Fish and Wildlife Service et al. 2016, U.S. Fish and Wildlife Service et al. 2017, Wyoming Game and Fish Department et al. 2018). Lethal take of wolves in response to depredations might in some cases include removal of up to an entire pack, but there will likely also be cases where no wolves would be taken in response to depredations. Despite the relatively high proportion of packs involved in at least one depredation, WS-Wyoming removal of wolves for depredation management has averaged only 16% of the population (range 11-26%; Table 4-1). The WGFD and tribes will continue to monitor and evaluate the wolf population annually to determine the wolf population status.

Impact of Management Actions to Protect Livestock and Human Safety

Under this Alternative, WS-Wyoming, as requested by and coordinated with the WGFD, WDA or tribes could continue to recommend nonlethal management methods when deemed practical and appropriate, or could lethally remove wolves to resolve wolf conflicts[15]. Additionally, livestock producers and/or their agents could legally shoot wolves to protect their livestock under existing WGFD and WDA rules and/or under the authority of permits issued by WGFD after confirmation of wolf predation. WGFC regulations for the WTGMA allow a property owner to immediately kill a wolf doing damage to private property: "doing damage to private property" is defined as "the actual biting, wounding, grasping, or killing of livestock or domesticated animal, or chasing, molesting, or harassing by gray wolves that would indicate to a reasonable person that such biting, wounding, grasping, or killing of domesticated animals is likely to occur at any moment."

Additionally, the WGFD shall issue "lethal take permits" authorizing property owners to kill not more than two wolves within the WTGMA. In instances of chronic wolf depredation, the WGFD may take further actions. WGFC regulations define "chronic wolf depredation" as "a geographic area limited to a specific parcel of private land or a specific grazing allotment described on the permit within the WTGMA where gray wolves have repeatedly (twice or more within a two-month period immediately preceding

[15] Includes take by designated agencies for the protection of human safety. Does not include euthanization of sick or injured wolves (injuries that are not related to actions proposed in this EA).

the date on which the owner applies for a lethal take permit) harassed, injured, maimed or killed livestock or domesticated animals." Wolves killed under the authority of a lethal take permit shall be reported to the WGFD representative specified on the permit within 24 hours.

In the Predatory Animal Zone, there are no restrictions on take of wolves, although take must be reported to the WGFD within 10 days. Individual reasons for taking wolves in the Predatory Animal Zone may include damage management or a desire for recreational harvest. Take in the Predatory Animal Zone during periods when wolves were delisted has been 12, 35, and 33 wolves in 2012, 2013 and 2017, respectively.

The number of wolf removals known to be taken by the agencies and landowners for protection of livestock in Wyoming from 1999-2017 (excludes take in the Predatory Animal Zone) has ranged from 7% to 27% of the wolf population per year (Table 4-1) with take by WS-Wyoming accounting for the majority of agency take for WDM. Wolves were delisted in 2012-2013 and 2017, and WGFD policies for WDM and wolf harvest described above were in place. During this period, take for WDM was 43, 33 and 61 wolves in 2012, 2013 and 2017, respectively, within the range of WDM take for the period of 2005-2011 of 31-63 wolves per year (Table 4-1). However, this estimate does not include wolves removed from the Predatory Animal Zone for damage management. If half the wolves taken in the Predatory Animal Zone are added to known take for damage management, then take for damage management in 2017 was over levels of damage management take documented in the past. Some of this take may be attributable to increases in the number of wolves in the Predatory Animal Zone and associated conflicts.

In the last 10 years, WS-Wyoming take of gray wolves has ranged between 11 and 18% of the population with a one-time spike in take in 2016 (27%) resulting from a record high wolf population and associated conflicts combined with restrictions on wolf take by private individuals experiencing damage. Take during this year was under the case-by-case direction of the USFWS. Based on historical levels take by WS-Wyoming is not anticipated to exceed 30% of the statewide wolf population with most years averaging under 18%of the statewide population.

Management Actions to Protect Ungulates

Under this alternative, WS-Wyoming would not assist in wolf removals to protect ungulates. The number of wolves which could be taken for this type of WDM is not known at this time, but, in accordance with applicable regulations and agency goals for the recovery and preservation of the species, would be adjusted and coordinated with other wolf removals so that cumulative take does not reduce the wolf population below minimum management thresholds established to protect the long-term viability of the species.

Regulated Public Harvest.

WGFD uses regulated public harvest to manage the wolf population inside the WTGMA. The Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011;2012) requires the WGFD to focus harvest in areas where wolf conflicts with livestock and/or ungulate herds may be occurring while allowing for lower levels of harvest in core population areas where conflicts are minimal (Wyoming Game and Fish

Department et al. 2018). As with all other forms of take, WGFD sets harvest limits in consideration of other known forms of take and mortality for the population to achieve state wolf population objectives including ensuring that cumulative take does not reduce the population below mandatory minimum levels set for population recovery and preservation. For example, the 2017 harvest was set to achieve the WGFD goal of reducing the state wolf population 24% in the WTGMA. Wolf hunting regulations will be developed annually through the same rule-making process used for other wildlife in Wyoming. The WGFD will generate management recommendations using the most recent wolf population, harvest, and mortality data and will present those recommendations to the public. The WGFD will then present final recommendations to the WGFC following the public input process. The WGFC will vote to approve, amend and approve, or reject the recommendations provided by the WGFD. Following approval, the WGFD will be responsible for implementing wolf hunting regulations. Wolf hunting seasons will primarily coincide with fall big game hunting seasons (Wyoming Game and Fish Commission 2011). Public harvest resulted in take of 66 wolves in 2012 (United States Fish and Wildlife Service et al. 2013), 62 wolves in 2013 (U.S. Fish and Wildlife Service et al. 2014), 12 wolves in 2014 (United States Fish and Wildlife Service et al. 2015), and 43 wolves in 2017 (Wyoming Game and Fish Department et al. 2018).

Incidental Mortality

Occasionally, wolves are killed accidentally (e.g., capture myopathy, vehicle accidents, or as incidental catch during legal trapping of other species). These types of mortalities are rare and, to date, have little impact on the state wolf population. WGFD will encourage other agencies and the public to report incidental mortalities within a reasonable timeframe. Prompt notification by the public will aid the WGFD in collecting important information from these types of mortalities.

Depending on the circumstances, lethal removal of wolves to address livestock depredation problems or risks to human health and safety may involve removing most or all members of a specific wolf pack. If these types of removals occur during the spring or early summer months, and the decision has been made to remove the entire pack, concerted efforts are made to remove all of the pups as well as the adults, in order to avoid orphaning the pups. When not all adult wolves are removed from a pack, a remaining wolf or wolves may continue to feed and care for the remaining pups (Boyd and Jimenez 1994, Packard 2003). There may be occasional circumstances however, where in spite of concerted efforts to humanely remove any pups left after all adult wolves have been removed, one or more pups may be left without any adult wolves to feed or care for them. The only way to avoid this circumstance altogether would be to limit wolf removal efforts during this time frame, so as to always ensure that at least one or more adult wolves were left to care for any pups. In some circumstances, this would be inconsistent with the objective of stopping recurring wolf predation on livestock.

Unfortunately, there could be occasional instances where dependent young may be orphaned during WDM activities. We expect the orphaning of wolf pups would occur very infrequently. Wolf population estimates reflect the cumulative impact of all factors on the wolf population including the potential orphaning of pups. Based on the increasing trend in the Wyoming wolf population in years when wolves were under ESA protection and the majority of take was for WDM, cumulative impacts of this factor appear to be very low.

Illegal Wolf Mortality

Wolves taken outside the framework established by state statute and WGFC regulation will be considered to have been taken illegally and will be investigated by WGFD law enforcement personnel. Appropriate law enforcement and legal action will be taken, which could include fines, jail terms, and/or loss of hunting privileges.

Natural Causes of Wolf Mortality

Natural causes of mortality in wolves may include factors such as disease, interspecific conflict and starvation. Primary diseases of concern for the Wyoming wolf population include mange, canine distemper virus and canine parvovirus. Mange and exposure to canine distemper have been documented in the wolf population in Wyoming (Jimenez et al. 2010a). For example, the 2005 decline in the state wolf population affected the wolves in YNP and was attributed to disease, although in 2006, there was no evidence of disease and the population had rebounded (Jimenez et al. 2007). In 2008, the decline in the wolf population hit the YNP wolves more than the packs in the WYO portion of the state population (Figure 4-1)(Jimenez et al. 2009). Interspecific strife and disease (mange) were the likely primary causes of the decline.

Indirect Impacts

Removal of wolves may have indirect impacts on the remaining wolves and packs that are not immediately reflected in counts of individuals in the wolf population. Potential indirect impacts may include changes in the genetic relatedness of individuals in packs and the social stability of packs (Rutledge et al. 2010, Wallach et al. 2015), the potential for suboptimal genetic traits to be selected-for resulting in reduced fitness (Darimont et al. 2009, Darimont et al. 2015), and changes in stress and reproductive hormones that may adversely impact the long-term health of the population (Bryan et al. 2014).

Rutledge et al. (2010) observed a decline in the degree of relatedness among individuals in wolf packs within a protected area, Algonquin Park, Canada, surrounded by an area of intensive hunting pressure. Wolf density did not change substantially after harvest was discontinued in the buffer area around the park, but the incidence of adoption of unrelated individuals into packs within the park declined substantially. Rutledge et al. (2010) hypothesized that restoring the high degree of relatedness among individuals may allow evolutionary processes to occur in response to natural selection and not human-mediated mortality. The authors suggest that conservation strategies that support natural selection may enhance the ability of populations to adjust to changing environmental conditions such as climate change.

Darimont et al. (2009) assesses the impact of human harvest pressure on specific phenotypes of prey species and report that their analysis of 29 species (21 fish, 4 invertebrates, 2 ungulates, and 2 plants) demonstrates phenotypic change over time as a consequence of human harvest. Harvest was primarily associated with commercial harvest. Given the lack of terrestrial vertebrates in the sample of species reviewed, we question the applicability of this information to wolves and wolf removals for WDM.

Additionally, removals for WDM do not in any way begin to approach commercial harvest in terms of intensity of effort or numbers harvested. Consistent with Darimont et al. (2009), Darimont et al. (2015) notes that humans harvest animals at rates far greater than that of other predators in the ecosystem, and that unlike mortality from other predators, human harvest disproportionately affects adult animals (i.e., reproductive adults). In cases where sport-hunting is intense, individuals with specific phenological traits (i.e., large body mass, antlers, etc.), are sought disproportionally which may affect the genetic structure of the population.

After careful review of the information in Rutledge et al. (2010), and Darimont et al. (2009, 2015) we do not believe the findings of these studies are directly applicable to conditions that may occur under Alternative 1. First, in lethal WDM, the removal of only wolves and packs associated with livestock predation is planned (see Section 3.3.5). Selections are made based on non-physical attributes, and potential selection pressure similar to that reported by Darimont et al. (2009), Darimont et al. (2015) would not be expected. This conclusion is supported by data from Stark and Erb (2014) which indicate that the assumption that hunting targets older individuals may not be accurate for wolf harvest in Minnesota. This data showed that over 60% of the wolves taken by hunters in 2013 were either young of the year or 1 year old individuals. Similarly in 2012, 71% of wolves harvested by hunters in the WTGMA were young of the year or subadults (1-2 years old)(Wyoming Game and Fish Department et al. 2013). In 2013 this percentage rose to 87% and declined to 60% in 2017(Wyoming Game and Fish Department et al. 2014, Wyoming Game and Fish Department et al. 2018).

Bryan et al. (2014) documented increased levels of stress hormones and reproductive hormones in tundra regions subjected to intensive hunting pressure when compared to forested regions where there was presumably less hunting pressure. The authors admit that their study's analysis was unable to completely differentiate between potential effects from other environmental factors and the hunting effect. The study did not collect any concurrent data on the reproductive biology and behavior of the affected packs, and instead presented hypothesis on reasons for the observed differences from information in the literature. Additionally, Bryan et al. (2014) provided no information on the level of wolf removals as a proportion of the wolf population that would enable extrapolation of their study results to other areas and differing types of wolf removals. While there are methodological problems with this design that limit the utility of the study, the study does raise interesting questions which we are considering here.

We are not surprised that Bryan et al. (2014) found measurable, hormonal responses (reproductive and stress hormones) in wolves subjected to "heavy rates" of hunting pressure. As noted by the authors, "Physiological responses are adaptive mechanisms by which organisms respond to complex interactions among individual, social and environmental conditions." Bryan et al. (2014) concluded that the observed differences likely reflected an interaction of hunting pressure, habitat, and sampling method. The study did not provide sufficient evidence to make predictions regarding the consequences of the observed differences for the wolf population. As noted above, at least some of the changes may be the beneficial response that enables populations to sustain some level of human removals (e.g., increased reproduction). The authors called for additional research to help clarify the cause of the observed changes and determine the impact of the observed changes on wolf populations. Bryan et al. (2014) also recommended that agencies may want to consider factors other than population size such as hormonal and genetic changes when assessing the health of wolf populations.

Wallach et al. (2015) discusses the importance of apex predators in native ecosystems and establishes a formal definition of an apex predator based on the extent to which social and biological factors (e.g., territoriality, pack structure, female reproductive suppression) and not top-down or bottom-up process limit the species population. The authors express concern that human persecution may disrupt social-stability in apex predator populations. In their opinion, perturbations in social stability may adversely impact the ability of the population to self-regulate via mechanisms such as female reproductive suppression and territoriality, and may also alter predation efficacy by perturbing cooperative foraging behavior. Shifts in hunting efficacy may result in changes in prey taken by packs and indirectly impact the impact of apex predators on prey populations (See Section 3.2.5.1 for discussion of impacts of wolf removals on the role of wolves in ecosystems). However, the extent to which this is an issue for Wyoming is unclear.

Many of the studies discussing disruptions to pack social structure as a result of lethal removals consider potential impacts on wolf populations and ecosystems that are not strictly related to the size of the wolf populations. It is not surprising that wolf removals can result in differences in predators without necessarily changing the wolf population density or size. Ultimately, the issue of concern is not whether differences can be measured, but what these differences mean for the population and it's interactions with prey and habitat. Available data indicate that disruption does not necessarily result in adverse impact on the overall wolf population (Nadeau et al. 2008, United States Fish and Wildlife Service et al. 2008, Nadeau et al. 2009, United States Fish and Wildlife Service et al. 2009, Mack et al. 2010, United States Fish and Wildlife Service et al. 2010). Pack resilience to mortality is inherent in wolf behavioral adaptation and reproductive capabilities (Brainerd et al. 2008). Pack dynamics, social status, movements, and certain aspects of seasonal habitat use are all affected by wolf reproductive behavior. Gray wolf packs normally consist of young of the year, several sub adults and the dominant male and female that can reproduce annually (Mech 1970). Lack of reproduction among sexually mature subordinate pack members is considered common (Packard et al. 1985), but increases in the occurrence of multiple breeding females have been documented (Mech 1999, Smith and Guernsey 2002, United States Fish and Wildlife Service et al. 2002, Mech et al. 2003, Mech and Boitani 2003, Brainerd et al. 2008). Brainerd et al. (2008) found that 62% of packs in recovering populations retained territories despite breeder loss, and of those who lost territories, one-half became re-established. Furthermore, pup survival was primarily dependent on size of pack and age of pup because multiple pack members feed pups despite loss of a breeder. Pup survival in 84% of packs with breeder loss was similar or higher than packs without breeder loss (Mech and Boitani 2003).

Contrary to the conclusion of some studies listed in this section, we believe that population size is an appropriate index to assess the long-term, well-being of the wolf population. Impacts that ultimately impair the ability of a population to respond to environmental factors, such as climate change, will be reflected in reduced survivorship or reproductive success and ultimately decreased population size. Nonetheless, WGFD wolf population monitoring is not limited to estimates of the number of the wolves in the population but also includes disease and genetic monitoring which may also provide insight into the status of wolf populations (Erb et al. 2017).

Although some studies discussed above noted differences in wolves subjected to heavy hunting pressure, the long term consequences of these differences for wolf populations and their role in ecosystems are largely unproven and theoretical. In the absence of conclusive data, the key factor in determining significance, is the extent to which the responsible agencies will monitor for and adapt to indications of unintended adverse cumulative impacts on the wolf population. This is especially true given that at least some of the differences observed appeared to be readily reversible. For example, restoration of "natural" social structure and relatedness in packs was restored relatively rapidly after establishment of buffer areas around a national park to reduce loss of wolves that wander outside the park (Rutledge et al. 2010).

The state gray wolf management plan and WGFD wolf monitoring reports reflect the State's commitment to population monitoring, and process of adjusting cumulative take of wolves to achieve state wolf population goals (e.g., the reduction in licensed harvest allowed after the first harvest season). Given WGFD commitment to managing for a sustainable and healthy wolf population, ongoing coordination among the State, YNP, WRR and WS-Wyoming, and the information above we conclude that the proposed action will not result in adverse indirect impacts on wolves that could significantly impact wolves or their role in native ecosystems.

Super-additive Mortality

Super-additive mortality may result from factors such as selective removal of breeding adults that could result not only in the loss of the adults but the year's reproductive effort for the pack, or loss of subsequent reproductive effort because of dissolution of the pack. Super-additive mortality could also result from disruption of social units needed for optimal survival e.g., foraging, territory defense or defense of prey from other predators and scavengers. Some authors have expressed concerns that traditional population harvest models may not adequately consider the potential for super-additive mortality. Creel and Rotella (2010) and Ausband et al. (2015) provide data indicating that removal of adult wolves can have impacts on wolf population dynamics in excess of that strictly predicted in wolf harvest models that only consider removal of individuals.

The primary concern relative to super-additive mortality appears to be that removals for WDM, or the cumulative impact of wolf removals for WDM, licensed harvest, and other factors, would adversely impact the long-term viability of the wolf population. Models are useful in predicting impacts of licensed harvest and WDM removals on wolf populations, but they are not used exclusively in evaluating impacts of removals on wolf populations or agency determinations regarding acceptable levels of WDM removal or sport harvest. Instead, the agencies responsible for determining acceptable wolf populations, in this case WGFD, use an adaptive process in which the impact of management decisions is predicted using models and data from similar areas and situations, and then adjusted as appropriate based on field observations (e.g., state wolf population monitoring) (Wyoming Game and Fish Department et al. 2018). Given the above information, even if super-additive mortality is a factor in wolf management in Wyoming we are confident that WGFD has the monitoring and management expertise to prevent substantial cumulative adverse impacts on the wolf population.

Table 4-1. Estimated Wyoming wolf population in the WYO (areas outside YNP and WRR), mortality from agency WDM actions and licensed hunting (when allowed), and percent population change from previous year, 2005-2017 (United States Fish and Wildlife Service et al. 2006, Jimenez et al. 2007, Jimenez et al. 2008, Jimenez et al. 2009, Jimenez et al. 2010b, Jimenez et al. 2011, Jimenez et al. 2012, Wyoming Game and Fish Department et al. 2013, U.S. Fish and Wildlife Service et al. 2014, United States Fish and Wildlife Service et al. 2015, Jimenez and Johnson 2016, U.S. Fish and Wildlife Service et al. 2017, Wyoming Game and Fish Department et al. 2018).

Year	Minimum Estimated Year-End Wolf Population	Known Mortality			% Estimated Mortality from Population[2]			% Change in minimum Estimated Wolf Population[3] (from previous year)
		Total	Agency and Public Take Actions[1] (take for damage management)	WS	Total	Agency and Public Take Actions[1] (take for damage management)	WS	
2005	134	51	41	41	28	22	22	+33
2006	175	59	44	44	25	19	19	+31
2007	188	75	63	63	29	24	24	+7
2008	178	79	57	46	31	22	18	-6
2009	224	40	31	31	15	12	12	+26
2010	246	58	40	40	19	13	13	+10
2011	230	51	36	36	18	13	13	-6
2012	186	124	109[4] (43)	43	39	35 (14)	14	-19
2013	199	109	95[4] (33)	33	35	31 (11)	11	+7
2014	219	64	52	31	23	18	11	+10
2015	264	77	54	54	23	16	16	+17
2016	285	128	113	111	31	27	27	+8
2017	238	162	137[4] (63)	52	40	34 (16)	13	-16

[1] Includes agency control, and authorized public take (permits from USFWS, predator control zone, hunter harvest).
[2] Total population for purposes of calculation adds known mortality to minimum population estimate.
[3] The percent change in population takes into account the agency removal data.
[4] Wolf hunting season open during these years.
[5.] Take for damage management in years when wolves are delisted, does not include take in the Predatory Animal Zone which may be for damage management or recreational harvest.

Cumulative Impact on the State Wolf Population

Wolf populations are dynamic and can undergo major fluctuations. Many studies have examined various levels of mortality and harvest and the impacts these mortality levels have on gray wolf populations. Wolf populations have sustained human-caused annual mortality rates of 30 to 50% without experiencing declines in abundance (Keith 1983, Fuller et al. 2003). Based on mean pack size of 8, mean litter size of 5, and 38% pups in

packs, Boertje and Stephenson (1992) suggested 42% of juveniles and 36% of adults must be removed annually to achieve population stability. While Mech (1970) suggested that more than 50% of wolves older than 5-10 months must be killed to control population size, other researchers have indicated declines may occur with human-caused mortality at 40% or less of fall wolf populations (Peterson et al. 1984, Ballard et al. 1987). Gasaway et al. (1983) reported stable wolf populations after early winter harvests of 16 to 24%, and wolf population declines of 20 - 52% after harvests of 42 - 61%. Ballard et al. (1997) suggests that the wolf population remained stable at 53% winter mortality, which included both natural and human-caused mortality. Fuller (1989) observed stable or slight increases in a wolf population with an annual human-caused mortality rate of 29%. Fuller et al. (2003) concluded that up to 35 % human-caused mortality of late fall or winter population could be tolerated by most wolf populations without causing population declines.

Mech (2001) looked at three scenarios for the management of Minnesota's wolf population when the population was estimated at 2,450 wolves during the winter of 1997-1998: 1) population and range limitation, 2) sustainable harvest, and 3) population reduction. For population and range limitation, an additional number of wolves equal to the annual increase in the wolf population (statewide for population stabilization, in the periphery of occupied range for range limitation) would need to be taken as long as lethal WDM continued at its present or greater level. Using data from other regions of North America, winter harvests of wolves of 28-47% did not permanently reduce wolf populations for sustainable harvest. Wolf populations have been reduced in Canada and Alaska when 38-80% of the populations were removed during the winter. These populations rebounded after population reduction was ceased (Mech 2001). In their analysis of multiple data sets, Adams et al. (2008) found human-caused mortality rates <29% did not cause wolf population declines.

Haber (1996) reported that wolf populations may not be able to withstand repeated annual reductions of 25-50%. He believes these removals, in the form of hunting, trapping, and government control efforts, may have impacts on wolf population dynamics, social interactions, and the long-term health of the population. Haber also reported that it is difficult to fully understand the impacts of wolf exploitation because detailed comparative information on behavior from both exploited and protected wolf populations is scarce. Haight et al. (2002) modeled the impacts of various wolf removal strategies for WDM including reactive removal (wolves removed after depredation occurs), delayed corrective removal (wolves removed in winter from areas with a history of wolf conflicts); and population size management (wolves removed annually from all territories near depredation sites). None of the strategies threatened wolf populations unless the wolf population was isolated. The model predicted that populations could withstand a sustained harvest of 20-25%. The authors considered this to be a conservative estimate and that the model likely underestimated compensatory factors in wolf population biology.

Creel and Rotella (2010) noted that most assessments of the ability of wolf populations to withstand human-caused mortality assumed that human-caused mortality was compensated for by density-dependent reductions in non-harvest mortality factors. The authors used data from existing studies of wolf populations, and USFWS reports for the NRM wolf population published through 2008 to assess the impact of human-caused mortality on total mortality and the impact of human-caused mortality on wolf population growth rates. Based on their modeling, Creel and Rotella (2010) concluded that human-

caused mortality was actually highly additive to or potentially super-additive to natural mortality. Super-additive mortality rates might occur in situations wherein wolf removals disrupt pack structure such that breeding activity was disrupted. Risks associated with pack disruption and associated impacts on the response of wolf populations to human-caused mortality were identified as being particularly great for small packs with 4 or fewer adults. However, the authors also found little evidence of density dependence in wolf population growth rates which could have been an indication that the population was below its ecological carrying capacity and that density-dependent factors did not have strong influence on population dynamics at that time. The authors concluded that while wolf populations could be harvested sustainably, within limits, human-caused mortality was additive to other factors and the level of harvest that could be sustained was likely lower than predicted in other studies. Creel and Rotella (2010) concluded that NRM populations could sustain harvests of approximately 22% of the population. Borg et al. (2015) evaluated the impact of human harvest on the wolf population and pack structure in Denali National Park and Preserve and also concluded that human-caused mortality may be a largely additive source of mortality in wolves. In determining harvest limits to meet population objectives, WGFD quantifies all mortality, and therefore would be able to document additive mortality, should it occur.

In social species like wolves, population structure (e.g., pack stability and reproductive success) can play an important role in overall population dynamics. As noted above, concern has been expressed that removal of breeding wolves could destabilize the breeding success of individual packs and have impacts greater than may be predicted. Brainerd et al. (2008) found that 62% of packs in recovering populations retained territories despite breeder loss, and of those who lost territories, one-half became re-established. Furthermore, pup survival was primarily dependent on size of pack and age of pup because multiple pack members feed pups despite loss of a breeder. Pup survival in 84% of packs with breeder loss was similar or higher than packs without breeder loss (Mech and Boitani 2003).

Brainerd et al. (2008) stated that breeder replacement was highest and fastest in populations with more than 75 wolves. Similarly, Borg et al. (2015) observed packs remained intact in 67% of cases following breeder loss. Impact of breeder loss appeared to be context-specific and depended on the timing of removal and the size of the pack. Loss of breeders late in breeding season or just prior to parturition appeared to have the greatest effects, likely because there was little time for replacement individuals to become established in the pack. Availability of replacement individuals was also a factor, with impacts likely to be greater in small isolated wolf populations and when pack sizes are small (<6 wolves). Overall wolf population growth appeared to be resilient to the effects of breeder mortality. Breeder loss did not affect population growth in the current year or the year following removal. Pack dissolution had a marginal negative effect on population growth during the year in which the dissolution occurred but no effect the following year. In Wyoming, average pack size for the period of 2005-2014 has been 6.6 wolves with a range of 2-22 wolves per pack. As noted above, the wolf population in Wyoming currently occupies almost all of the available suitable habitat (U.S. Fish and Wildlife Service et al. 2014). The WYO area is adjacent to YNP where there is no wolf hunting and any WDM (protection of human health and safety) would be extremely rare. Montana, Idaho and Wyoming are working to ensure that state wolf populations are not isolated. Given this information, we believe it is reasonable to expect impacts on wolf packs and wolf population structure to be more similar to the saturated wolf population studied by Borg et al. (2015) than a low or recovering wolf population.

Therefore, although some disruption of packs may occur as a result of WDM actions, these projects are expected to be short term and unlikely to jeopardize the viability of the state wolf population.

Data on wolf population trends in the WYO and human-caused mortality rates indicates that human-caused mortality has generally been at or below even the conservative sustainable harvest threshold of 22% estimated by Creel and Rotella (2010). The Wyoming wolf population has increased most years from 2005 – 2017. Wolf population declines have been documented in years when human-caused mortality was 22, 13, and 35% of the population in 2008, 2011 and 2012 (Table 4-1). Conversely, population increases were observed in 2007, 2013, and 2016 when authorized human-caused mortality was 24, 31 and 27% of the population, respectively. Mange and interspecific strife may have been contributing factors in population declines in 2008 and 2011. The declines in 2012 (United States Fish and Wildlife Service et al. 2013) and 2017 (Wyoming Game and Fish Department et al. 2018) were in accordance with state management goals and consistent with state objectives when setting hunter harvest limits. The variability of wolf population response relative to human harvest emphasizes the importance of population monitoring and use of adaptive management in wolf population management. WGFD monitors the wolf population using the best science available and has been able to maintain the population above the wolf recovery criteria.

Under this or any of the other Alternatives, it is reasonable to expect that the WGFD adaptive management approach will ensure that the cumulative impacts on Wyoming's wolf population do not result in the population dropping below approved recovery levels or state management objectives (Wyoming Game and Fish Department et al. 2018). Data posted in Table 4-1 indicates that the cumulative mortality in the population is within parameters the studies described above indicate can be sustained by wolf populations and/or used to adjust wolf populations to meet management objectives without jeopardizing the long-term viability of the population. In recognition of the importance of overall wolf population numbers and population structure, management objectives and thresholds set to ensure the future viability of the wolf populations include total population and breeding pair objectives. The wolf population in the WYO has met or exceeded minimum population recovery goals (100 wolves and 10 breeding pairs) and included management for additional wolves and breeding pairs above the minimum recovery goals for 16 years even with lethal wolf removal to reduce damage by and conflicts with wolves, wolf removals in the Predatory Animal Zone (when permitted) and wolf hunting seasons, as well as all other sources of wolf mortality. Consequently, the cumulative impacts of the proposed action would not be expected to adversely affect the state or regional wolf population to the extent that this would result in a significant adverse effect on the quality of the human environment.

Local Impacts on Wolves in Wyoming

Reviews of impacts on wildlife populations generally focus on areas large enough to support a viable population of the species in question (e.g., regional and state wolf populations). Analysis of impacts must also take into consideration the scale at which management decisions are made and the nature of the available data on the population. While wolves were federally protected under the ESA, the USFWS management plan, data collection and reporting was conducted at the state and regional level. The USFWS plans for delisting wolves set state level population minimums necessary for sustained population recovery (United States Fish and Wildlife Service et al. 2015). For these

reasons, we believe the analysis above represents the best scale for understanding impacts on the Wyoming wolf population. However, we also understand that there is interest in smaller-scale information on the wolf population. Due to the differences in management strategy between the WTGMA and Predatory animal zone and given that WGFD reports population size and take at the management zone level and given that WGFD sets short-term population management objectives for the WTGMA, management zones are the most practical scale for localized analysis. This section reviews available management zone-specific data for the WYO.

Data on wolves in the WTGMA and Predatory Animal Zone is only available for the years when wolves were primarily under state management. For purposes of the discussion below, take and population estimates for the WTGMA refers to the WTGMA and the Seasonal WTGMA.

Table 4-2. Estimated Wyoming wolf population in the Wolf Trophy Game Management Area (WTGMA – includes WGTMA and Seasonal WTGMA) and the Predatory Animal Zone for years when wolves were under state management (Wyoming Game and Fish Department et al. 2013, U.S. Fish and Wildlife Service et al. 2014, United States Fish and Wildlife Service et al. 2015, Wyoming Game and Fish Department et al. 2015, Wyoming Game and Fish Department et al. 2018).

Year	Minimum Estimated Year-End Wolf Population		Known Mortality		% Estimated Mortality from Population[2]	
		Packs (Breeding Pairs)	Total	Agency and Public Take[1] (agency take for damage management)	Total	Agency and Public Take[1] (agency take for damage management)
WOLF TROPHY GAME MANAGEMENT AREA						
2012	169	26 (19)	89	72 (31)	34	28 (12)
2013	179	26 (20)	66	61 (26)	27	25 (11)
2014[6]	186	32 (16)	37	26 (1)	17	12 (1)
2017	198	34 (23)	113	92 (49)	36	30 (16)
PREDATORY ANIMAL ZONE						
2012	17	5[7]	35	35 (12)	67	67 (23)
2013	20	4[7]	35	34 (7)	64	62 (13)
2014[6]	8	2[7]	26	17 (6)	76	50 (18)
2017	40	6 [7]	49	45 (14)	55	51 (16)

[1] Includes agency control, and authorized public take (permits from USFWS, predator control zone, hunter harvest).
[2] Total population for purposes of calculation adds known mortality to minimum population estimate.
[3] The percent change in population takes into account the agency removal data.
[4] Wolf hunting season open during these years.
[5] "Control" in years when wolves are delisted, does not include take in the Predatory Animal Zone which may be for damage management or recreational harvest.
[6] WGFD reporting interval ended with the court ordered return of wolves to federal management in September 2014 which curtailed some population assessment activities and led to underestimates of wolf populations, packs and breeding pairs.
[7] Due to the status of wolves in the Predatory Animal Zone, fewer resources are committed to wolf population estimation, identification of packs and verification of pack status as a breeding pair. Consequently these numbers are an incomplete representation of the total wolf population in the Predatory Animal Zone.

All WS-Wyoming take of wolves in the WTGMA is directed on a case-by-case basis by the WGFD. In 2012, the WGFD established a management objective of 172 wolves in the WTGMA and an objective of 160 wolves in the WTGMA for 2013, 2014 and 2017. The wolf population in the WTGMA was slightly lower than the management objective in 2012 and WGFD adjusted harvest accordingly. The population in the WTGMA during the subsequent years under state management has remained slightly above target levels despite known human take levels at the high end of sustainable harvest estimates, discussed above in the review of cumulative impacts on the statewide wolf population. Future wolf management in the WTGMA is anticipated to be consistent with established policy. Based on this information, and given that the WGFD has demonstrated ability to maintain the WTGMA wolf population near or above management objectives and that WS-Wyoming does not conduct any WDM in the WTGMA without the express direction of the WGFD, this alternative is not having a significant impact on the quality of the human environment.

The Predatory Animal Zone is described by the WGFD as being exemplified by low habitat suitability for wolves, low recolonization potential and historically high wolf-livestock conflicts. As such the State has no goal to reestablish wolves in this zone or set management objectives for the wolf population. WS-Wyoming take in this zone ranged from 13 to 23% of the total population and comprised approximately a third of authorized wolf take in this zone. Although WS-Wyoming take is within sustainable harvest thresholds and levels that occurred while the wolf population was federally protected under the ESA, cumulative take is in excess of most known sustainable harvest estimates. Nonetheless, the wolf population continues to persist and slowly expand into this area. Take of wolves in the Predatory Animal Zone is consistent with state objectives for the population and based on discussion in Section 3, take would likely occur at a similar or greater level in the absence of involvement by WS-Wyoming. Consequently, WS-Wyoming take of wolves in the Predatory Animal Zone is not causing substantive changes in wolf management, wolf take or impacts on the wolf population in the Predatory Animal Zone.

Some concerns have also been expressed regarding the repeated removal of wolves in some areas over consecutive years. WS-Wyoming has reviewed the data on agreements where wolves have been taken over the last 5 years. In the last 5 years, wolves were removed for WDM at 62 properties. Only 4 properties (6%) had recurring conflicts warranting repeated removal of wolves in 3 or more of the last 5 years. Recurring issues at these sites appear to primarily be attributable to the location of the sites and high density of wolves in the area. Producers on these sites have employed nonlethal methods such as carcass disposal and animal husbandry techniques in which there is an increased human presence near the livestock, but wolf conflicts with livestock are still recurring. Recurring need for removal is indicative of either partial pack removal or rapid recolonization of the site by new individuals. As such, and given the limited extent of recurring wolf removals in context of local state and regional wolf populations that are increasing or maintained as state population objectives, the limited recurring removal of wolves from local sites is not having a significant adverse impact on the wolf population.

4.3.1.3 Effects on public and pet health and safety

WS-Wyoming's wolf damage management activities may impact human and pet health and safety in two ways. First, WS-Wyoming activities may provide relief from damage or threats to public health or safety. For example, people with pets that are killed in their

yards, express concern for human safety. Second, WS-Wyoming WDM activities may pose a risk to human and pet health and safety through unintentional capture in devices used for WDM. The greatest risks to public health and safety from the use of wolf conflict management techniques are incurred by the individuals who use these methods. There have been no instances of public injury in equipment set by WS-Wyoming to capture wolves or reported injuries to WS-Wyoming, USFWS or WGFD personnel from WS-Wyoming wolf management activities.

WS-Wyoming strategically places traps and snares to reduce the likelihood of exposure to the public and pets. Appropriate warning signs are posted at access points to areas or properties where traps or snares are set to alert the public of their presence. Based on review of WS-Wyoming activities to reduce conflicts with other predators in the state and similar WDM activities in other states, it is possible to unintentionally capture pets in traps and snares. Any nontarget take of pets is undesirable, and WS-Wyoming strives to prevent capture of pets. Consequently, occurrences of these types of events are rare, especially relative to total WS-Wyoming use of traps and snares and the number of target animals captured (USDA 2019a, b).

There is a risk of bites and scratches to anyone that attempts to release a live animal that is captured in trapping devices. An individual that is unfamiliar with the operation of traps or trapping devices would be at risk for such injuries if attempting to release an unintentionally captured pet from a trap. WS-Wyoming employees are trained in the use of all trapping devices they use and also have catch poles and other animal handling devices including immobilization drugs all of which can help with safe release of captured animals.

Nationally in FY13, WS had 22 injuries, 12 falls, 8 lacerations and other cuts, 2 allergic reactions, 1 finger sprain (cage trap), and 1 puncture from all WDM and office activities. Two of these injuries were from setting foothold traps while none were known to be associated with the use of cable devices. Considering the number of employees (~1,900 agency-wide), these incidents are relatively few for the number of hours spent afield. There is also some risk that an employee may be bit when releasing an animal captured in a snare. From FY08 to FY12, WS field personnel in the Western Region were bitten 14 times (1 bear, 1 coyote, 2 feral cats, 3 feral dogs, 2 bats, 1 pelican, and 4 unknowns). For context, WS killed 110,005 predators in the Western Region and released 3,751 during this time period. It is likely that all or most bite incidents related to releasing captured animals. If the bite incidents occurred from only the released animals, it would equate to one bite per 341 releases with the unknowns counted as predators. In summary, risks of setting foothold traps are relatively low to WS-Wyoming employees and the general public.

Firearm use is a very sensitive issue and a public concern because of fears regarding the potential for misuse of firearms. To ensure safe use and awareness, WS employees may not use firearms in an official capacity until they have completed the NRA Basic Firearm Course specific to the firearms the employee will use on the job. Employees who use firearms as part of their duties must also complete additional annual firearms training which may consist of any of the options listed in the continuing education section of the WS Firearms Manual (WS Directive 2.615). All firearm safety precautions would be followed by WS when conducting conflict management and WS would continue to comply with all applicable laws and regulations governing the lawful use of firearms. Shooting with shotguns or rifles would be used to reduce wolf damage when lethal

methods are determined to be appropriate and firearms would be used to euthanize captured wolves. WS employees who use firearms as a condition of employment are required to certify that they meet the criteria stated in the *Lautenberg Amendment*, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

The low-level flights used for wildlife management including wildlife surveys like those conducted by the WGFD, USFWS, and other natural resource agencies are inherently higher risk than those for general aviation. Low-level flights introduce hazards such as power lines and trees, and the safety margin for error during maneuvers is diminished compared to high-level flights. Accidents have been associated with WS aerial operations and are a concern to WS. WS has conducted multiple reviews of the aviation program as part of ongoing efforts to improve aircraft safety including reviews in 2007, 2010 and 2017. Wildlife Services developed the WS Aviation Training Center with the goal of reducing pilot error accidents to zero. The WS Aviation Training Center provides safety training, individual instruction and aviation consultation to all aviation programs in WS. The Center trains pilots to effectively respond to different types of mechanical failures and other safety concerns associated with low-level flight. Wildlife Services complies with all Federal Aviation Administration issued Service Bulletins, Airworthiness Directives, aircraft manufacturing recalls, and similar documents.

Wildlife Services' safety measures and training for aerial shooting are the same as those for aircraft used in surveillance with the addition that the individuals conducting the shooting also have specialized training in the safe and effective use of shooting from aircraft. Wildlife Services employees must have a clear view of the animal before shooting, so there is no risk of accidentally shooting a person. Overall risks to human health and safety are slightly higher to the flight crews because of the increased intensity and duration of the action but are still very low.

In 2007 and 2008, WS conducted a programmatic safety review to assess and improve employee safety (USDA 2008). The review covered nine WS program areas including the aviation program. The review of the aviation program was conducted by the Interagency Committee on Aviation Safety. The review team concluded that the WS aviation program is being operated in a safe, efficient and effective manner and that the program met the Interagency Committee on Aviation Safety requirements for the Gold Standard Certificate for Excellence. At the time of the report, the WS program was the only USDA aviation program to be awarded this certification. Wildlife Services' program pilots and contractors are highly skilled with commercial pilot ratings and have passed proficiency tests in the flight environment encountered by WS. Wildlife Services' pilots are trained in hazard recognition and surveillance flights would only be conducted in safe environments. Federal aviation regulations require pilots to fly a minimum distance of 500 feet from structures and people, and all employees involved in these operations are mindful of this. Although the goal of the aviation program is to have no accidents, accidents may still occur. However, the protective measures implemented by WS keep the risk of aircraft accidents and injuries to the public and aircraft crew low.

Drugs used in capturing, sedating, handling, and euthanizing wildlife for wildlife management purposes include ketamine hydrochloride, a mixture of tiletamine and zolazepam (Telazol), xylazine (Rompun), sodium pentabarbitol, potassium chloride, Yohimbine, antibiotics, and others. Wildlife Services would adhere to all applicable requirements of the Animal Medicinal Drug Use Clarification Act to prevent any

significant adverse impacts on human health from use of these methods. All drugs used in capturing and handling wildlife would be under the direction of state veterinary authorities, either directly or through procedures agreed upon between those authorities and WS-Wyoming.

This alternative could provide relief from damage or threats to public health and safety for people who would have no relief from such damage or threats if nonlethal methods were ineffective or impractical. Many people directly affected by wolf depredations on domestic animals, especially pets that are killed in their yards, express concern for human safety. Wolves that have become habituated to humans are unpredictable and may attack people or pets (Section 1.4.3, Linnell et al. 2002, McNay 2002). In many situations where wolves may pose a risk to health and safety, management of human behavior and nonlethal techniques may be sufficient to resolve the problem; however, in some situations, removal of the problem individual may be the most appropriate solution (WGFC 2011). Perceived threats to human safety from wolves would continue to receive a high priority response from WGFD and/or WS-Wyoming under this alternative.

Since the delisting of wolves, WS-Wyoming is not the only entity who may use methods such as traps, snares, shooting and aerial shooting to address conflicts with wolves, particularly in the predatory animal zone (Section 3.2.1). Entities conducting aerial operations independent of WS-Wyoming do not have access to the WS Aviation Training Center and the improvements in safety associated with this program. Similarly, while individuals using traps, snares and shooting for WDM or other authorized harvest of wolves must comply with state regulations on the use of these methods, they are not required to comply with the safety provisions listed in Section 3.4.3 and established in WS program directives. Consequently, risk to public and pets associated with these tools would be similar to or greater than if the methods are implemented by WS-Wyoming, depending on the choices and skills of the people implementing the techniques. In general, use of lethal WDM by non-WS entities is expected to be lower in areas where WDM assistance is available from WS-Wyoming. Consequently cumulative impact on human and pet safety under this alternative is expected to be lower than for Alternatives 2 and 3.

4.3.1.4 Humaneness and animal welfare aspects of the methods to be used

Under this alternative, preference would be given to use and recommendation of nonlethal methods where practical and effective. However, as noted in Section 3.4, most nonlethal methods are best implemented by the landowner/manager or permittee (e.g., use of livestock guarding animals, herders, fencing, and other animal husbandry practices), and WS-Wyoming involvement in these methods is limited to technical assistance on their safe and effective use. Wolves that depredated domestic animals or caused humans safety threats may be captured with foot-hold traps or neck snares and then euthanized per AVMA guidelines covering euthanizing wildlife in a field setting. Wolves may also be removed with shooting from the ground or aircraft by experienced WS personnel. Wolves captured for research and pack/population monitoring would be captured with foot-hold traps or snares, chemically immobilized by WS-Wyoming personnel experienced and trained with immobilizing drugs, radio-collared and released on site. Alternatively, WS-Wyoming is working with NWRC on a pilot project using advanced break away snares to remotely attach radio collars for short term wolf monitoring purposes.

Individual perspectives on what is and is not humane vary. Many individuals consider lethal methods to generally be less humane than nonlethal methods and methods such as traps and snares which capture and hold animals until the WS-Wyoming specialist arrives to be the least humane. Methods which pose a risk of capturing nontarget species or any risk of adverse impact on pets, even if low, may be considered inhumane and unacceptable by some individuals. Conversely, some individuals with domestic animals that have been injured, threatened or killed by wolves may see this alternative as being more humane because it has the greatest probability of promptly reducing the risk of continued killing or injury of their livestock and pets by wolves.

In 1991, with the encouragement of animal rights and welfare groups, the European Union (then the European Economic Community) promulgated a trade regulation banning fur imports from countries deemed to be using inhumane traps. This ban was subsequently modified to permit imports from countries using traps that have been evaluated according to international standards for humaneness. These standards were developed by the major fur-exporting countries (Canada, Russia, and the United States), and the 2008 Agreement on International Humane Trapping Standards (AIHTS) was subsequently signed by Canada, Russia, and the E.U. The U.S. did not sign the agreement because the primary authority for managing furbearing animals rests with the states and tribes, not the federal government. However, the federal government cooperated with the Association of Fish and Wildlife Agencies (AFWA) to meet the intent of the agreement to improve animal welfare in U.S. trapping and to avoid the E.U. trade ban. The U.S., led by AFWA, has developed Best Management Practices (BMP) guidelines for private fur harvest and other trapping activities (AFWA; https://www.fishwildlife.org/afwa-inspires/furbearer-management). The BMP process scientifically evaluates the traps and trapping systems used for capturing furbearers for specific species and regions in the United States Evaluations are updated periodically as new information and devices become available and are based on animal welfare, efficacy, selectivity, practicality and safety. WS recognizes the value of BMPs and utilizes these guidelines as a basis for policy formulation, recognizing that some devices used in wildlife damage management are not commercially available and that not all devices recommended in the BMPs guidelines for general public use meet the more stringent performance requirements for durability and efficacy under a range of environmental conditions required for use in WS' wildlife damage management activities (WS Directive 2.450). WS-Wyoming uses foothold traps that comply with Best Management Practices (BMPs) established by the Association of Fish and Wildlife Agencies (Association of Fish and Wildlife Agencies 2019).

Research suggests that with methods such as restraint in foothold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements of fox indicate that this is the case for fox that have been held in traps, snares, and chased by dogs (Kreeger et al. 1990). Marks (2010) used blood chemistry indicators to compare stress to red foxes associated with use of softcatch traps, treadle snares, shooting, cage traps and use of dogs to chase foxes into nets. Physiological data indicated restraint by treadle snare was more stressful for fox than capture in traps, and both methods resulted in higher stress indicators than cage traps and shooting. The situation is likely to be similar for wolves caught in traps and cable devices. Use of traps that are demonstrated to minimize suffering and pain such as those recommended in trapping BMPs as well as frequent trap checks, can increase public acceptance of trapping and perceptions of the humaneness of this method (Proulx and Barrett 1990, Andelt et al. 1999). Using (Association of Fish and Wildlife Agencies 2019)experienced and skilled trappers to

educate new trappers in the effective use of more humane and selective traps can also improve the overall practice and humaneness of trapping.

Under this alternative, wolves would be killed by experienced WS-Wyoming personnel, using the best and most appropriate method(s) available. WDM methods viewed by some persons as inhumane would be employed by WS under this alternative. These methods could include shooting, trapping, snares and aerial shooting. Over the period of FY 07-FY 16 shooting from the air or the ground (cumulatively 91%) was preferentially used by WS-Wyoming specialists when lethal methods were needed to address conflict problems. Snares were not used for WDM during this period. Despite protective measures and state trapping regulations designed to maximize humaneness, the perceived stress and trauma associated with being held in a trap or snare until the WS employee arrives at the capture site to dispatch or release the animal, is unacceptable to some persons. Shooting generally results in a faster, more humane death, and is selective for target species, but is also considered unacceptable and inhumane by some individuals.

Although trapping is not the method most commonly used for lethal removal of wolves, it is the primary method used to live-capture wolves. Some individuals may prefer that methods such as cage traps be used to capture wolves and would perceive this method as being more humane than foot-hold traps and snares. Unfortunately, the use of cage traps to capture wolves is both impractical and ineffective because it is extremely difficult to get a cage trap large enough for an adult wolf into remote locations, and because it would be highly unlikely to capture an animal as wary as an adult wolf in a cage trap. WGFD's experience also suggests that cage traps are ineffective. Although injury rates in cage traps are lower than cables and snares, use of cage traps is not without risk of injury to the captured animal, because animals can injure themselves attempting to escape the trap (e.g., swelling, damage to teeth and muscles: (Shivik et al. 2005, Muñoz-Igualada et al. 2008)).

No data is available comparing wolf capture in cage traps to capture in other devices, but information is available testing these devices with coyotes which may provide insight as to their use and impact for WDM (Shivik et al. 2005). For example, in an Arizona and Texas test comparing foothold traps (Softcatch®), cable restraints (Collarum®), a WS Turman snare that used a throw-arm for foothold capture of coyotes, and cage traps (Tomahawk®)(Shivik et al. 2005), no coyotes were captured in the Tomahawk live trap in contrast to catch rates of 87% for the Collarum, 88% for the WS throw arm, and 100% for the Softcatch. Cage traps were also the least selective for target animals with none of the animals captured target species, in comparison to the WS Turman (50%), Softcatch (69%) and Collarums (100%). No indicators of poor welfare were noted for 92% of coyotes captured in the Collarums, 57% of coyotes captured in the WS Turman, and 92% of soft-catch traps. Both the Collarum and softcatch traps surpassed the injury acceptability standards set by the United States of America and European Union (1997) which required at least 80% of animals to have no indicators of poor welfare. Lack of coyotes captured in the cage traps precluded comparison of injuries using that method. The studies demonstrate the need to balance the multiple factors regarding humaneness and efficacy when selecting management methods.

Selectivity of wildlife damage methods is related to the issue of humaneness in that greater selectivity results in less potential suffering of nontarget animals. Methods vary in their selectivity for nontarget animals. The selectivity of each method is augmented by the skill of the WS-Wyoming employee applying the technique, and on specific measures

and modifications designed to reduce or minimize nontarget captures. All WS-Wyoming employees are trained in techniques to minimize the risk of capturing nontarget wildlife. Section 4.3.1.6 discusses the proposed project's potential for affecting nontarget species.

WS continues to work to improve the selectivity and humaneness of management techniques through research and development. Research is continuing to bring new findings and products into practical use. For example, the NWRC is currently conducting a study evaluating new breeds of livestock guarding dogs for their suitability in reducing predation by wolves and other large predators. However, until new findings and products are found practical, a certain amount of animal suffering could occur when some WDM methods are used in situations where nonlethal damage management methods are not practical or effective.

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-Wyoming personnel are concerned about animal welfare. WS-Wyoming is aware that techniques like snares and traps that could be used under this alternative are strongly opposed by some members of the public, but also believes that these activities are being conducted as humanely and responsibly as practical. WS operational programs and the National Wildlife Research Center are striving to bring additional nonlethal damage management alternatives into practical use and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when nonlethal damage management methods are not practical or effective. WS-Wyoming supports the most humane, selective and effective damage management techniques and would continue to incorporate advances into its WDM activities. WS-Wyoming field employees conducting WDM are highly experienced professionals, skilled in the use of management methods and committed to minimizing pain and suffering. WS Program Directives, protective measures (Section 3.4.3) and training work to ensure that WS WDM methods are used in a manner that is as humane and selective as possible. WS-Wyoming personnel are experienced and professional in the use of management methods to increase humaneness as much as possible under the constraints of current technology, workforce, and funding. Protective Measures used to maximize humaneness are listed in Chapter 3. Other practices which help to improve the efficacy, selectivity and humaneness of WS-Wyoming use of WDM methods include implementing Trapping Best Management Practices where appropriate for WDM actions and compliance with the state 72 hour foothold trap check requirement.

Since the delisting of wolves, the general public has access to use the same WDM methods as WS-Wyoming (Section 3.2.2). Use of WDM methods by individuals who may not have the same experience and training as WS personnel could lead to increased concerns regarding incidents that individuals may perceive as particularly inhumane, including risk of nonfatal wounding and capture and injury or death of nontarget species. In general, use of lethal WDM by non-WS entities is expected to be lower in areas where WDM assistance is available from WS-Wyoming. Consequently, perceptions of the overall (cumulative) humaneness may be better for this alternative than for Alternatives 2 and 3.

4.3.1.5 Impacts to stakeholder, including aesthetics of wildlife

Social and recreational concerns are discussed in U.S. Fish and Wildlife Service (1994), 71 FR 43410, 73 FR 10514, 76 FR 61782, the Wyoming Gray Wolf Management Plan (Wyoming Game and Fish Commission 2011), and relevant portions have been referenced as appropriate. Public reaction to this alternative would be variable and mixed because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to reduce conflicts/problems between humans and wolves. The impacts of this alternative to stakeholders would primarily depend on their values towards wolves and their relationship to the damage problem. This alternative would likely be favored by property owners who are experiencing damage because this alternative has the greatest likelihood of successfully resolving wolf conflicts under a wide range of circumstances, but others may be dismayed by the idea of lethally removing wolves and may request only nonlethal WDM assistance from WS-Wyoming. Individuals not directly affected by the threats or damage may be supportive, neutral, or totally opposed to any removal of wolves from specific locations or sites. Some individuals would strongly oppose this alternative because they believe it is morally wrong to kill or use animals for any reason or they believe the benefits from wolves outweigh the associated damage. Individuals totally opposed to lethal wolf conflict management methods want agencies to emphasize tolerance for wolf damage and threats to public and pet health or safety.

Views of wildlife management often contain an emotional component that can be variable depending on location and species being considered, can change over time or can be conditional dependent upon the nature of the management issue (Littin et al. 2004, Haider and Jax 2007). Various types of viewpoints can influence ethics and value systems. For example, factors influencing value systems may include the degree of dependence on land and natural resources as indicated by urban or rural residency, property ownership and agriculture or resource dependent occupations (Kellert 1994, George et al. 2016). People in rural areas tend to have a higher tendency for utilitarian and dominionistic values.

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 wolves had increased since the study by Kellert with positive attitudes towards wolves increasing 42%, and that overall attitudes towards wildlife apparently 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. Although George et al. (2016) identified a nationwide trend for increasing favorable attitudes towards wolves, this shift is not necessarily the case for members of the public living in or near wolf range. (Chavez et al. 2005) conducted a survey of rural landowners within and adjacent to but outside wolf range. Attitudes of both groups toward the statement “I think wolves should be allowed to exist in northwest Minnesota” were neutral to negative (2.61 and 2.67 on a scale of -strongly disagree to 5-strongly agree inside and outside wolf range, respectively). There was a statistically significant difference between individuals in and adjacent to wolf range in response to the statement “Wolves are causing unacceptable levels of damage to

northwest Minnesota's livestock industry" with respondents within the wolf range agreeing slightly more than respondents outside wolf range. However average scores were neutral to only slightly positive and were not substantially different from one another (3.78 and 3.48 on a scale of 1-strongly disagree to 5-strongly agree inside and outside wolf range, respectively). Chavez et al. (2005) hypothesized that the lack of substantial differences in options between the two locations and between individuals who were or were not involved in livestock production may reflect deeply ingrained biases among agriculturalists and rural residents, particularly livestock producers, against wolves, as has been proposed by other authors (Kellert et al. 1996, Fritts et al. 2003). Other factors may have included that the study areas were not as distinct as the authors hypothesized. Although fewer individuals outside wolf range reported that they or their immediate family members had personally experienced livestock depredations (32%) than individuals within wolf range (56%), the number of landowners outside wolf range with close experience with wolf depredations was not negligible. Chavez et al. (2005) noted that the lack of difference may also have been related to the fact that agriculture producers in the study perceived wolves as less of a threat than other agricultural threats, or that concerns related to wolves were not limited to livestock predation (e.g., predation on pets, competition for big game). Although not addressed by the authors, an additional factor may have been that the area of cultural effect of wolf depredations was not limited to the individuals experiencing the damage and their family members so the two study areas may not be as discrete as needed to detect a difference. Information exchange (word of mouth, common news sources) within rural communities may lead to sympathy for neighbors experiencing damage and affect attitudes.

Treves et al. (2013) evaluated the attitudes of Wisconsin residents living in wolf range towards wolves over the period of 2001-2009. The time frame of the study included a 2003-2005 period when wolves in Wisconsin were listed as Threatened and use of lethal WDM methods was allowed under a special rule, and a 2007-2008 period when wolves were removed from the federal list of Threatened and Endangered species and access to lethal WDM methods was permitted by the state. It may also have included a similar brief period from May to June 2009 when wolves were delisted. Study participants responded to a survey on attitudes towards wolves in 2001 or 2004 and again in 2009. Responses to the questionnaire indicated attitudes towards wolves had become increasingly negative and that fear of wolves had increased over time, as had perceptions that wolves compete with hunters for deer. Inclination to poach wolves, approval of lethal methods to resolve problems with predation on livestock and pets, and endorsement of public hunting increased. The strongest correlation with increased inclination to poach wolves was associated with perceptions of competition with wolves for deer and not risks to livestock or pets. Familiarity with wolves did not increase tolerance, and there was a substantial decrease in agreement with the statement "Seeing a wolf in the wild would be one of the greatest outdoor experiences of my life" among individuals who had seen or heard wolves around their land. The variable status of wolves under the ESA over the span of the study resulted in increased debate among some members of the public as to the actual biological status of the wolf population and frustration relative to stakeholder perceptions of inclusion in decision-making and access to management tools (Olson et al. 2015). These factors likely contributed to declining attitudes towards wolves in the state.

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.

As discussed in Sections 1.5.1, 1.5.2 and 2.3.5, wolves have high non-consumptive (*i.e.*, viewing, hearing, photographing) and indirect (*e.g.*, spiritual and existence) values for many people. The ability to view and aesthetically enjoy wolves at a particular site could be temporarily limited if these wolves are removed. New animals would most likely reoccupy the site in the future if suitable habitat exists, although the length of time until new wolves arrive is variable, depending on habitat features, time of year, and the population density of wolves in the vicinity of the removals. Given the relatively healthy number of wolves and wolf packs in Wyoming ((Jimenez et al. 2011), 76 FR 61782), and given that this action will not jeopardize the viability of the wolf population, other opportunities to view, hear, and aesthetically enjoy wolves will continue to be available to the public. WDM would not be conducted in Yellowstone National Park, one of the primary areas where the public can go to view wolves, except in the exceedingly rare instance of a demonstrable threat to human safety that cannot be adequately resolved using other methods (only at the request of YNP authorities). The likelihood of getting to see wolves will probably be greatest for people who have knowledge of wolf behavior and habits and make the effort to visit sites with adequate habitat outside of conflict management areas. People interested in seeing or hearing wolves could contact the land management agencies, WGFD, or the tribes to inquire about the best opportunities.

Borg et al. (2016) evaluated the impact of wolf hunting seasons on sightings of wolves within YNP and Denali National Park and Preserve. In general, sightings were primarily influenced by wolf population size and proximity of den sites to roads. However, sightings in YNP increased by 45% following years when lethal removal of wolves for WDM was permitted but there was no licensed harvest of wolves. Impacts on viewing likely resulted from a combination of numeric reductions in the number of wolves present and behavioral impacts on the wolf packs (e.g., through removal of wolves less likely to avoid human activity). There was no data from YNP from a period when lethal removal of wolves was not available. Given the increase in viewing opportunities when licensed harvest was discontinued, we conclude that the cumulative impact of adding a wolf harvest season was primarily responsible for the observed reductions in wolf sightings at YNP and not lethal removals for WDM *per se*. WS-Wyoming has no control over the establishment of harvest seasons or harvest quotas in Wyoming.

Cumulative impacts on opportunities for aesthetic enjoyment of wolves will be tied, in part, to the size and range of the state gray wolf population (Borg et al. 2016). WS-Wyoming used lethal WDM methods under the direction of the USFWS during the period while wolves were protected under the ESA. Although there were temporary local reductions in the wolf population and associated opportunities to view wolves, the overall wolf population expanded in numbers and range during this period. WS-Wyoming take of wolves during periods when the population has been delisted have been similar to or a lower proportion of the overall population than occurred during listing (Table 4-1) and are expected to continue in similar manner as noted in Section 4.3.1.2. However, since delisting, cumulative impacts on the wolf population have increased primarily due to WGFD implementation of a wolf hunting season in the WTGMA and removal of restrictions on wolf take in the Predatory Animal Zone. Management decisions by the

state of Wyoming and associated cumulative impacts on stakeholders are the result of state management choices made to balance the desire for aesthetic enjoyment of wolves with stakeholder desire for wolf harvest and wolf depredation management (Borg et al. 2016). WS-Wyoming does not have the authority to direct state management decisions and cumulative impacts on stakeholders are likely to persist regardless of WS-Wyoming involvement in WDM.

4.3.1.6 Effects on nontarget species populations, including State and Federally listed Threatened or Endangered (T&E) species and ecosystems.

Concerns about potential risks to nontarget species and ecosystems from the proposed action include concerns that the proposed action may have direct adverse cumulative impacts on wildlife populations through disturbance, injury or death of nontarget animals including T&E species. There are also concerns that removals of individual wolves or wolf packs for damage management may have indirect adverse impacts on nontarget species and ecosystem function (i.e., the proposed action may have disruptive impacts on trophic cascades) and biodiversity. Wolves are apex predators with the potential to impact prey species population size and distribution (Section 1.5.3). Prey species, in turn, may impact vegetation community composition and structure. There is concern that wolf removals would be of sufficient magnitude and duration that the proposed action would indirectly result in loss of ecosystem benefits from wolves and decreased biodiversity.

Direct Impacts on Nontarget Species Populations

The species at greatest risks of incidental take during WDM actions are coyotes, this species is abundant in Wyoming, and they occur at varying levels in many of the same areas where wolves occur. Coyotes are the only species for which the annual average unintentional mortality as a result of WDM actions was more than one individual per year over the period of FY 2006-2017 (Table 4-3). This species is attracted to the same types of baits and lures used to attract wolves to trap sets, and most unintentional take of coyotes occurs when trapping wolves. The use of pan-tension devices on foothold traps set for wolves helps reduce the number of unintentional captures, but does not eliminate all such captures. Some of the unintentionally captured coyotes taken during wolf trapping efforts are released, but in other cases, they are euthanized because the site may also have ongoing coyote predation issues or as part of proactive predator damage management actions conducted at sites with recurring problems, during seasons when particularly vulnerable livestock are present and there has been a recurring issue with coyote predation, or where problems were not resolved before livestock were moved from the pasture the prior grazing season.

Wyoming's coyote population has been conservatively estimated at 49,854+22,718 (Gese and Terletzky 2009). A population model developed by (Pitt et al. 2001) assessed the impact of removing a set proportion of the coyote population in one year and then allowing the population to recover (referred to as pulse removal). In the model, all populations recovered within 1 year when up to 60% of a population was removed. Recovery occurred within 5 years when 60-90% of the population was removed. Pitt et al. (2001), Pitt et al. (2003) also evaluated the impact of removing a set proportion of the population every year for 50 years (sustained removal). When the removal rate was <60% of the population, the population size was the same as for an unexploited population although a shift in population structure was noted. For example, the

population with 50% removal had fewer transient animals, a younger age structure, and higher reproduction. Sustained removal rates of >70% of the population resulted in removal of the entire population after 7 years, but the authors acknowledged that annual removal of 70% of the population would become increasingly difficult at low densities. The model did not take into consideration immigration of coyotes from surrounding areas. Immigration of non-territorial individuals from surrounding areas would enable natural populations to withstand greater levels of harvest than indicated by (Pitt et al. 2001).

Combining unintentional coyote take with intentional take for coyote damage management for cumulative impact analysis, yields WS-Wyoming annual average coyote take of 6,915 coyotes statewide (about 13.9% of the estimated minimum population) from FY 2010 through FY 2017. The data indicate that total WS-Wyoming coyote take has ranged from 5,327 (11.0%) to 8,225 (16.5% of the estimate fall population) coyotes taken per year from FY 2010 through FY 2017. 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.

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. We reviewed harvest report data from Montana and Idaho to obtain an indication levels of furbearer harvest in the area. Estimated annual coyote take per state over the period of 2010 to 2016 by hunters and trappers in Montana and Idaho 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.

Given the low level of unintentional take for WDM relative to take by other sources, the proposed action will have a very low level of impact on the state coyote population and is not contributing substantively to current cumulative impacts on the state coyote population. Based on the analysis above, WS-Wyoming concludes that cumulative impacts on the coyote population in Wyoming would have a moderate level of impact on the coyote population but would be within sustainable harvest limits.

With the exception of grizzly bears (discussed below), populations of the other species which have been taken by WS (lethal or nonlethal) are sufficiently healthy that the state permits harvest of these species. The removal of an annual average of one individual per year is not of sufficient magnitude to have an adverse direct or cumulative impact on these species populations.

Threatened and Endangered Species: The WS-Wyoming program has consulted with the USFWS regarding the potential impacts of all WS-Wyoming activities on T&E species in the state including the current and proposed WDM program (Letter to R. Krischke, WS from R. Mark Sattelberg, USFWS February 6, 2015 and March 10, 2015 Biological Opinion). Additionally, WS-Wyoming has determined that program activities will have no effect on piping plover (*Charadrius melodus*), interior least tern (*Sterna antillarum*), whooping crane (*Grus americana*), Kendall Warm Springs dace (*Rhinichthys osculus thermalis*), pallid sturgeon (*Scaphirrynchus albus*), bonytail chub (*Gila elegans*), razorback sucker (*Xyrauchen texanus*), humpback chub (*Gila cypha*), Colorado pikeminnow (*Ptychocheilus lucius*), Wyoming toad (*Bufo baxteri*), whitebark pine (*Pinus albicaulis*), Colorado butterfly plant (*Gaura neomexicana* spp. *coloradensis*), blowout pensemon (*Penstemon haydenii*), Ute ladies'-tresses (*Spiranthes diluvialis*), desert yellowhead (*Yermo xanthocephalus*) and western prairie fringed orchid (*Platanthera praeclara*) because the proposed action would not be conducted in habitats where these species occur, because the proposed action will not result in take of these species or alteration of their habitats, or because of established protective measures (Letter from R. Krischke, WS to R. Mark Sattelberg, USFWS January 15, 2015, M. Foster memo to file 2/14/2019).

The USFWS concurred with WS' determination that state program activities (all activities combined) are not likely to adversely affect Preble's meadow jumping mouse (*Zapus hudsonius preblei*), yellow-billed cuckoo (*Cocyzus americanus*), and northern long-eared bat (*Myotis septentrionalis*). The USFWS also concurred with WS' conference determination that WS-Wyoming' activities were not likely to jeopardize the continued existence of black-footed ferrets (*Mustela nigripes*) (U.S. Fish and Wildlife Service 2015b).

WS-Wyoming may conduct WDM in areas where the proposed threatened North American wolverine (*Gulo gulo luscus*) may be present. Under the ESA, a "proposed species" warrants listing as threatened or endangered, but has not yet been listed. USFWS issued a proposed rule for wolverines in 2016, however no further listing action has been taken. As a proposed species, federal agencies must enter into conference with USFWS under Section 7 of the ESA if the proposed action is "likely to jeopardize the continued existence of a species". While methods used by WS-Wyoming are capable of capturing a wolverine, there is little risk of that occurring under the proposed actions based on the locations where WS-Wyoming generally conducts WDM and the protective measures implemented by WS-Wyoming.
The majority of wolverine habitat falls outside of areas where WS-Wyoming typically conducts WDM. The majority of WS-Wyoming WDM activities occur on private property below 7,000 feet elevation in open livestock grazing areas, mountain valleys, open prairies, high desert, or sagebrush habitats. Inman et al. (2012) reported that wolverines in the GYE avoided areas less than 7,000 feet in elevation, and that natal dens occurred between 7,218-9,259 feet (Inman et al. 2007).

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

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

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

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

Through consultation with the USFWS, WS-Wyoming determined that the grizzly bear and the Canada lynx might potentially be affected by WS-Wyoming wolf damage management activities. The USFWS has concurred that WS-Wyoming wolf damage management methods are not likely to jeopardize grizzly bears or Canada lynx in Wyoming (U.S. Fish and Wildlife Service 2007;2015a).

The USFWS determination regarding grizzly bear was based, in part, on the following considerations"

- The location and habitat of most operations (all WS-Wyoming operations combined) will occur outside of occupied grizzly bear habitat. The majority of occupied grizzly bear habitat in Wyoming occurs on Federal lands while most WS-Wyoming predator damage management activities occur primarily on private lands. When WDM actions are proposed for areas of overlap between grizzly bears and wolves, WS Wyoming limits program actions to aerial operations and calling and shooting during times of the year when grizzly bears are out of their dens.

- Based on 20 years of data from Wyoming, Montana, and Idaho, WS-Wyoming has incidentally captured seven grizzly bears using the control methods proposed for wolf damage management and Montana WS incidentally captured one grizzly bear. As a result, the potential to capture and/or injure grizzly bears using the proposed control methods has been reduced. The potential for captures that result in mortality has also been reduced.

- Of the seven incidental captures in Wyoming, only one incident resulted in a grizzly bear mortality (incidental capture in a neck snare). Five were released unharmed and one escaped on its own. Under current management policy, WS-Wyoming does not utilize neck snares set for mountain lions, black bears, or gray wolves, with or without stops, within occupied grizzly bear habitat between March 1 and December 1 unless specifically authorized.

- WS-Wyoming will implement several conservation measures that will reduce the likelihood of adversely affecting grizzly bears (U.S. Fish and Wildlife Service 2015a). These measures include:
    - WS-Wyoming will assist the USFWS and WGFD with grizzly bear recovery by maintaining interagency coordination and communication, reporting grizzly bear sightings, assisting with grizzly bear damage management, and assisting with research projects related to grizzly bear conservation and recovery;
    - WS-Wyoming personnel will be trained in the identification of grizzly bears (particularly in distinguishing between black bears and grizzly bears) and grizzly bear sign, training will be conducted by WS-Wyoming, in collaboration with the local USFWS or WGFD offices and by attending annual bear handling workshops organized by the USFWS and WGFD; and
    - WS-Wyoming personnel will carefully consider the possibility of the presence of grizzly bears before conducting any predator damage management activities within or adjacent to occupied grizzly bear habitat and if there are foreseeable conflicts with grizzly bears, WS will adjust their operations accordingly to minimize the chances of adversely affecting grizzly bears.

- If grizzly bear sign occurs in the area WS-Wyoming will attempt to set wolf traps away from livestock carcasses to reduce the likelihood of capturing a grizzly bear: if grizzly bears are in the area, WS-Wyoming would utilize scents at trap sites that are less attractive to grizzly bears, such as wolf urine/scat and wolf traps would be staked solidly with an appropriate drag attached to the trap.

Based on the above information and a review of the last 10 years data the USFWS predicted that 5 grizzly bears might be unintentionally captured by WS-Wyoming (all WS-Wyoming damage management actions combined including WDM). Of the 5 captures, no more than 2 are expected to result in the death of the bear. The USFWS has determined that this level of mortality will not result in jeopardy to the grizzly bear population (U.S. Fish and Wildlife Service 2015a).

The majority of WS wildlife damage management actions in Wyoming occur below 7,000 feet in open grazing areas, mountain valleys, prairies, high desert and sagebrush habitats that are not generally preferred by Canada lynx, although dispersing lynx may

move through these areas. There have been no instances of unintentional capture, injury or death of a Canada lynx in the last 30 years of the WS-Wyoming program. Should a lynx be unintentionally captured or killed, WS-Wyoming would report such an incident to the WGFD nongame program. Conservation measures and terms and conditions used by WS to reduce risks to lynx in addition to WS protective measures include:

- All WS personnel will be trained in the identification of Canada lynx and lynx sign. Recent maps of lynx locations obtained from the USFWS will be used in training;
- All sightings of Canada lynx will be reported to the USFWS as soon as possible;
- Coordinate wildlife damage management activities on U.S. Forest Service lands and Bureau of Land Management lands during work plan meetings to share information about lynx observations or issues that may affect WS activities.
- If lynx or lynx sign are observed, restrict coyote and bobcat control actions in the area and contact the Service within one working day of observation, or as soon as possible thereafter to discuss additional management options. Restrictions are as follows:
    - Disallow use of fish oil and anise oil attractants, fresh meat and visual attractants of the type that entice felids in coyote sets where lynx or lynx sign are observed. For purposes of this BO, visual attractants are of the type expected to attract lynx such as feathers, shiny metal or fabric that are suspended in the air and have movement with the wind.
    - Disallow use of M-44s where lynx or lynx sign are observed.
- Restrict wildlife damage management actions in suitable lynx habitat. Suitable lynx habitat in Wyoming is identified as subalpine forests dominated by subalpine fir and Engelmann spruce, and the upper montane forests of mesic lodgepole pine, including mixed stands of pine, aspen and spruce. In Wyoming, the subalpine and upper montane forest zones, are typically 8,000 to 12,000 feet in elevation. Vegetation communities such as high elevation sagebrush and riparian and wetland shrub habitats, adjacent to subalpine and upper montane forest communities, also provide suitable lynx habitat. Dry forests, such as ponderosa pine and climax lodgepole pine are not suitable lynx habitat (Ruediger et al. 2000). These restrictions are as follows:
    - Disallow use of fish oil and anise oil attractants, fresh meat and visual attractants of the type that entice felids in coyote sets within suitable lynx habitat.
    - Disallow use of M-44s in suitable lynx habitat.
    - Only use foot-hold traps and foot snares for mountain lions, bears, and wolves that are equipped with pan tension devices set to trip at weights that will preclude capture of lighter-weight lynx.
- Positively identify the species of a target animal, prior to implementing any lethal management action involving shooting or aerial shooting and actions conducted at den sites.
- When using neck snares to capture mountain lions and bears ensure that the cable loop is large enough to preclude capture of lynx (12 inches or greater).
- M-44s sets will not be baited with fish oil or anise oil attractants, fresh meat or visual attractants statewide.
- Immediately call tracking dogs off lynx trails and harness them.
- Immediately release any lynx incidentally trapped, captured or inadvertently treed, and notify the Service as soon as possible. If a lynx has been injured and cannot be rehabilitated or safely released, it may be euthanized by WS at the

capture site. Any such euthanasia will be considered a take under the incidental take statement. WS will use humane measure to euthanize the injured animal and will contact the Service as soon as possible regarding the incident.

Based on the above information and information presented in the WS Biological Assessment the USFWS Biological Opinion concluded that the proposed action would not result in the death of more than 2 Canada lynx and that this level of take would not jeopardize the Canada lynx population (U.S. Fish and Wildlife Service 2007)(letter to M. Sattelberg, USFWS from R. Krischke WS R. Krischke, December 12, 2014).

In addition to consultation with the USFWS regarding impacts on threatened and endangered species, WS would also work with land management agencies and tribes to address any concerns about potential risks to sensitive species that they have identified as needing additional management concern. Any issues and applicable risk minimization measures are addressed during annual work plan meetings and WS would not conduct WDM on applicable public or tribal lands until the issues are addressed. With the exception of grizzly bears and eagles addressed in this section, none of the nontarget species taken by WS-Wyoming during WDM are listed by the USFS or BLM as sensitive species.

Table 4-3. Direct impacts on species unintentionally taken by WS-Wyoming during wolf damage and conflict management operations (lethal and nonlethal), MIS FY 2006 –FY 2017.

	Estimated Statewide Population[3]	12-Year Total WS Unintentional Take[2] (Euthanize)	12-Year Total WS Unintentional Take[2] (Released)	Hunter Harvest[4]	WS Unintentional Take as % of Population (Euthanized)	WS Unintentional Take as % of Hunter Harvest[4] (Euthanized)
Coyote	49,854 ± 22,718[1]	4	6	Data not available	<0.01%	Data not available
Red Fox	Data not available	0	1	Data not available	Data not available	Data not available
Grizzly Bear[5]	712	0	4	NA	NA	NA
Black Bear	Data not available[6]	1	3	451	Data not available	<0.01%
Badger	Data not available	1	1	704	Data not available	<0.01%
Bobcat	Data not available	1	4	1,397	Data not available	<0.01%
Mule Deer	409,100	1	5	31,237	<0.01%	<0.01%
White-Tailed Deer	84,600	1	1	17,614	<0.01%	<0.01%
Pronghorn	425,400	0	3	39,027	0%	0%
Mountain Lion	Data not available[6]	0	1	255	Data not available	0%

[1] Based on information provided in Gese and Terletzky 2009
[2] Includes 12-year total number of animals taken by WS through WDM activities by FY (MIS FY 2006-2017).

[3] Estimated statewide populations are reported for biological year 2016-2017 and provided by WGFD.
[4] Cumulative take impacts are the effects on the biological year 2016-2017 hunter harvest provided by WGFD Annual Tables.
[5]Estimated Grizzly Bear population is reported as the 2017 Demographic Monitoring Area population in the Greater Yellowstone Ecosystem
[6]WGFD evaluates population trends for black bear and mountain lion populations using harvest and mortality data, rather than estimating densities or abundance statewide.

Risks Associated with the Use of Aircraft: Wildlife Services uses low-level fixed-wing aircraft and minimal use of helicopters to manage damage by other predators throughout much of Wyoming. Wildlife Services may also use aerial shooting to remove wolves. Fixed-wing aircraft are the primary tool used for aerial shooting in Wyoming, but a limited use of helicopters is employed in locations where the terrain is rough, heavily wooded, or mountainous. WS-Wyoming aerial shooting operations occur in relatively remote rangeland areas where tree cover is, at most, scattered to allow for visibility of target animals from the air. Requests for aerial shooting in Wyoming are fairly constant, especially during the months from March to September. In addition, WS-Wyoming spends relatively little time over any one area. Disturbance associated with WS use of aircraft in Wyoming does not reach the level which would constitute chronic exposure.

A concern is sometimes expressed that aerial shooting might disturb other wildlife species populations and wild horses and burros to the point that their survival and reproduction could be adversely affected. Deer, wild horses, pronghorn antelope, and other wildlife are occasionally seen during aerial shooting operations. However, WS avoids horses and wildlife seen during aerial operations and presents little disturbance to them. Particular effort is made to avoid nontarget animals displaying any signs of aversion to the aircraft. The U.S. Department of the Interior, Bureau of Land Management (BLM) Annual Work Plans specify that WS personnel in "hot pursuit" of a target animal by aircraft may pursue it into a NO PLANNED CONTROL AREA or RESTRICTED CONTROL AREA unless an obvious conflict will occur

- High Desert District BLM Work Plan: WS personnel in hot pursuit of a target animal by aircraft may pursue it into a No Planned Control Area or a Restricted Control Area unless an obvious conflict will occur, such as approaching a dwelling or flying over a concentration of wintering elk, mule deer, or antelope. When coyotes are moving into Planned Control Areas from adjacent No Planned Control Areas, WS may conduct control on a case-by-case basis after coordination with the appropriate Field Manager (Pinedale, Kemmerer, Rawlins, or Rock Springs).

- High Plains District BLM Work Plan: WS personnel in "hot pursuit" of a target animal by aircraft may pursue it into a No Planned Control Area or a Restricted Control Area unless an obvious conflict will occur, such as approaching a dwelling or flying over a concentration of wintering elk, mule deer, or antelope or game animal parturition areas during reproductive periods.

- Wind River/Bighorn Basin District (Northwest) BLM Work Plan: WS personnel in "hot pursuit" of a target animal by aircraft may pursue it into a No Planned Control Area or a Restricted Control Area unless an obvious conflict will occur, such as approaching a dwelling or flying over a concentration of wintering elk, mule deer, or antelope or game

animal parturition areas during reproductive periods. Wild horse herd areas would also be avoided when horses are located in or near flight paths and during foaling periods (March 1 to July 31).

Waterbirds and Waterfowl: Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no drastic disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Bélanger and Bédard (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. Bélanger and Bédard (1989;1990) also 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 lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the time/activity budget[16] of the species. Aerial operations conducted by APHIS-WS would not be conducted over Federal, State, or other governmental agency property without the concurrence of the managing entity and would be coordinated to minimize potential for any adverse effects on waterbirds and waterfowl.

Raptors: The analyzed and summarized the effects of overflight studies conducted by numerous Federal and State government agencies and private organizations. Those studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (Air National Guard 1997). A study conducted on the impacts of overflights to bald eagles suggested that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggests that golden eagles are not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Finally, one other study found that eagles were particularly resistant to being flushed from their nests (Awbrey and Bowles 1990). Therefore, there is considerable evidence that eagles would not be adversely affected by overflights during aerial operations.

Mexican spotted owls (*Strix occidentalis lucida*) (Delaney et al. 1999) did not flush when chain saws and helicopters were greater than 110 yards away; owls flushed to these disturbances at closer distances and were more prone to flush from chain saws than helicopters. Owls returned to their pre-disturbance behavior 10 to 15 minutes following the event and researchers observed no differences in nest or nestling success (Delaney et al. 1999), which indicates that aircraft flights did not result in adverse effects on owl reproduction or survival.

[16] An animal's activity budget is how it divides its time between activities (e.g. foraging, incubating eggs, building shelter, etc.) daily or seasonally.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period; results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but found that ferruginous hawks (*B. regalis*) were sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco* spp.), and golden eagles (*Aquila chrysaetos*) were "incredibly tolerant" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and the overflights never limited productivity.

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 fledglings were not adversely affected, indicating that no special management restrictions were required in the study location.

The above studies indicate raptors were relatively unaffected by aircraft overflights, including those by military aircraft that produce much higher noise levels. Therefore, we conclude that aerial operations would have little or no potential to adversely affect raptors.

Passerines (e.g. songbirds): Reproductive losses have been reported in one study of small territorial passerines ("perching" birds that included sparrows and blackbirds) after exposure to low altitude overflights (Manci et al. 1988), but natural mortality rates of both adults and young are high and variable for most of those species. The research review indicated passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which indicated quieter noise would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988). Those studies and reviews indicated there was little or no potential for aerial operations to cause adverse effects on passerine bird species.

Pronghorn (antelope) and Mule Deer: Krausman et al. (2004) found that Sonoran pronghorn (*Antilocapra americana sonoriensis*) were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. (Krausman et al. 1986) reported that only three of 70 observed responses of mule deer (*Odocoileus hemionus*) to small fixed-wing aircraft overflights at 150 to 500 feet Above Ground Level (AGL) resulted in the deer changing habitats. The authors believed that the deer might have been accustomed to overflights because the study area was near an interstate highway that was followed frequently by aircraft. (Krausman et al. 2004) also reported that pronghorn and mule deer do not hear

noise from military aircraft as well as humans, which potentially indicates why they appeared not to be disturbed as much as previously thought.

Mountain Sheep: Krausman and Hervert (1983) reported that, of 32 observations of the response of mountain sheep to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 81% in no or "slight" disturbance, and 19% in "great" disturbance. Krausman and Hervert (1983) concluded that flights less than 150 feet AGL could cause mountain sheep to leave an area. Another study (Krausman et al. 1998) found that 14% of bighorn sheep had elevated heart rates that lasted up to 2 minutes after an F-16 flew over at an elevation of 400 feet, but it did not alter the behavior of the penned bighorns. When Weisenberger et al. (1996) 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 (dB) levels, with lower noise levels prompting lesser increases. When they were 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 exposure.

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

Domestic Animals and Small Mammals: A number of studies with laboratory animals (*e.g*., rodents (Borg 1979)) and domestic animals (*e.g*., sheep (Ames and Rehart 1972)) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "fight or flight" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 db (United States Department of Agriculture - United States Forest Service 1992).

Although many of the wildlife species discussed above are not present in all areas where WDM occurs, the information was provided to demonstrate the relative tolerance most wildlife species have of overflights, even those that involve noise at high decibels, such as from military aircraft. In general, the greatest potential for impacts to occur would be expected to exist when overflights were frequent, such as hourly and over many days that could represent "chronic" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species become habituated to overflights, which appear to naturally minimize any potential adverse effects where such flights occur on a regular basis.

WS-Wyoming would generally only conduct overflights on a relatively small percentage of the land area of the State involved in WDM, which indicates that most wildlife would not be exposed to overflights. Additionally, such flights would occur infrequently throughout the year which would further lessen the potential for any adverse effects. Military aircraft produce much louder noise and are flown over certain training areas many more times per year, and yet, were found to have no expected adverse effects on wildlife (Air National Guard 1997). Therefore, it is reasonable to conclude that the aircraft used to shoot wolves should have far less potential to cause any disturbance to wildlife than military aircraft.

***Eagles*:** Under the Bald and Golden Eagle Act, activities that could result in the "*take*" of Bald Eagles cannot occur unless the United States Fish and Wildlife Service allow those activities to occur through the issuance of a permit. Both purposeful take and non-purposeful take require a permit from the United States Fish and Wildlife Service (see 50 CFR 22.26, 50 CFR 22.27). In those cases where purposeful take could occur or where there is a high likelihood of non-purposeful take occurring, WS would apply for a permit for those activities. The primary risk to eagles from WS WDM activities is the risk of unintentional take of an eagle in a trap or snare set to capture a wolf.

WS-Wyoming protective measures include specific methods to reduce the risk of unintentional capture of an eagle. To date, no eagles have been captured by the WS-Wyoming program during WDM activities, although there has been unintentional take of eagles using traps and snares for other types of predator control. WS-Wyoming 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, WS-Wyoming 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.

Based on the above measures, and WS record of not capturing eagles during WDM activities, risks of inadvertently capturing and injuring or killing and eagle during WDM are very low.

"Disturb" has been defined under 50 CFR 22.3 for purposes of implementing the Act as those actions that cause or are likely to cause injury to an eagle, a decrease in productivity, or nest abandonment by substantially interfering with their normal breeding, feeding, or sheltering behavior. WS has reviewed those methods available under the proposed action alternative and the use patterns of those methods. The routine measures that WS conducts would not meet the definition of disturb requiring a permit for the non-purposeful take of eagles. The USFWS states, *"Eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before 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*b*). Therefore, activities that are species specific and are not of a duration and intensity that

would result in disturbance as defined by the Act would not result in non-purposeful take. Activities, such as walking to a site, discharging a firearm, or riding an ATV along a trail, generally represent short-term disturbances to sites where those activities take place. Data presented above indicate that eagles would not be adversely affected by overflights during aerial operations. WS would conduct activities that were located near eagle nests using the National Bald Eagle Management Guidelines (United States Fish and Wildlife Service 2007b). The categories that would encompass most of these activities are Category D (Off-road vehicle use), Category F (Non-motorized recreation and human entry), and Category H (Blasting and other loud, intermittent noises). These categories generally call for a buffer of 330 to 660 feet for category D and F, and a ½-mile buffer for category H. WS would take active measures to avoid disturbance of eagle nests by following the National Bald Eagle Management Guidelines. However, other routine activities conducted by WS do not meet the definition of "*disturb*" as defined under 50 CFR 22.3. Those methods and activities would not cause injuries to eagles and would not substantially interfere with the normal breeding, feeding, or sheltering behavior of eagles.

Indirect Impacts

Indirect Impacts on Grizzly bears: Concerns have been expressed by the public that wolf removals could result in a reduction in the amount of wolf-killed carrion available to grizzly bears, and this carrion may be increasingly important to grizzly bears if global warming contributes to a reduction in other important grizzly bear foods.

Initial discussions with the USFWS on this issue suggest there is little likelihood of any significant indirect effect, based on the limited numbers of wolves removed in grizzly bear range in Wyoming. According to WS MIS data, since the first reintroductions in 1995, WS-Wyoming has removed 654 wolves in response to livestock depredations. The GYA grizzly bear population has actually been increasing during the time that wolf removals have occurred, which suggests these removals are not limiting grizzly bear recovery. The majority of Wyoming wolf depredations occur outside of occupied grizzly habitat, so there is likely little, if any, effect on grizzly bear survival related to WS wolf damage management operations.

Due to the low reproductive rate of the grizzly bear (Schwartz et al. 2003) and its status as a threatened species (United States Fish and Wildlife Service 1993), the effects of wolves on carrion availability and cub survival was an important consideration for wolf reintroduction and grizzly bear conservation efforts. Grizzly bears now occupy 44,624 km^2 (17,229 mi^2) or 89% of the GYE DMA (82 FR 3052 30633) When grizzly bears in the GYE were listed in 1975, numbers ranged from 136-312 individuals. The most recent estimates (2008-2017) place the GYE grizzly population at 718 bears. Current data suggest that the rate of increase for the population during the last decade (0% to 2% per year) has slowed from the rate observed during the decades of the 1980s and 1990s (4% to 7 % per year), and the population is now stable to slightly increasing (Schwartz et al. 2006, Interagency Grizzly Bear Study Team 2012). Most recent estimates indicate 75% of females with cubs occupy the Primary Conservation Area (PCA)(82 FR 3052 30633). The GYE DPS now has a viable grizzly population of sufficient numbers and distribution of reproductive individuals to provide a high likelihood that the species will continue to exist and be well distributed throughout this portion of its range for the foreseeable

future. The agreement between State and Federal agencies to implement the extensive Conservation Strategy and state management plans ensures that adequate regulatory mechanisms are in place to protect grizzly bears and that the GYE grizzly bear population will not become endangered (Interagency Grizzly Bear Study Team 2017).

The potential effects of wolves on the region's grizzly bear population were evaluated by Servheen and Knight (1993) and 15 North American gray wolf and wolf-prey scientists prior to the reintroduction (Lime et al. 1994). There was consensus among the 15 panelists that in other locations, such as the Yukon, Alaska and Glacier National Park, wolves and grizzly bears generally coexist well (Lime et al. 1994). It was recognized that in areas where wolves and grizzly bears coexist, interspecific killing by both species occurs (Ballard 1980;1982, Hayes and Baer 1992) with most agonistic interactions involving defense of young or competition for carcasses (Murie 1981, Ballard 1982, Hornbeck and Horejsi 1986, Hayes and Mossop 1987, Kehoe 1995, MacNulty et al. 2001). Opinions regarding the role of wolves in providing protein for grizzly bears were mixed (Lime et al. 1994). Servheen and Knight (1993) predicted that reintroduced wolves could reduce the frequency of winter-killed and disease-killed ungulates for grizzly bears to scavenge, but that grizzly bears would occasionally usurp wolf-killed ungulate carcasses. Servheen and Knight (1993) and (Lime et al. 1994) hypothesized that interspecific killing and competition for carcasses would have little or no population level effect on either species. Lime et al. (1994) further added that "this is not surprising considering the historic coexistence of these animals throughout most of their range."

Grizzly bears obtained ungulate meat primarily by preying on and scavenging rut-weakened and rut-killed elk and bison in late summer and fall (Mattson 1997), by scavenging winter-killed elk and bison carcasses in spring (Green et al. 1997) and by preying on elk calves in late spring and early summer (Gunther and Renkin 1990). Female grizzly bears with reliable high-energy foods have been shown to attain larger body size and litter sizes than their counterparts with less reliable food resources. However, grizzly bears, and particularly female bears with cubs, may not be able to take advantage of the carrion during mid-winter due to hibernation. In addition, Gunther and Smith (2004) documented two incidents where wolf packs probably killed grizzly bear cubs. Although neither incident was directly observed, evidence from the carcasses and kill sites suggests that wolves killed both cubs. Both cubs were killed near the carcasses of ungulates that had attracted grizzly bears and wolves. In addition, the distances between canine puncture wounds in the hides of both cubs suggested that they were attacked by more than one animal, consistent with predation behavior by wolf packs (Mech 1970), but not by solitary mountain lions (Dixon 1982) or black bears (Jonkel 1978, Pelton 1982).

Impact of Wolf Kills on Other Scavengers*:* Foraging theory provides a context to understand and predict the amount of wolf-provisioned carrion available to scavengers. Elk carrion is an important winter food for many scavengers in YNP (Houston 1978). When gray wolves partially consume prey, they subsidize scavengers with a high calorie food. In addition, depending on weather conditions, wolves can change the timing of carrion availability from a more abundant resource at the end of severe winters to a more constant resource throughout the winter (Wilmers and Getz 2005, Wilmers and Post 2006). Carrion abundance before wolf reintroduction was primarily attributed to abiotic factors (severe winters and snow depth) (Gese et al. 1996), but is now primarily provided by wolves (Mech 2001, Wilmers et al. 2003a) and it's likely that carrion provisioning by wolves is at least partially compensatory to carrion resulting from other factors..

(Wilmers et al. 2003a) hypothesize that wolves found in the Lamar Valley of YNP would: 1) increase the abundance, 2) alter the timing, 3) decrease year-to-year variation, and 4) change the variance of carrion available to scavengers. During mild winters, (Wilmers et al. 2003a) model predicts that wolves would increase the amount of carrion available to scavengers from February to March. During severe winters, wolf predation would result in a small increase in carrion overall, with a decrease in mid-winter carrion, when conditions were most severe, and a small increase in carrion at the end of winter, when conditions were milder. (Wilmers et al. 2003a) also reported that as wolf pack size changes, the amount of carrion available to scavengers also changes. Initially the amount of carrion available to scavengers would increase as wolf numbers increase and kill more but would decline as wolf numbers continue to increase as wolves would consume a higher percentage of their kills. Wolf packs of intermediate size kill at a relatively high rate but consume only part of the carcass, thereby maximizing the amount of carrion for scavengers in YNP. To the extent wolf removals through depredation control efforts might reduce larger packs to more intermediate sized packs, such wolf removals might contribute to an increase in the availability of wolf-killed carrion. But with the limited number of wolf removals that have occurred and are expected to occur in the GYA, there would likely be little, if any, effect on carrion availability to grizzly bears or other scavengers.

Impacts on Biodiversity and Trophic Cascades:

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, (Miller et al. 2001, Estes et al. 2011b) 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; Estes et al. 2011 (Crooks and Soule 1999, Ritchie and Johnson 2009, Estes et al. 2011b, Beschta et al. 2013, 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 populations 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, Wallach et al. 2010, Estes et al. 2011b, Miller et al. 2012). Foraging pressure by predators can help to suppress dominant prey species and can create ecological boundaries that create opportunities for less dominant prey species and promote biodiversity in the system (Henke and Bryant 1999, Miller et al. 2001). 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, or cause shifts in herbivore and small prey populations impacted by mesopredators, 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, Miller et al. 2001, Beschta and Ripple 2006b, Beschta and Ripple 2006a, Ripple and Beschta 2006, Beschta and Ripple 2008, Prugh et al. 2009, Estes et al. 2011a, Estes et al. 2011b) (Beschta and Ripple 2006a)Additional information on the positive role of wolves in ecosystems is provided in Section 1.5.

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. 2001)) 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. 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 (Beschta and Ripple 2012, Ripple et al. 2013). Depending on the nature of the impact and the prey species, changes in vegetation and prey behavior can have impacts on abiotic factors such as soil compaction, soil nutrients and river morphology (Beschta and Ripple 2006,(Naiman and Rogers 1997, Beschta and Ripple 2008, Beschta and Ripple 2012).

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 2015)). 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 Soule 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 (Nunley 1977, Crooks and Soule 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 fawns (Berger and Conner 2008). 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.

Some individuals have expressed concern that wolf removals by WS would cause disruptions to trophic cascades by eliminating predators. However, most studies

evaluating the impacts of predators on trophic cascades primarily focus on areas where predators were either absent, were intensively and continually controlled over large geographic areas, or were reintroduced after being extirpated which resulted in relatively consistent, long-term shifts in densities or behavior of other predators and prey. As discussed in this EA, WS only conducts WDM when and where it is needed. When direct management of a depredating animal(s) is needed efforts focus on management of the specific depredating animal or local group of animals. WS-Wyoming would not strive to eliminate or remove wolves from any area on a long term basis, and no predators or prey would be extirpated from the state or large regions of the state as a result of WS' actions. As discussed in detail in Section 4.3.1.2, impacts are generally only temporary, and in relatively small or isolated geographic areas compared with population levels of target species.

While wolves were federally protected as an NEP population under the ESA, the wolf population in Wyoming increased despite cumulative impacts of all factors including removals for WDM. The total range of occupied wolf habitat in the state has been relatively stable for years (Section 2.2.1) although the density of packs within the range has varied. Wolves do not occupy all lands within potential wolf range and general distribution of packs is patchy (Fig. 1-1). Wolf removals for WDM may result in reductions in pack size or removals of individual packs but these impacts are short-term and localized. In Alberta, vacant wolf territories were refilled in 1-2 years (Bjorge and Gunson 1985). Time frames for territories to become re-colonized may be longer in areas where wolf populations are small and still recovering than areas with larger recovering wolf populations and saturated habitat (Brainerd et al. 2008). As noted in Section 2.2.1, much of the suitable wolf habitat in the state has been occupied and we believe that information on recolonization in large recovering populations is applicable to the situation in Wyoming where WS conducts WDM.

Concerns have been expressed that lethal removal of wolves may remove older or dominant individuals that may be more experienced in capturing large prey such as elk and cause a shift to smaller prey with associated changes in the impact of wolves on ecosystem processes. MacNulty et al. (2009) discussed evidence from observations of YNP wolves and suggested that as wolves age, their ability to kill elk declines due to physiological deterioration. The authors' data suggested that 2-3 year old wolves were in the best physical condition to attack and kill prey, and the higher the proportion of wolves over age 3 in the population, the lower the rate at which they kill elk. The success rate of wolf packs preying on elk appears to plateau at relatively low levels (2-6 wolves) with some individuals in larger packs, primarily nonbreeding adults with no dependent offspring, withholding participation in predation events (MacNulty et al. 2012). Given this information, implementation of this alternative is unlikely to result in a significant change in wolf predation on elk and deer in the state.

Pack size does appear to play a greater role in the success of foraging on higher risk species (bison) with predation success rates plateauing for packs with 9-13 wolves and evidence of additional improvements for even larger packs (MacNulty et al. 2014). Data is available indicating that even in YNP, where there is no wolf hunting or removals for WDM and pack sizes are larger, wolves preferentially take less abundant but relatively safer species (elk) than more abundant but higher-risk/effort bison (MacNulty et al. 2014, Tallian et al. 2017). The Jackson bison herd spends much of the summer and fall in Grand Teton National Park, until winter weather forces them to migrate out of the park and predominately to the National Elk Refuge and Bridger-Teton National forest. WS-

WY could conduct wolf damage management activities in Bridger-Teton National Forest and any nearby private lands at the request of WGFD, given this area is part of the WTGMA. Given that the herd spends much of the year in areas where removal for WDM does not occur and that this is the only bison herd in the state in an area where WS-Wyoming could conduct WDM, we conclude implementation of this alternative would have a low level of impact on bison population dynamics in Wyoming

Bradley et al. (2015) completed a review of the impacts of lethal removal of wolves for WDM on local livestock depredations in Idaho, Montana and Wyoming over the period of 1989 to 2008. There were no differences in depredation recurrence if breeding females or males >1 year of age were removed during partial pack removal. For partial pack removal, probability of recurrence of depredation event increased 7% for each animal left in the pack after the management response. However, the number of animals left in the pack was also directly related to the likelihood that a pack would meet criteria as a breeding pair the subsequent year, which is important for population restoration.

MacNulty et al. (2009) discussed evidence from observations of YNP wolves and suggested that as wolves age, their ability to kill elk declines due to physiological deterioration. The authors' data suggested that 2-3 year old wolves were in the best physical condition to attack and kill prey, and the higher the proportion of wolves over age 3 in the population, the lower the rate at which they kill elk.

Based on the above information, we do not believe there is sufficient evidence to indicate that wolf removals for damage management would lead to increased likelihood of depredation. Further evidence of this conclusion is provided by the relatively low rate of repeat requests for lethal WDM assistance from WS-Wyoming with only 3% of cooperators in the Predatory Animal Zone, and 8% of cooperators in WTGMA requesting assistance from WS in 3 or more years over the 6-year period of FY 2013-2018.

As discussed in Section 4.3.1.2, now that wolves in the WYO are delisted and under state management, wolves may be taken by entities other than WS for damage management, during licensed hunting as regulated and monitored by the WGFD and as desired, without permits, in the Predatory Animal Zone. Population decreases are possible depending on state management objectives, so long as the population remains above the minimum levels required to ensure long-term population recovery established by the USFWS. Long-term population reductions, if they occur, could result in loss of ecosystem benefits in local areas where packs no longer occur. However, these impacts are not attributable to WS actions or under the control of WS or this EA and would occur with or without a WDM program conducted by WS, especially given that the majority of take and associated impacts on the population would be related to licensed harvest. As discussed in Section 4.3.1.2, due to the inter-related nature of hunting, private WDM efforts and WS actions, lethal removal of wolves by WS may decrease under this alternative. Consequently, given that, independent of other efforts, WS actions do not cause declines in the state wolf population, WS take may decline under this scenario, and WS actions are incorporated into the cumulative impact monitoring of the state when working to achieve their population management goals, implementation of this alternative would not have a substantial cumulative impact on the environmental status quo under this alternative.

Global Climate Change/Greenhouse Gas Emissions: The State of the Climate in 2012 report indicates that since 1976, every year has been warmer than the long-term average

(Blunden and Arndt 2013). Global surface temperatures in 2012 were among the top 10 warmest years on record with the largest average temperature differences in the United States, Canada, southern Europe, western Russia, and the Russian Far East (Osborne and Lindsey 2013). Impacts of this change will vary throughout the United States, but some areas will experience air and water temperature increases, alterations in precipitation, and increased severe weather events. The distribution and abundance of a plant or animal species is often dictated by temperature and precipitation. According to the United States Environmental Protection Agency (2013), as temperatures continue to increase, the habitat ranges of many species are moving into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (e.g., less snowfall, range expansions of other species).

APHIS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Climate change is also anticipated to impact agricultural practices. The combination of these two factors over time is likely to lead to changes in the scope and nature of wildlife-human conflicts in the state. Because these types of changes are an ongoing process, the EA has developed a dynamic system including mitigations and standard operating procedures, and built in measures which allow the agencies to monitor for and adjust to impacts of ongoing changes in the affected environment (Section 3.6). APHIS-WS will monitor activities conducted under this analysis in context of the issues analyzed in detail to determine if the need for action and associated impacts remain within parameters established and analyzed by this EA and will supplement the analysis and/or modify program actions in accordance with applicable local, state and federal regulations including the NEPA. Established protective measures also include reporting all take to the USFWS and WGFD annually as appropriate for review of project-specific and cumulative impacts on wildlife populations. Coordination with agencies that have management authority for the long-term wellbeing of native wildlife populations and review of available data on wildlife population size and population trends enables the program to check for adverse cumulative impacts on wildlife populations, including actions by WS that could jeopardize the long-term viability of WS actions on wildlife populations. Monitoring will include review of federally-listed threatened and endangered species and consultation with the USFWS as appropriate to avoid adverse impacts on threatened and endangered species. As with any changes in need for action, WS-Wyoming will supplement the analysis and/or modify program actions in accordance with applicable local, state and federal regulations including the NEPA as needed to address substantive changes in wildlife populations and associated impacts of the WDM program. In this way, we believe the proposed action is responsive to ongoing changes in the cumulative impacts of actions conducted in Wyoming in accordance with the NEPA.

WS-Wyoming WDM actions have the potential to produce criteria pollutants (pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies) while working in the office, during travel from office to field, travel in the field (vehicles or ATV), and from aircraft activities. The WS program reviewed greenhouse gas emissions for the entire national WS program (United States Department of Agriculture - Animal and Plant Health Inspection Service 2015) including the ongoing WDM program in Wyoming. The analysis estimated impacts of vehicle, aircraft, office, and ATV use for FY13 and potential new vehicle purchases that could be associated with a proposed national feral swine damage management program. The review concluded that the range of Carbon Dioxide Equivalents (includes CO2, NOx CO and SOx) for the entire national program would be below the CEQ's suggested reference point of 25,000

MT/year for actions requiring detailed review of impacts on greenhouse gas emissions. The WS-Wyoming program activities likely to result from the proposed action would have a negligible cumulative effect on atmospheric conditions including the global climate.

In summary, given the protective measures discussed above and in the Chapter 3, direct, indirect and cumulative risks to nontarget wildlife from the current program have been very low and are not of sufficient magnitude, frequency or scope to have a substantive impact on nontarget species populations. WS-Wyoming review above and consultations with the USFWS regarding impacts to federally-listed species indicate, the current program will have no effect on or may affect but is unlikely to adversely affect the federally listed threatened, endangered, candidate and proposed species in the state with the possible exception of grizzly bear and lynx. There is a risk the current program may result in unintentional take of Canada lynx or grizzly bear, but if appropriate terms and conditions and reasonable and prudent measures established by the USFWS are implemented, the current program will not jeopardize or have a significant impact on Canada lynx or grizzly bear populations.

4.3.2 Alternative 2 - WS Nonlethal Wolf Conflict Management Only

4.3.2.1 Ability of alternative to meet management objectives and efficacy of methods

Description of the efficacy of individual WDM methods including the nonlethal methods that WS could implement under this alternative is the same a noted in Sections 3.4 and 4.3.1.1. As noted in Section 3.4, integrated use of nonlethal methods can be effective means of reducing conflicts with wolves in some situations and, where effective, may help reduce the need for lethal WDM. However, as with lethal WDM methods, the efficacy of some nonlethal methods can be short-term (e.g., frightening devices), or limited to only a specific set of circumstances (e.g., fencing, herders) or inappropriate for some locations (e.g., frightening devices near campgrounds or residences). Differences in cattle and sheep husbandry practices in large pastures (1.000s of acres) and open range result in substantial differences in the utility and applicability of some nonlethal practices, with fewer practical options available for use with cattle. Consequently, in some situations, lethal removal of wolves may be the only practical approach to resolving incidents of wolf predation on livestock (Mech 1995, Bangs et al. 2009). Under Alternative 2, WS-Wyoming would not use lethal WDM methods. Given that this alternative would narrow the options available when developing site-specific WDM strategies, WS-Wyoming WDM efforts would not be as effective in reducing or preventing wolf predation as under Alternative 1

As with the current program, some wolf depredation problems would be addressed through implementation of nonlethal methods. Overall use of nonlethal methods may increase under this alternative due to increased WS-Wyoming advocacy for the methods. Given that WS-Wyoming already recommends and assists producers with nonlethal methods where practical and effective, the overall change in use of nonlethal methods is expected to be limited, particularly in the WTGMA.

Depending on cooperator perceptions of a nonlethal only WS program, overall requests for WS-Wyoming assistance could decrease under this alternative. For example, since delisting, all field expenses for WDM in Wyoming are paid by WGFD and the ADMB.

In the WTGMA, WGFD requests and pays for WS-Wyoming assistance on a case by case basis, usually in situations where consultation and issuance of depredation permits to landowners have proven ineffective in resolving conflicts. WGFD stipulates which methods are to be implemented by WS-Wyoming and rarely requests to assist with implementation of nonlethal methods. If WS-Wyoming selects an alternative that only provides some of the services requested by the WGFD (i.e., only assists with nonlethal methods), then the state may switch to providing assistance on its own or seeking alternative sources of WDM assistance (e.g., contractors). Similarly, decisions as to the nature of WDM assistance requested from WS-Wyoming in the Predatory Animal Zone are made by the ADMB and County Predatory Animal District Boards. To date, these entities have requested a program that includes assistance with nonlethal and lethal WDM methods. Given current patterns in request for WS-Wyoming assistance, if WS-Wyoming selects Alternative 2, the ADMB and County Predatory Animal District Boards may transfer all or a portion of funds for these activities to private entities or a different agency that can provide assistance with lethal WDM or a fully integrated nonlethal and lethal WDM program.

Given current patterns in requests for WS-Wyoming assistance and available data indicating that lethal methods can also provide effective localized resolution to wolf depredation under some circumstances (Section 3.4), livestock producers would likely seek alternative methods for implementing legally available lethal control methods in the absence of assistance with lethal methods from WS-Wyoming. The overall efficacy of this alternative would depend largely on whether the WGFD, ADMB and County Predatory Animal District Boards, as appropriate, were able to establish an equally prompt and effective wolf conflict management program. At least in the short-term, while alternative systems are established, livestock losses to wolves would likely increase under Alternative 2 because it would be difficult for livestock producers and/or WGFD personnel to devote the required time, resources, and expertise to adequately addressing depredation problems. It may also take time for new service providers to obtain experience equivalent to that of WS-Wyoming specialists. In the WTGMA, WGFD may increase use of hunting in chronic problem areas to reduce depredations. Use of hunting to address depredations is not as targeted as targeted WDM removals by WS and could result in greater take of wolves and may not always be as effective as a targeted removal of wolves for WDM as currently implemented by WS-Wyoming (DeCesare et al. 2018).

Analysis in the rest of Section 4.3.2 indicates this alternative would not jeopardize the long-term viability of the state or regional wolf population, although total take of wolves for WDM would vary depending on the skill of the individuals conducting WDM, the extent to which livestock producers seek alternative sources of lethal WDM, and the extent to which WGFD uses hunting as a mechanism to help resolve conflicts. Similarly risks to nontarget species would vary depending on the skills and training of the individuals conducting the damage management action, but are not expected to jeopardize the long-term sustainability of nontarget species populations. Private entities using lethal WDM methods may not consult with the USFWS regarding measures to reduce risks to T&E species in the same manner as a state or federal agency, so risks associated with their actions may be greater than for Alternative 1.

Under this alternative, lethal WDM methods would be implemented by entities other than WS. The training these individuals have in the use of lethal WDM methods would be variable and may lead to increased risk of adverse environmental impacts associated with unsafe or illegal use of WDM methods. All entities are expected to comply with

applicable state, federal and tribal regulations, but enforcement and coordination would be increasingly difficult if the number of entities involved in providing WDM assistance and services increases under this alternative. Similarly, as described under Alternative 1, reporting and monitoring of the impacts of WDM activities may be more difficult and limited when non-WS entities are conducting lethal WDM, especially for actions conducted on private lands in the Predatory Animal Zone.

In summary, WS WDM activities are likely to be less effective than under Alternative 1 because WS would not be able to use lethal methods in situations where nonlethal methods are impractical or ineffective. Long-term efficacy of this alternative would be variable depending on the entities conducting legally-available lethal wolf removal, and the extent to which WS-Wyoming assistance with use of nonlethal methods is retained. Ability of this alternative to achieve the remaining management objectives would be more uncertain and more difficult under this Alternative than Alternative 2 but better than for Alternative 3 depending on the extent to which the WGFD, WDA and County Predatory Animal Districts retain services from WS-Wyoming.

4.3.2.2 Effects on the wolf population in Wyoming

Under this Alternative, WS-Wyoming would not conduct any lethal wolf conflict management and would have no direct impact on the wolf population in Wyoming. In the WTGMA, WGFD would continue to issue wolf kill permits to landowners and livestock producers who have confirmed wolf predation, and producers could take wolves caught in the act of actively preying on or harassing livestock without a permit. In the WTGMA, WGFD could expand wolf hunting opportunities for the public in areas where wolves have been or are currently killing livestock (Wyoming Game and Fish Commission 2011;2012), conduct the lethal WDM actions that would have been conducted by WS-Wyoming on their own or arrange for assistance from a contractor. The WGFD is already balancing take for WDM and licensed harvest so that cumulative impacts help achieve state management objectives, and may offset changes in take for WDM with changes in licensed harvest. Consequently, we do not anticipate any substantive changes in cumulative impacts to the wolf population in the WTGMA.

If the WGFD, ADMB and County Predatory Animal District Boards choose to retain some nonlethal WDM services from WS-Wyoming, this alternative could increase the amount of technical assistance WS-Wyoming could provide individual cooperators (e.g., WS-Wyoming could provide increased assistance with optimizing use of nonlethal methods) but not necessarily the number of cooperators who receive WS-Wyoming technical assistance on nonlethal methods. WS-Wyoming already provides technical assistance with nonlethal methods where practical and effective. Depending on the available funding, it might also increase the amount of operational assistance with nonlethal methods WS-Wyoming could provide. Increased WS-Wyoming involvement in implementation of nonlethal WDM methods may reduce overall take of wolves for WDM. However, given that WS already recommends nonlethal WDM where practical and effective, WGFD rarely asks for WS-Wyoming assistance with nonlethal WDM in the WTGMA, and WS is likely to be working with a subset of current funding, the extent of any reduction in cumulative lethal take of wolves may be low.

There are no restrictions on take of wolves in the Predatory Animal Zone, but take must be reported to the WGFD. Ultimately, the impact of this alternative on the wolf population in the Predatory Animal Zone would depend on the extent to which the

ADMB and the County Predatory Animal District Boards choose to retain and fund WS-Wyoming assistance, the extent to which livestock producers would choose to implement nonlethal methods, and the skill level of individuals providing assistance with lethal WDM. Given the nature of current requests for WS-Wyoming assistance by these entities, a complete conversion to only supporting nonlethal methods is unlikely in Wyoming at this time (Wyoming Game and Fish Commission 2011;2012, Albert 2018). Even if WS-Wyoming assistance with nonlethal methods is retained, overall funding to WS-Wyoming is likely to decrease as some funds are reallocated to entities that can provide lethal WDM assistance. Nonetheless, WS-Wyoming's continued involvement with nonlethal WDM could decrease the extent to which lethal methods are used, and may be valuable in areas that have been recently colonized by wolves.

Decreases in lethal take of wolves due to nonlethal WDM assistance by WS could be offset by increases in take by other entities. In the Predatory Animal Zone, in the absence of WS-Wyoming assistance with lethal WDM methods, individuals may seek to conduct lethal WDM on their own or County Predatory Animal District Boards may arrange for assistance from a contractor. The impact of this alternative on take in the Predatory Animal Zone would depend, in part, on the experience level of the individuals conducting lethal WDM. Individuals with less experience in WDM may take more wolves when working to resolve a conflict than a specialist from WS-Wyoming (e.g., the individual may need more time to capture wolves which could impact the utility of partial pack removal (Bradley et al. 2015)). However, efficacy in use of lethal methods by non-WS entities is expected to improve over time. There may be a brief drop in total wolf take as alternative sources of support for methods such as aerial shooting are identified.

On occasion, WS-Wyoming has placed radio tracking collars on wolves in the Predatory Animal Zone to help monitor, and if needed, remove wolves involved in ongoing livestock depredations. Given the limited WS-Wyoming use of this strategy (generally only 1-2 collars in use per year) lack of use of radio collars by WS-Wyoming is not expected to substantively impact the number of wolves taken in the Predatory Animal Zone under this Alternative.

4.3.2.3 Effects on public and pet health and safety

We anticipate that the WGFD, Tribes, WDA and County Predatory Animal Districts, as appropriate, would place the highest staff priority on responding to issues of risk to human health and safety and would not delegate such responses to personnel who lack the training and experience to effectively address these concerns. Consequently, risks to human health and safety from wolves would be similar under this alternative as under the other alternatives.

Under Alternative 2 there would be no lethal wolf conflict management conducted by WS, so the already low level of potential risk to the public and pets associated with any WS-Wyoming use of lethal WDM methods would be greatly reduced. There may be some limited use of foothold traps and break-away auto-attach collars associated with live-capture of wolves (e.g., to attach radio collars needed for monitoring wolf movements and to activate RAG boxes and similar systems), but overall WS-Wyoming use of traps and snares would be lower than for Alternative 1. However, the cumulative risk to the public and domestic animals from WDM actions could increase. Entities other than WS-Wyoming can and are using aerial shooting in Wyoming to reduce some types of predation on livestock (e.g., coyote predation) and some have already requested and

received authorization to shoot wolves from aircraft. Non-WS aerial shooting operations may not have access to the training of WS personnel or use the safety policies and procedures discussed for WS under Alternative 1. Consequently, overall risks to personnel conducing aerial shooting may be higher under this alternative. WS posts warning signs to alert members of the public about deployment of capture devices, but those types of notices would not necessarily be posted by private individuals conducting trapping efforts. These methods have a low but greater risk of capturing nontarget species including pets than shooting.

Risk to public and pets from lethal WDM methods would also depend on the experience and training of the individuals using the lethal methods. Not all individuals may have the same training and access to equipment as WS, so risks are likely to be similar to or slightly greater than Alternative 1. In some cases, frustration with continued depredations might lead some individuals to consider use of illegal toxicants[17] or trapping methods and this could present a greater risk of harm to pets.

As with impacts on the wolf population, cumulative effects on this issue would depend on the extent to which WS-Wyoming assistance is used by WGFD, WDA and the County Predatory Animal Districts, and the skills of non-WS individuals who may provide lethal WDM assistance. Reductions in risk that may result from decreased use of lethal methods (Sections 4.3.2.1 and 4.3.2.2) may be offset by increases in risks associated with the use of lethal methods by non-WS entities.

4.3.2.4 Humaneness and animal welfare aspects of the methods to be used

Because WS-Wyoming would not be using lethal WDM methods under Alternative 2, some people would consider this Alternative more humane than under Alternative 1. Although WS-Wyoming would be limited to using only nonlethal methods, lethal methods similar to those available in Alternative 1 would most likely be employed by agencies, tribes, livestock owners and their agents to address wolf depredations. If the entities conducting the lethal wolf management lack the training, experience and resources of WS personnel, there may be a greater risk of unnecessary injury or pain from less than optimal application of some techniques. It is conceivable, that in some cases, there may be frustrated attempts to remove wolves through the use of illegal poisoning or trapping methods. Depending on the illegal toxicant or trapping methods used, death might occur over a protracted period of time as compared to other methods, such as shooting (Allen et al. 1996). Consequently, when the cumulative actions of all entities are considered, perceptions of the humaneness of this alternative may not be substantially different than Alternative 1.

4.3.2.5 Impacts to stakeholders, including aesthetics of wildlife

As with Alternative 1, stakeholder perceptions of this alternative would be variable depending on individual's values regarding wildlife and their relationship to the problem. Individuals directly impacted by wolf depredation are likely be less tolerant of wolves than individuals whose property and pets are not at risk. Under Alternative 2, WS would limit assistance to only nonlethal methods, and individuals opposed to WS-Wyoming use

[17] In 2006, a rural resident from central Idaho pled guilty to illegally placing poisoned meatballs on the Salmon-Challis National Forest in an effort to kill wolves. Three pet dogs were poisoned as a result of his actions.

of lethal methods may prefer this alternative. However, the WGFD, WDA, County Predatory Animal Districts, or other entities, as appropriate, would likely provide assistance with lethal control in response to confirmed wolf depredations. The extent to which there is an overall reduction in use of lethal methods will depend, in part, on the extent to which the WGFD, WDA and County Predatory Animal Districts chose to retain and fund WS-Wyoming WDM activities. If stakeholders experiencing wolf damage receive quick and effective assistance in resolving conflicts, they would likely be more accepting of wolves and the program. However, if depredation complaints are not readily addressed, stakeholders experiencing wolf damage would likely oppose this alternative.

As with Alternatives 1, there would continue to be opportunities to see and hear wolves, or experience other evidence of their presence, particularly if individuals seek out areas where non-WS entities have not recently conducted wolf removals. If WGFD chooses to increase licensed wolf harvest to make up for take by WS-Wyoming and achieve other state wolf population management objectives, there may be increased recreational opportunities for individuals who wish to harvest wolves. Members of the public could contact their local USFWS or WGFD office to inquire about the best opportunities for wolf viewing.

4.3.2.6 Effects on nontarget species populations, including State and Federally listed Threatened or Endangered (T&E) species

Under this Alternative, WS would not conduct any lethal wolf conflict management. Shooting is virtually 100% selective for the target species, so discontinuing use of this method would have little impact on risks to nontarget species. WS-Wyoming use of aircraft would cease or be substantially reduced as would associated risks to nontarget species. WS-Wyoming use of foothold traps and snares would cease except for use associated with nonlethal capture of wolves. There might be increased attempts to use methods such as shock collars and RAG devices by WS-Wyoming which would require a slight increase in live-capture of wolves, but overall use of foothold traps and snares would decline. WS-Wyoming use and recommendation of frightening devices, fladry and other nonlethal methods may increase. These methods may result in minor noise disturbance of nontarget animals. Fladry may also temporarily impact movement patterns of nontarget species. Overall risks of lethal take of nontarget species by WS-Wyoming would decline from already low levels, and risks of disturbance of nontarget species would increase slightly.

Although there would be less use of lethal methods by WS-Wyoming, use of lethal methods by WGFD and others would still be permitted and would likely increase under this alternative (See section 4.4.3.1). Use of lethal WDM methods by personnel from WGFD is likely to have similar impacts as described for WS under Alternative 1. However, use of lethal WDM methods by private citizens would have similar or greater risks than WS-Wyoming personnel, at least in the early years of implementation of this alternative, because the individuals may not have the same training and equipment as WS-Wyoming personnel. Non-WS entities may not be required to adhere to some of the provisions for the protection of nontarget species that would be used by WS-Wyoming. Increases in risks to nontarget species from use of lethal WDM methods by non-WS entities may offset any decreases in risks associated with WS-Wyoming discontinuing use of lethal methods

Given the above information, cumulative impacts of this alternative on nontarget species are likely to be similar to or slightly higher than under the Alternatives 1 and 2.

4.3.3 Alternative 3 - No Wolf Conflict Management by WS in Wyoming

4.3.3.1 Ability of alternative to meet management objectives and efficacy of methods

Under this Alternative, WS-Wyoming would have no role in WDM in Wyoming and no impact on the efficacy of WDM in the state. The degree to which implementation of Alternative 3 would be effective in addressing wolf predation on livestock and/or wild ungulates would depend on the nature of the available sources for WDM assistance. It is conceivable that the WGFD and other entities could attain the resources and expertise to conduct WDM in a manner similar to WS-Wyoming. However, there is likely to be a transition period where implementation of both lethal and nonlethal methods by other entities would likely not be as effective as actions by WS-Wyoming. Aerial shooting would be one example of a management method that is highly effective, but requires specialized training and equipment to be conducted safely and effectively.

Frustration with available WDM assistance and levels of wolf conflict may be highest for this alternative, especially initially, before some other entity besides WS-Wyoming begins effectively providing assistance with wolf conflicts. Control efforts by untrained individuals with a lack of knowledge about control methods and wolf biology and behavior are less likely to target specific depredating wolf packs or individuals, and less likely to be effective in resolving problems (Mech 1995). Similarly, WGFD could increase use of licensed hunting as part of their WDM strategy, but this methods is less effective in reducing loss than targeted removals conducted in response to a specific depredation incident (DeCesare et al. 2018).

Analysis in Section 4.3.3.2 indicates this alternative would not jeopardize the long-term sustainability or health of the state or regional wolf population, although total take of wolves for WDM would vary depending on the skill of the individuals conducting WDM and the extent to which the WGFD uses hunting to address depredation problems. Similarly risks to nontarget species would vary depending on the skills and training of the individuals conducting the damage management action. Some of the private entities conducting WDM may not consult with the USFWS, state, or land management agencies regarding measures to reduce risks to T&E and sensitive species in the same manner as a state or federal agency, so risks associated with their actions may be greater than for Alternative 1 and, in the absence of assistance with any WDM from trained professionals from WS, may also be higher than for Alternative 2.

The training non-WS entities may have in the use of WDM methods would be variable and may lead to increased risk of adverse environmental impacts associated with unsafe or improper use of WDM methods. All entities are expected to comply with applicable state, federal and tribal regulations, but enforcement and coordination would be increasingly difficult if the number of entities involved in providing WDM assistance and services increases under this alternative. Similarly, as described under Alternative 2, reporting and monitoring of the impacts of WDM activities may be more difficult and limited when non-WS entities are conducting lethal WDM.

In summary, overall efficacy of this alternative would be variable depending on the entities conducting WDM and would be similar to or less effective than an integrated nonlethal and lethal program conducted by WS under Alternative 1. Ability of this alternative to achieve the remaining management objectives would be more uncertain and more difficult under this alternative than for Alternatives 2 and 3.

4.3.3.2 Effects on the wolf population in Wyoming

Impacts on the wolf population in the WTGMA would likely be similar to Alternative 1 for reasons presented in Alternative 2. The impact on wolves in the Predatory Animal Zone as a result of implementing Alternative 3 would depend on the alternative sources of WDM assistance. Lack of WS-Wyoming assistance with nonlethal methods may result in a slight increase in overall use of lethal methods, if alternative sources of WDM assistance do not place similar emphasis on use and recommendation of practical and effective nonlethal methods. All of the mechanisms for take of wolves discussed under Section 4.4.3.1 would be available to non-WS entities and could be implemented at increasing levels under this alternative. As with Alternative 2, the number of wolves taken for WDM will depend on the skills and experience of the individuals implementing WDM methods. Cumulative take may be similar to or higher than Alternative 2, and slightly higher than Alternative 1.

4.3.3.3 Effects on public and pet health and safety

We anticipate that the WGFD, County Predatory Animal Districts and tribes as appropriate, would place the highest staff priority on responding to issues of risk to human health and safety and would not delegate such responses to personnel who lack the training and experience to effectively address these concerns. Consequently, risks to human health and safety from wolves would be similar under this Alternative as under the other Alternatives.

It is reasonable to assume that whatever wolf conflict management program is implemented in the absence of WS-Wyoming, there would be an increase in the number of individuals attempting to resolve wolf conflict problems who lack the training and experience of WS-Wyoming personnel. There would likely be permits issued to landowners who had lost livestock to wolf depredation and increased use of hunting as a mechanism to reduce conflicts with wolves. Less experienced individuals may require more time to resolve a problem, which would result in an increase in the number of traps and snares in use. Private individuals who would be authorized to conduct wolf control through shooting and trapping permits are not required to implement all WS-Wyoming protective measures, which could lead to increased risks to pets and human safety. Aerial shooting is also unlikely to be conducted by individuals with access to the same safety training and safety requirements as WS personnel, so risks to individuals conducting WDM may also be higher under this alternative. The cumulative impact of these changes could be an increase in the risks to humans and pets.

4.3.3.4 Humaneness and animal welfare aspects of the methods to be used

This alternative might be considered more humane by many people who are opposed to lethal conflict management methods employed by WS-Wyoming because WS-Wyoming would no longer use such methods. However, lethal management of wolves would most

likely continue in the absence of WS-Wyoming in accordance with the state wolf management plan (Wyoming Game and Fish Commission 2011;2012) and establishment of the Predatory Animal Zone. Traps and snares to capture and euthanize depredating wolves and to radio collar wolves for population monitoring and nonlethal wolf conflict management techniques that require a radio-collar on one or more wolves would continue as would aerial shooting. In the WTGMA, there would likely be a greater dependence on private landowners who would be issued take permits. These individuals would likely have less training and experience than WGFD or WS-Wyoming personnel, and might not employ the most appropriate tools and methods. WGFD may also issue permits to reduce wolf populations in areas with persistent conflicts. Although some people may oppose all use of lethal methods, hunting is less selective for specific depredating individuals and packs and would be considered less humane than a professional PDM program. In the Predatory Animal Zone, the perceived humaneness of WDM actions in terms of selectivity for target species impacts on wolves held in capture devices will depend on the experience of the individuals conducting WDM. Animal welfare aspects in terms of pain and suffering of some livestock and pets would likely be worse under this Alternative because overall efficacy in addressing damage problems would likely be lower than with Alternatives 1 and 2.

4.3.3.5 Impacts to stakeholders, including aesthetics of wildlife

Like Alternative 2, some stakeholders who are opposed to WS use of lethal conflict management methods may view this alternative favorably, while others who are impacted by wolf damage would likely view this Alternative unfavorably, particularly if they felt they would be receiving less assistance or less effective assistance with WDM. WGFD, would most likely continue to provide assistance with wolf conflicts, but the strain on WGFD resources and staff and costs to other programs would be greatest under this alternative. If WGFD had to redirect resources from other program areas to make more resources available to address wolf conflicts, that could have a negative impact on members of the public who depend on WGFD to provide abundant fish and wildlife, whether for consumptive or non-consumptive use. Consequently, problems may not be resolved as effectively or efficiently as with Alternatives 1 and 2. Livestock producers and pet owners with wolf depredation would likely be more frustrated because of the lack of quick response to losses. Individuals who feel their aesthetic enjoyment is compromised by the knowledge that wolves could be killed for wolf conflict management may still be dissatisfied under this Alternative because lethal control would still be conducted, albeit by sources other than WS-Wyoming.

Wolf abundance in the WTGMA would be similar to Alternatives 1 and 2 as the WGFD adjusts cumulative take of wolves from WDM and licensed harvest to achieve established management objectives. Opportunities to view, hear and aesthetically enjoy wolves in the WTGMA would continue under Alternative 3 as they would under all the other alternatives. Opportunities to aesthetically enjoy wolves in the Predatory Animal Zone may vary depending on the alternative sources of WDM assistance identified by the WDA and County Predatory Animal District Boards, the skill level of the individuals conducting WDM, and the extent to which alternative sources of WDM assistance will use or recommend nonlethal methods. Overall impacts of this alternative could result in localized decreases in opportunities to view and enjoy wolves over those available under Alternatives 1 and 2.

4.3.3.6 Effects on nontarget species populations, including State and Federally listed Threatened or Endangered (T&E) species

No operational WS activities would be conducted pursuant to this alternative so there would be no risks to nontarget or T/E species from WS. The WGFD, any agents designated by the WGFD, WDA, and County Predatory Animal District Boards and private citizens would still conduct lethal WDM activities. The WGFD or their designated agents would conduct wolf trapping activities for population monitoring purposes and lethal and nonlethal WDM. WGFD actions are anticipated to have impacts and risks to nontarget species similar to those of WS-Wyoming. The state and county agencies may have difficulty obtaining and retaining designated agents with the same level of training, experience and access to research and WDM resources as WS-Wyoming. If designated agents lack the training and resources of WS staff, there may be greater risks to nontarget species, including T&E species. Consequently, cumulative risks to nontarget species would be greatest for this alternative.

4.4 SUMMARY OF IMPACTS

Table 4-4 briefly summarizes the potential impacts of each alternative against each of the issues that were analyzed in detail. None of the four Alternatives would be expected to adversely affect Wyoming's wolf population, because the state is required to have a management plan in place that provides adequate protections to ensure long-term maintenance of the state wolf population above minimum levels identified by the USFWS as necessary for population recovery. Agreements have also been established among the USFWS, Wyoming, Montana, and Idaho to preserve genetic diversity and connectivity of the wolf population in the NRM. People opposed to lethal control of wolves may be opposed to implementation of Alternative 1, but as discussed in the EA, lethal control of wolves is expected to occur regardless of whether WS-Wyoming is involved.

Table 4-4. Summary of Impacts of Alternatives.

	Alternative 1 - Continue the Current Wolf Conflict Management Program (No Action/Proposed Action)	**Alternative 2 – WS Nonlethal Wolf Conflict Management Only**	**Alternative 3 – No WS Wolf Conflict Management by WS in Wyoming**
Effects on wolf population	Moderate, when considered in the context of WGFC (2011, 2012). WGFD would maintain a healthy, sustainable wolf population in excess of minimums set by USFWS.	In the WTGMA, impacts similar to Alternative 1. In the Predatory Animal Zone, impacts variable. In both zones, some risk of increased take by non-WS entities is expected. And a possible temporary decline in WDM take.	In the WTGMA, impacts similar to Alternative 1. Similar or increased use of lethal methods in Predatory Animal Zone because no WS-Wyoming advocacy for nonlethal. In both zones, highest risk of increased take by non-WS entities. Similar possible temporary decline in wolf take for WDM.
Effects on public and pet health and safety	Low risks to the public and peoples' pets.	Overall risks slightly greater than under Alternative 1.	No risks from WS-Wyoming to public and pet safety. Overall risks similar to Alternative 2.
Humaneness and animal welfare aspects of the methods to be used	Management methods are employed as humanely as practical, but any use of lethal methods would be perceived as inhumane by some people. There would continue to be perceived trade-offs between the welfare of wolves and the welfare of domestic animals attacked by wolves.	WS-Wyoming actions perceived by some as more humane than Alternative 1. Overall humaneness similar or slightly greater than Alternative 1 depending on actions of non-WS entities.	Overall impacts could be perceived to be slightly less humane than Alternative 2 because of likely reduced advocacy for nonlethal methods.

Impact to stakeholders, including aesthetics of wildlife	Impacts would be variable and mixed because of differing philosophical, aesthetic, and personal attitudes, values, and opinions.	Impacts would be variable and mixed, as with Alternative 1. Temporary increase in potential adverse impacts to individuals with animals at risk from wolves may be greater, at least until non-WS sources of lethal WDM are identified.	Individuals adversely impacted by use of lethal WDM methods may be negatively impacted by lack of any WS-Wyoming advocacy for nonlethal methods. Other impacts Overall impacts similar to Alternative 2.
Nontarget Species, Including T&E Species	Low risks to nontarget species from WDM and research methods. Low risk of take and no jeopardy to Canada lynx, grizzly bears and black-footed ferrets and no effect or not likely to adversely affect all other T&E species populations.	Risk to nontarget species is slightly greater than under Alternative 1, given WS' policies and procedures for the protection of nontarget and T&E species.	Risk to nontarget species is slightly greater than under Alternative 2, given WS' policies and procedures for the protection of nontarget and T&E species.

CHAPTER 5: RESPONSES TO COMMENTS

This chapter contains issues raised by the public during the comment period for the WS-Wyoming WDM EA and the WS-Wyoming response to each of the issues. WS-Wyoming received 22 comments regarding the EA. Based on our review of all of the public comments, we have clarified or enhanced the analysis in the final EA, or responded to the comments below. The issues raised in the EA are organized according to the content of the EA most applicable to the issue. Issues are numbered and are written in bold text. The WS-Wyoming response follows each comment and is written in standard text.

5.1 ISSUES ADDRESSED IN DETAIL

NEED FOR ACTION

1. **Almberg et al. (2009) detected *Neospora caninum* in wolves in YNP. Has there been any research on *N. caninum* in wolves outside YNP? *N. caninum* is infectious in cattle, and wolves can be a main distributor of this disease. Have cattle in Montana, Idaho or Wyoming been infected with this disease? If the cattle have been infected, has the source of the infection been identified? Is *N. caninum* transmissible to humans?**

Section 1.4.2 provides information on *N. caninum* in wolves and has been updated to address commenter questions. In general, reports of *N. caninum* to the Wyoming State Veterinary Lab have been rare and there is no information directly linking the incidents to wolves. Coyotes and dogs can also transmit *N. caninum* and the parasite is not limited to areas with wolves.

2. **Have wolves or elk in Wyoming been infected with *Echinococcus granulosus* strains G8 and G10? *E. granulosus strains* G8 and G10 have been identified in wolves in Idaho and it seems likely these strains will be found in wolves and ungulates in Montana and Wyoming.**

Section 1.4.2 provides information on *E. granulosus* and has been updated with available information to address commenter questions. In brief, *E. granulosus* has been detected in Wyoming wolves, but data was not collected on the specific strain of *E. granulosus*.

3. **There is no need for WDM because losses to wolves are a small proportion of total livestock losses. Total livestock losses verified by WS are 0.04% of total 16,000 sheep that died. Even multiplying by 7 as per WY compensation system losses are only about 0.3 and 0.4% of total sheep and cattle losses. It is disproportionate for WS to kill 15% of the state's wolf population when wolves are responsible for less than 1% of total livestock losses.**

The fact that livestock losses to predation are only a small proportion of the total number of livestock in the state and total livestock losses is addressed in Section 1.4.1, including specifics on how losses to predation are not evenly distributed across the state. The economic impact of wolf depredation on livestock can be substantial for individual producers. It is important to remember that these are the losses that have occurred with an effective WDM program in place and producers implementing their own methods for WDM for years. These numbers do not reflect the losses that would have occurred had no action been taken in response to losses.

Livestock producers work to reduce all sources of loss. The existence of other sources of loss does not preclude producers from requesting assistance from WS-Wyoming related to wolf depredations on

livestock. Variations in individual perceptions of whether or not livestock losses justify the use of lethal WDM methods area addressed in Section 3.2.3.

4. **Does the EA overstate the potential role of wolves in disease transmission? Given the limited amount of information on this topic, should Section 1.4.2 be re-written or eliminated from the EA? All canids and many ungulates carry the diseases discussed and have been confirmed in transmitting those diseases. WS needs to clearly state that WS will not use lethal methods to address concerns regarding potential disease transmission from wolves to livestock or ungulates.**

The potential for wolves to transmit diseases to livestock and the people is an ongoing topic of interest for biologists and some members of the public (See issues 1 and 2 above). Section 1.4.2 accurately reflects current knowledge regarding these diseases. Although wolves can and do carry diseases that may affect livestock, other wildlife, or humans, the risk of significant disease issues with wolves appears to be low or, as of yet, undetermined. Therefore, WS-Wyoming would not remove wolves to control diseases except in the case of an immediate and demonstrable threat to human safety as might occur in the extremely rare instance of rabies in wolves (See Section 1.4.3). WS-Wyoming would need to conduct additional NEPA analysis prior to conducting any project involving lethal removal of wolves to reduce disease threats to livestock. However, WS-Wyoming has opportunistically collected samples for disease monitoring from wolves handled during damage management and population monitoring activities and, depending on the alternative selected, could do so in the future. Section 1.4.2 has been edited for clarity.

5. **EA needs to acknowledge the role of wolves in managing *Brucella abortus* and Chronic Wasting Disease. Federal land management agencies have acknowledged these benefits with wolves' ability to seek and remove infected ungulates. The EA needs to consider positive benefits of wolves in controlling disease transmission in ungulates particularly in areas ungulates concentrate (e.g., feedgrounds) and or naturally reach high densities.**

The potential role of wolves in reducing disease in prey populations was addressed in EA Section 1.5.3. The likelihood that wolves will help reduce disease in prey varies depending on a variety of factors including the nature of the disease, the manner in which the disease is spread among individuals, the timing and manner in which the disease manifests in prey, biology and behavior of the prey population, response of the prey population to presence of wolves and other factors. Additional details on the role of wolves in managing disease in wild prey populations have been added to Section 1.5.3.

The issue of the role of wolves in disease management as it pertains to feedgrounds is complex. Although the use of feedgrounds is outside the scope of this analysis, some commenters have asked about the impact of wolves on the occurrence of disease in elk at the feedgrounds. The feedgrounds were initiated to maintain abundant elk populations during winter when feed is scarce, but they have also become an effective tool in reducing the potential of transmission of brucellosis to livestock by reducing movement of elk into areas where livestock are kept (Wyoming Game and Fish Department 2007, USDA APHIS Veterinary Services 2015). As noted in Section 1.5.3, diseases such as Brucellosis and Chronic Wasting Disease are more readily spread in areas with high ungulate densities, as may occur at feedgrounds. An average of 22% of the elk that frequent the 22 state and one federal feedground in the Greater Yellowstone Ecosystem test positive for exposure to brucellosis (Scurlock and Edwards 2010). This is higher than the 0-7% reported by (Scurlock and Edwards 2010) for unfed herd units, although prevalence in some units has been increasing concurrent with increases in herd size (Cross et al. 2010). Wolves may help reduce disease in elk herds by reducing overall herd size and removing sick individuals, but some facets of elk response to wolves at the feedgrounds confound disease management efforts. For example, in the Gros Ventre area, instead of dispersing among multiple feedgrounds, elk form a larger group that congregates at individual feedgrounds, leaving other feedgrounds with few or no elk (Wyoming Game and Fish Department 2007). At times, predation by wolves has also caused increased elk movements

away from feedgrounds and into agricultural areas, particularly in the fall, thereby increasing potential for contact between Brucellosis infected elk and cattle (USDA Forest Service 2015). In addition, predation pressure by wolves may also decrease the time elk spend in feedgrounds in the spring before returning to summer range (USDA Forest Service 2015).

6. **Risks to human safety from wolves are extraordinarily rare. Should they really be part of the need for action, especially given that there are other species more likely to pose a risk to human safety? Does the EA overstate the need for WDM to protect human health and safety? Should risks to human health and safety be a primary onus for WDM given that there are so many other things that pose greater risk to human safety?**

The EA does not overstate the risks to human health from wolves. EA Section 1.4.3 clearly states "*Wolf-related threats to human safety are rare. To date, WS-Wyoming has not received any requests for this type of assistance.*" The material presented in the EA is proof that threats to human safety can occur. Addressing risks to human safety in the EA lets WS-Wyoming consider alternatives for addressing risks and cumulative impacts of management options before an event occurs so WS-Wyoming can respond promptly if a verified threat does occur. More importantly, including threats to human safety in the need for action enables WS-Wyoming to consider options for involvement in educating the public on ways to reduce the likelihood that a threat could occur. The existence of other more common types of threats to human safety does not preclude WS-Wyoming from being prepared to address threats that are within the scope of WS' authorization established by Congress (Appendix B).

7. **Is there really a need for action if other people can and do conduct WDM without WS?**

Yes, there is a need for action. As stated in Section 1.4, the need for action in Wyoming is based on verified wolf depredation, harassment, and threats to livestock, game farm animals and pets; property damage; and risks to human safety from potentially hazardous or threatening wolves or habituated/bold wolves. The availability of alternative sources for WDM assistance is addressed in the review of potential alternatives to meet the need for action (Section 3.2). Alternative 3 - – No Wolf Damage Management by WS in Wyoming is a viable alternative that was analyzed in detail in the EA.

8. **EA needs to provide details on the private and public entities that receive WS-Wyoming WDM assistance. The EA needs to say who has received services in the past and who they are expected to be in the future. Use of blanket statements fails to inform the public of the true nature of WS-Wyoming's proposed WDM activities.**

As noted in Section 1.4.1, almost all WDM assistance provided by WS-Wyoming is to reduce predation on privately owned livestock and domestic animals. In accordance with 7 USD 8791, WS does not disclose the names of individual private agriculture producers. WS-Wyoming assistance in reducing depredation on livestock and domestic animals has been provided as a result of agreements with the USFWS (while wolves were federally-listed as a nonessential experimental population), WGFD and WDA. WS can also provide assistance to the Eastern Shoshone and Northern Arapaho Tribes based on a signed MOU. WS does not anticipate that the nature (private vs public) of the entities requesting WS assistance will change substantively in the future. Information on the number of requests per year is provided in the description of the current program in Section 3.

9. **Is the purpose and need statement too narrowly defined because it does not include the need to conserve the health and sustainability of wolf populations in Wyoming.**

The purpose and need statement in Chapter 1 of the EA is consistent with the authorities of the WS program (Appendix B) and is not too narrowly defined. WS-Wyoming's actions are only one facet of overall wolf management and are provided as a service to assist the agencies and tribes with responsibility for wolf management. Responsibility for overall management of the Wyoming wolf population including monitoring population size and health, development of population management objectives, establishment

of hunting seasons and regulations, and regulation of all other forms of wolf take is the responsibility of the WGFD, tribes, and federal land management agencies with independent authority for wildlife management on their lands (EA Section 1.3). We agree that conservation of the health and sustainability of the wolf population is important and, as noted in Section 1.9, one of the primary objectives of the proposed action is that, "*The proposed action must not jeopardize the recovery of the state or regional wolf population*." Impacts of the alternatives on the state wolf plan are analyzed for each of the alternatives considered in detail in Sections 4.3.1.2, 4.3.2.2, and 4.3.3.2.

10. Does the EA punish wolves for being wolves and preying on animals?

No, WS-Wyoming is not focused on "punishing" wolves. The alternatives and methods proposed in the EA are part of an integrated effort intended to reduce damage and conflicts caused by wolves that includes operational and technical support with nonlethal methods. Nonlethal methods used and recommended to deter predation by wolves include strategies that alter the behavior and practices of humans, and not just efforts to remove wolves (Section 3.4.1). Furthermore, the presence of wolves near livestock is not a guarantee of conflict between livestock and people. WS recognizes that only a portion of the wolves and packs in the state are involved in depredation on livestock or other conflicts with humans (See Figure 1-2 and Response 27) and strives to focus management actions on the individual animals and packs involved in conflicts.

11. WS depredation reports provide inadequate evidence to support whether wolves are the probable or confirmed cause of loss. Form has little to no room for trapper to write comments. WS must provide photographic or video evidence to support conclusions about wolf and all other claims. WS needs to consider the criticisms of C. Neimeyer in his book relative to WS wolf depredation investigations. WS provides no accountability methods to adequately determine whether questionable calls are being made by personnel. Protocols for investigations should include, at a minimum, photographs and specific notes about condition of carcass including estimated date of death. Alternatively, depredations should be confirmed by an entity other than WS.

The form noted by commenter is not used by the WS-Wyoming program. In the WTGMA, the WGFD responds to almost all requests for assistance with wolf depredation on livestock and makes the determination as to whether or not the incident was caused by wolves. In the rare instances when WS-Wyoming is the first responder, the Specialist completes the Wyoming Game and Fish Livestock Affidavit (Appendix A). This form was developed by the WGFD and the form that they require WS-Wyoming to use. WS-Wyoming discusses their findings with WGFD personnel who ultimately confirm the complaint and the nature of the WDM action, if any, to be taken. Therefore, in the WTGMA where the State has established intensive wolf management as a priority, cause of livestock depredations are determined or confirmed by an entity other than WS.

In the Predatory Animal Zone, where the state has chosen to give priority to livestock production instead of the intensive wolf management in the WTGMA, the WDA has chosen to rely on the training and experience of WS-Wyoming personnel. The WGFD does not ask for photographs or video evidence. In the Predatory Animal Zone, the WDA has primary authority for wolf management, and they have determined that they do not want forms completed for wolf depredation investigations. Instead, the end result of WS-Wyoming's investigations are reported in the WS MIS database.

In the over 11 years since Mr. Neimeyer was involved in wolf management, WS has obtained substantial experience and expertise in identification of depredation by wolves. WS personnel who confirm the cause of depredation on livestock use procedures for evaluating predation on livestock like those identified in (Wade et al. 2010) and receive extensive on-the-job training. Additionally, peer to peer consultations amongst WS personnel, and interagency consultation between WGFD and WS personnel are common when confirming the cause of depredation on livestock. WS-Wyoming experience with

conducting field investigations of predation incidents—including necropsies—indicates that photographs and video evidence are unlikely to provide the degree of detail needed for accurate identification of the responsible predator. For example, an entire scene frequently can't be captured and still provide sufficient detail or scale for analysis. Consequently, WS has determined that obtaining video evidence of all depredation incidents would not substantively improve decision-making and would create an undue burden and expense.

12. The EA needs to discuss Airborne Hunting Act.

The Airborne Hunting Act restricts shooting or attempting to shoot or harass any bird, fish or other animal from aircraft except for certain specified reasons, including protection of wildlife, livestock and human life as authorized by federal or state-issued license or permit. The USFWS has responsibility for implementing the Act, and has delegated permitting of aerial shooting to the states. Details on the Act have been added to Appendix B.

13. The EA cannot present speculation by Lehmkuhler et al. (2007) regarding stress in livestock from being chased as fact.

Lehmkuhler et al. (2007) provides an overview of concerns regarding indirect impacts of predation on livestock. The discussion in Section 1.4.4 has been augmented by findings of more recent research that has also documented adverse indirect impacts of wolf predation on livestock.

14. Aren't there numerous compensation programs in place, such that many or most losses to wolf predation do not cause economic hardship? If there is no economic hardship is there really a need for action?

Now that wolves are no longer protected under the ESA, the only compensation program for losses to wolf predation in Wyoming is provided by the WGFD for wolf depredations that occur in the WTGMA. There is no compensation for losses to wolf predation in the Predatory Animal Zone. Compensation programs can be a useful component of WDM programs but are not suitable for exclusive use in resolving conflicts with wolves. See EA Sections 3.4.1 and 3.5.8.

15. Cross tabulations of Wyoming livestock loss in Chapter 1 are at least current but are not "scientific approach". WS should consider study by Berger 2006 that uses an econometric model to assess the impact of predation on the sheep industry. Scientific data by Berger (2006) disprove the macro-economic rationale behind WS' need for action.

The study by Berger (2006) was designed to test whether predator damage management programs in the U.S. improved the viability of the U.S. sheep industry. WS data in Table 1-1 and Figure 1-2 are provided as a simple quantification of losses that have occurred to illustrate the need for WDM. Experimental design such as the one used by Berger (2006) are not warranted when simply tabulating events.

The proposed action is intended to provide assistance to individual livestock producers experiencing losses to wolf predation (EA Section 1.4.1). Although WDM assistance is beneficial to the individual livestock producers who request assistance, as noted in EA Section 1.4.1 only a small portion of Wyoming livestock producers report losses to predators, including wolves. Therefore, consistent with the findings of Berger (2006), we do not anticipate that the proposed action will have substantial impacts on the Wyoming livestock industry as a whole. The rationale considered by Berger (2006) is not applicable to the proposed program.

16. Do wolves cause problems with deer, livestock and domestic animals in the Snake River Corridor?

The Snake River extends from Jackson Lake in Grand Teton National Park to Palisades Reservoir in Idaho; most of the wolf packs in this area are located in the park, where there are limited livestock. As is typical in most areas, the nature and extent of conflicts with wolves varies from year to year. For example, no livestock or dog mortalities were verified in the Snake River corridor in 2014, but in 2015, WGFD verified 14 lambs and 3 ewes killed by wolves in the Snake River Corridor. Additionally WS-Wyoming responded to the verified loss of 9 adult sheep, 17 lambs, 4 adult cattle, and 5 calves in the area in 2016.

17. **Did Section 1.4 of the EA wrongly assert that there is a need for WDM in order to maintain public tolerance and acceptance of wolves? The studies cited were old and more recent investigations have revealed that negative attitudes are reflected on an increasing level long after reintroduction of wolves (Houston and Bruskotter 2010, Bruskotter et al. 2007). A study conducted regarding the social tolerance of wolves in Wisconsin found that as lethal-control measures increased, tolerance actually decreased. (Browne-Nunez et al. 2015).**

In general, prompt and effective assistance in reducing wildlife damage can improve tolerance of wildlife among individuals who experience damage and may help increase wildlife acceptance capacity (Decker and Brown 2001). There was some confusion among commenters as to whether this statement was intended to indicate that lethal removal of wolves was necessary to improve public tolerance of wolves, however at this point in the analysis, WS only intended to note that the assistance must be prompt and effective and make no assertions as to what types of methods must be included. This section has been edited for clarity. We agree that factors impacting public attitudes towards wolves are complex and include a number of issues not directly related to specific conflicts or their resolution include long-standing cultural attitudes regarding wolves, concerns pertaining to federal protection of wolves despite many years of wolf numbers in excess of thresholds in wolf recovery plans, and preferences regarding the federal role in wolf management (Bruskotter et al. 2007, Houston et al. 2010, Browne-Nuñez et al. 2015, Olson et al. 2015). The statements noted in the EA were relevant to the inclusion of provisions for WDM in the USFWS planning regulations associated with wolf reintroductions, and were relevant to the analysis insofar as they pertained to USFWS requests for WS assistance while wolves were federally listed (Bangs et al. 1998). Regardless, it does not appear that Browne-Nuñez et al. (2015) determined that tolerance decreased with the advent of lethal control, but that rather "Participants expressed favorable attitudes toward lethal-control measures, but believed there were limitations in the implementation of the lethal-control measures."

The WGFD, USFWS and WS-Wyoming are aware that some illegal killing of wolves does occur and that frustration regarding the former protected status of wolves under the ESA may be contributing to negative attitudes towards wolves (Treves et al. 2013, Browne-Nuñez et al. 2015, Olson et al. 2015, Chapron and Treves 2016a, Olson et al. 2017, Pepin et al. 2017). The EA discusses the relative likelihood that individuals will seek illegal or ill-informed solutions to conflicts with wolves under each of the alternatives and for listed and delisted wolves (e.g., Section 3.1.2, 3.1.4). Ultimately WS-Wyoming has no control over the status of wolves under the ESA.

ISSUES CONSIDERED IN THE EA

18. **The EA needs a cost:benefits economic analysis for comparison of the alternatives. The EA needs a detailed spatial and temporal analysis of costs and impacts of past WDM efforts.**

This issue has been addressed in detail in Section 2.4.7. Based on a thorough review of the issue, WS has determined that a detailed economic analysis is not required by CEQ; and that there are important qualitative values relevant and important to its decision-making that cannot be readily monetized. These values include recreational, aesthetic, safety, ecological and spiritual benefits. These qualitative

considerations are evaluated for each alternative in Chapter 4. WS's decision, based on all considerations, including non-quantifiable values, is explained in the decision document.

While wolves were federally listed, data on wolf management including costs was collected and addressed at a statewide level. Due to the split status of wolves and the different agencies involved in WDM, a centralized system is not currently in place. WS-Wyoming has data on the cost of its own operations during years when wolves were delisted and provides this information in Section 3.2.1. However, costs of WDM by other entities, particularly WGFD in the WTGMA are not readily available, which precludes more detailed economic analysis.

19. The EA needs to consider the generous 7:1 compensation program the state employs for livestock losses to wolf predation under Alternative 1. A cost:benefit analysis could indicate that compensation is more cost-effective than lethal programs.

Additional details regarding the 7:1 compensation ratio the state employs in the WTGMA has been added to EA Sections 3.4.1 and 3.5.8. In Section 3.5.8 we discuss concerns regarding compensation programs which render them unsuitable as an exclusive tool for addressing conflicts with wolves. An economic analysis would not change the nature of our concerns regarding compensation programs and associated determination of their suitability as a management alternative. Comparative information on the cost of WS-Wyoming activities and WY state expenditures for compensation are provided in Section 3.2

20. The EA needs to consider Richardson and Loomis (2009) regarding economic/recreation benefits of wolves.

Richardson and Loomis (2009) compiled data from 31 studies assessing willingness to pay for the preservation of a particular species and found that wolves ranked 8th from among 23 species considered (if annual and lump sum WTP values are considered collectively), with a value of $61 dollars assigned (average of 23 species was $71) to the species, not to each individual wolf. WS is not surprised by the relatively high dollar value assigned to the benefits of wolves given the ecological, recreational, spiritual, and existence value for many members of the public, but the applicability of the study for this analysis is limited. Calculations regarding the value of wolves were based on studies assessing willingness of Yellowstone National Park Visitors and residents of Idaho, Montana and Wyoming to pay for wolf reintroduction that were conducted from 1990-1993 and a survey of Minnesota residents regarding support for management actions needed to preserve the state wolf population at levels above the recovery threshold for the species. Unlike circumstances at the time the surveys were conducted, wolves in Wyoming have recovered to the point where they are no longer federally listed under the ESA and analysis in Section 4.4.1.1, 4.4.2.1, and 4.4.3.1 indicates that none of the alternatives will jeopardize the recovery of the state or regional wolf population. Wolf removals for WDM have been conducted throughout the period of wolf population recovery and have not precluded the recovery and eventual delisting of the species. Consequently, it is unclear how the willingness of individuals to pay for the recovery or preservation of a species relates to the proposed action.

21. The EA needs to discuss how the EA externalizes costs of doing business for ranchers, how each alternative influences private behavior and whether or not this enabling role for ranchers is actually more expensive, detrimental to the environment and less effective than if the private sector were to incorporate its own costs and take responsibility for the protection and stewardship of its own property. The EA needs to consider whether this entitlement encourages rather than discourages artificial dependency on what amounts to corporate welfare and whether or not this is economically healthy for the industry.

WS involvement in WDM does not externalize costs of WDM for livestock producers in Wyoming. All operational costs of WDM in Wyoming are paid by the WGFD, WDA or Counties with money primarily generated through fees to livestock producers (e.g. brand inspection fees and grazing fees), private and business contributions to counties, and/or hunting licenses. These decisions to use public funds to provide assistance to private individuals adversely impacted by a public resource are not subject to NEPA review and cannot be changed through the WS NEPA process. As noted in Section 3.2, none of the methods proposed for use are restricted to WS-Wyoming, and there are alternative sources for the WDM services provided by WS-Wyoming. State and County agencies are likely to either provide these services on their own or seek alternative providers for the services currently offered by WS-Wyoming.

22. Jones (2015) economics review of a recent Idaho predator damage management EA concluded the ID WS PDM program was an economic loss. Is it possible that if a more detailed economic analysis was conducted like that of Jones (2015) that there would also be an economic loss associated with the proposed action?

As noted in Section 2.4.7, WS-Wyoming has determined that there are important qualitative values that are relevant to its decision-making that cannot be readily monetized, including recreational, aesthetic, safety, ecological and spiritual benefits. For these reasons, WS-Wyoming has determined that a formal cost:benefit analysis would not contribute substantively to WS' decision making at this time and has decided to address these issues qualitatively. Additionally, the report by Jones (2015) has not been subject to agency or peer review or published in a scientific journal. This type of review could have led to the identification and potential correction of erroneous assumptions which may have had a substantial impact on the Jones (2015) calculations. For example, Jones (2015) uses budget data for the ID WS program as a whole and credits all costs to management of the predators when, in fact, WS-Idaho also provides assistance with wolf, rodent and bird conflict management (United States Department of Agriculture – Animal and Plant Health Inspection Service – Wildlife Services 2004;2011). Consequently, the total cost per work task is artificially inflated which impacts all associated calculations. Given this information, we do not believe Jones (2015) provides compelling information that would warrant reconsideration of our decision to not provide a cost:benefit analysis in the EA

23. WS-Wyoming needs to provide information on the amount of money spent for WDM.

Data on the costs of WS-Wyoming WDM work and other known WDM costs are provided by management zone in Section 3.2.1.

24. If WS has been collecting information on project costs and efficacy for years under its Decision model as promised, why is that information not presented here?

The Decision Model (Section 3.3.3) is an undocumented thought process used for assessing, and responding to, instances of wildlife damage which resembles the problem-solving process used by wildlife management agencies when addressing wildlife conflicts (Slate et al. 1992). Costs, when considered in context of the Decision Model reflect site-specific circumstances and are linked to the practicality of implementing a method. For example, a producer with a small flock of sheep on private property may not be able to afford a full-time herder. Constructing predator proof fencing may not be a cost-effective solution for large pastures (1,000s of acres) used for large herds of cattle, particularly if it is not clear that wolf predation will be a recurring issue (80% of cooperators in the WTGMA and 70% of

cooperators in the Predatory Animal Zone only requested WS-Wyoming assistance one year during the period of FY 2013-2018).

25. WS-Wyoming ignores the fact that when properly combined and adjusted to the specifics of a livestock operation, nonlethal methods can ultimately be more effective and cost-efficient than traditional lethal methods. Increased assistance with nonlethal will decrease conflicts, reduce need for unnecessary killing of wolves and enable increased collaboration between interests which can decrease social tension regarding wolves.

The statement regarding the efficacy of nonlethal methods appears to be in reference to a publication by Stone et al. (2017) evaluating the Wood River Wolf Project that assists sheep producers with adaptive use of nonlethal strategies for minimizing wolf depredation on sheep managed on open range grazing operations in Idaho. This study is addressed in Sections 3.4.1 and 3.4.2. WS agrees that in some circumstances, integrated use of nonlethal methods can effectively resolve livestock conflicts and, where effective, may reduce the need for lethal WDM methods. Based on decades of WDM experience in Wyoming and in other states including Minnesota where WS has been involved in WDM for decades, it has been WS's observation that each WDM strategy has its strengths and weaknesses. Access to the full array of WDM methods improves the likelihood that conflicts with wolves may be promptly and effectively resolved.

WS-Wyoming is willing to form partnerships with other agencies, tribes and organizations to promote use of nonlethal methods. These efforts have included providing financial assistance for a workshop on nonlethal WDM methods and participation in a 2017 demonstration project testing fladry for protection of cattle (Section 3.5.7). WS-Montana has been able to build cooperative relationships promoting nonlethal WDM with NGOs while working under an IWDM alternative that allows access to nonlethal and lethal methods similar to the one proposed in Wyoming. WS-Wyoming would be open to developing similar partnerships with NGOs in situations where willing landowners were open to the idea of collaborative nonlethal projects.

26. Lethal control does not permanently stop livestock predation and must be repeated when depredation recurs. Does the fact that WS still receives requests for assistance mean that the current program is not effective?

No, the need to repeat or continually implement a WDM method is not necessarily an indicator that the method is ineffective. Very few methods, nonlethal or lethal, provide permanent resolution of wildlife conflicts without ongoing effort. Just as lethal methods may need to be periodically repeated on the same property, nonlethal methods such as herding, livestock guarding animals, and frightening devices require sustained effort to implement for effective damage reduction, yet these methods are commonly perceived to be effective. WS-Wyoming responds to individual depredation events to assist in resolving those conflicts, then addresses the next conflict as requested and funded. Given the analysis in Chapter 4 of the EA that indicates wolf populations quickly recover from removals by WS-Wyoming, this approach does not guarantee predation events will not recur at some later point. However, only a small proportion of properties (3% in Predatory Animal Zone, 8% in WTGMA) have recurring predation issues (defined as requesting WS assistance in 3 or more years over the period of FY13 to FY18). Conversely, 80% of cooperators in the WTGMA and 70% of cooperators in the Predatory Animal Zone only requested WS-Wyoming assistance one year during the 6-year period of FY 2013-2018. WS does provide technical assistance on methods that make it less likely for predation to reoccur (e.g., fencing, habitat management, carcass disposal, livestock husbandry practices, livestock guarding animals) where applicable. It is also not reasonable to assume that localized actions to target specific depredating animals or small groups of animals would impact losses elsewhere in the state. In a study by Bradley et al. (2015), the average time to recurrence of depredation after lethal removal of wolves was 64 days following partial pack removal and 730 days following full pack removal.

27. Did the EA adequately consider the finding of studies indicating that lethal WDM may not work? EA needs to consider findings of Musiani et al. (2003, 2005), Harper (2008), and Muhly et al. (2010) regarding the efficacy of lethal wolf removal for damage management. EA also needs to consider Peebles et al. (2013), Lambert et al. (2006), Maletzke et al. (2014), and Smith et al. (2015), and Treves et al. (2010).

WS has consolidated and augmented a discussion of the efficacy of individual methods including Musiani et al. (2003, 2005), Harper et al. (2008), Muhly et al. (2010a), Muhly et al. (2010b) in Section 3.4.2 and augmented some of the discussion of individual methods in Section 3.4.1. Discussion of the other studies listed in this comment is included in Section 2.4.8.

28. Is there a risk that non-depredating wolves will be removed only to have depredating wolves fill the territory?

Because of the territorial nature of wolves, risks that multiple packs may access a particular property or livestock herd at a given time are relatively low which minimizes the likelihood that members of packs not associated with the depredation may be taken. Nonetheless, there is some risk. When working to remove wolves from depredation sites, WS-Wyoming strives to conduct removals close to the depredation location and may use existing information on known wolf packs and their movements in the project area to maximize the likelihood that wolves involved with the depredation will be taken including information from radio collars primarily used for population monitoring in the WTGMA. In a small number of cases (average of 1 per year), in the Predatory Animal Zone WS-Wyoming may capture and radio-collar a wolf near a depredation site and use that information to help identify the pack associated with the conflict. A number of factors contribute to the likelihood that a site will experience repeat depredations including availability of natural prey, proximity of livestock to wolf den and rendezvous sites, and livestock production practices. Even when the depredating animals are taken, there is some risk that the remaining wolves (in cases of partial pack removal) or new wolves may depredate on livestock. However, available data indicates that the number of properties with recurring depredation (defined as requesting WS assistance with WDM in at least 3 of the last 5 years) is low. See also Section 2.4.3 and Response 26

29. The EA needs to provide analysis of efficacy of past actions for lethal and nonlethal methods. Information on the success or failure of nonlethal methods is needed to assess why tools fail or if they are being used correctly. Without this information methods cannot be improved or accurately evaluated. Information should be presented in an annual report.

WS-Wyoming is aware of the interest in specific information regarding nonlethal management methods used by cooperators, particularly in situations where lethal WDM is implemented. WS-Wyoming will begin collecting information on use of nonlethal methods by cooperators and will report this information in monitoring reports. Instances of chronic depredation may be considered, in part, as a measure of long-term success, although instances of chronic depredation are also impacted by environmental conditions that can influence the likelihood that wolves will encounter and prey on livestock (e.g., abundance of natural prey, proximity of suitable den and rendezvous sites to livestock, landscape characteristics, habitat, proximity to roads)(Muhly et al. 2010a, Edge et al. 2011, Treves et al. 2011). In Wyoming, instances of chronic depredation (defined for purposes of this EA as sites with conflicts meriting the use of lethal methods in 3 or more of the last 5 years) where wolves are removed repeatedly at the same location are very low. Only 3% of the agreements in the Predatory Animal Zone and 8% of agreements in the WTGMA requested WS assistance 3 or more times over the period of FY 2013-2018. Conversely, 80% of cooperators in the WTGMA and 70% of cooperators in the Predatory Animal Zone only requested WS-Wyoming assistance one year during the 6-year period of FY 2013-2018.

30. Will removing wolves make depredation problems worse? When you kill breeding adults, younger coyotes breed and juvenile males move in to fill in gap. Increasing the number of juvenile males results in more breeding and increased likelihood of predation on ungulates and livestock.

Although coyotes are similar to wolves, there are differences in species biology and behavior, so caution should be used when extrapolating from one species to the other. Wolf populations do not appear to exhibit the same resilience to lethal removals as coyote populations as demonstrated by the difference in species response to historic periods of overharvest and large scale removals for livestock protection. The issue of efficacy of lethal removal in reducing wolf depredation on livestock is provided in Section 3.4.2. Based on this information, we conclude that although the efficacy of lethal WDM may be limited in time and scope of area protected, there is insufficient evidence to indicate that lethal methods make depredation on livestock worse.

31. Wielgus and Peebles (2014) is the best available science and should not be discredited. The WS memo discounting the Wielgus study is an in-house review and is flawed and has deficiencies. Weilgus and Peebles was published in an accredited peer-reviewed journal.

Since the publication of the EA, there have been peer reviewed articles assessing the analysis in Wielgus and Peebles (2014) that have reached conclusions similar to those of the WS review. Details of these articles have been added to Appendix C.

32. Is the point of the Wagner and Conover (1999) study to prove whether shooting wildlife from a helicopter the year before was more effective than just snaring, trapping or poisoning?

Wagner and Conover (1999) evaluated the impact of preventive aerial coyote shooting on livestock losses during the subsequent summer. Wagner and Conover (1999) compared the extent to which corrective predation management techniques such as traps, snares, and M-44s were used in areas with and without preventive areal hunting. Devices such as traps, snares and M-44s have higher risks to nontarget species, and information on the impact of aerial shooting on the need for these methods would also be important to managers.

ALTERNATIVES

33. The fact that no single approach is universally successful is not adequate reason to dismiss nonlethal methods altogether. Nonlethal must not be dismissed while lethal methods are given limited scrutiny.

Nonlethal methods were not dismissed. The preferred alternative includes the integrated use of nonlethal and lethal methods with preference given to WS-Wyoming use and recommendation of practical and effective nonlethal methods. Information on the efficacy of nonlethal methods is provided in Section 3.4. Also, the efficacy of nonlethal methods is one of the reasons for rejection of a lethal-only alternative (Section 3.5.4). Lethal methods were subjected to similar scrutiny as nonlethal methods in Section 3.4 which discusses the spatial and temporal limits of lethal methods. See also Responses 25, 30 and 34.

34. WS needs to consider the successful program in Marin County, California. Marin County redirected funds toward nonlethal measures. Funds were allocated for tools such as night corrals, fencing, lamb sheds, noise- and light-generating devices, and compensation to farmers for livestock losses. These measures proved less expensive and more effective than lethal control; average annual losses declined from 5 percent to 2.2 percent.

A discussion of the Marin County, California predator damage management assistance program has been added to Section 3.5.9. Based on analysis in this section and as explained in this section, we have determined that this alternative was not suitable for development as a viable alternative for WDM in Wyoming.

35. BLM's manual 6330 set forth new standards for wildlife killing in WSAs and established that shooting animals from aircraft is only allowed where specifically authorized. All impacts from WS activities must be compared to the baseline levels of disturbance present in each WSA when it was designated on all the resources the WSA was intended to protect. The EA lacks any such impact analysis or description of baseline conditions. The EA fails to provide discussion of how WS will ensure compliance with the legislative mandates for each WSA. If WS proceeds without this analysis it will be in violation of the NEPA, NFMA FLPMA, the wilderness act and others.

BLM Manual 6330 fully states: "Predator control activities must be directed at the specific offending animal or group of animals." The Manual does not restrict where animals may be taken with the use of aircraft. The closest resemblance of restriction may be found in subparagraph iv, which states, "Acceptable control measures include lethal and nonlethal methods. Criteria for choosing a particular method include need, location, environmental conditions, the preservation of wilderness characteristics, and applicable Federal and State laws. Use only the minimum amount of control necessary to solve the problem." Although the current BLM guidance on management in wilderness study areas (BLM 2012) does not speak to the use of specific WDM methods, earlier guidance (United States Department of Interior - Bureau of Land Management 1995, United States Department of the Interior - Bureau of Land Management 2007) specifically addresses use of aircraft and provides insight in understanding activities which may be conducted in WSAs. Specifically, the guidance notes that, "Shooting of animals from aircraft can occur in WSA's in any State where the activity is consistent with State law and has been previously coordinated with the BLM State Director". WS-Wyoming discusses necessary protective measures for any work conducted in WSAs during annual work plan meetings.

WS does not conduct lethal proactive WDM, and all actions are taken in response to a current depredation incident, so activities are directed at specific offending animals or groups of animals. WSAs are not fully-fledged wilderness areas and some of the restrictions applicable to Wilderness Areas do not apply to WSAs. The primary issue of concern is that any action conducted in a WSA must not alter the site in such a manner that it compromises the likelihood that the site would qualify for wilderness designation. Primary consequences of WDM actions that might potentially impact wilderness characteristics could be noise from aircraft, disturbance through WS access of the site and wolf and nontarget species removals. None of the proposed WDM activities would result in substantive alterations in habitat. Noise and disturbance impacts could immediately be halted upon designation of a site as wilderness. WS-Wyoming would only use site access methods permitted for the area and would access the sites on established roads or by foot or horseback. As noted in Section 4.3.1.2, WS-Wyoming WDM activities have not precluded the recovery of the wolf population in the state or region, or the expansion of wolf range in the state. Localized population reductions are short-term in nature. Wolf hunting and trapping could occur in WSAs outside of the WTGMA. Wolf hunting by licensed hunters could also occur in WSAs inside the WTGMA and would be conducted in accordance with WGFD management objectives for the species. WGFD adjusts wolf harvest permits with the amount of wolves taken for depredation management in mind, so reduction or elimination of take for WDM would likely result in corresponding adjustments in licensing by WGFD to maintain management objectives. All WS-Wyoming activities would be

conducted in accordance with applicable laws and regulations. WS activities which are not suitable for lands designated as wilderness can be discontinued immediately if and when these areas are designated as wilderness and, as such, do not compromise the suitability of these areas for future listing as wilderness. Consequently, the proposed action is not anticipated to result in any lasting alterations that would compromise the wilderness characteristics of these sites.

36. EA ignores diversity of management mandates considering different land ownership and land-use designations in violation of NEPA. EA needs to fully disclose and analyze different respective Organic Act mandates considering the differences in management objectives on Forest Service land, BLM land, various wilderness objectives and other land use designations. It is inadequate to say the land management agencies will change their direction and leave it at that. WS may not rely on annual work plan meetings which take place without public participation and review required by NEPA.

We do not assert that land management agencies would change their management direction to suit WS-Wyoming. To the contrary, WS-Wyoming adjusts its WDM practices to ensure consistency with the needs and management priorities identified by the respective land management agency during annual work plan meetings (Section 2.3.9). WDM would be conducted on National Forest System and BLM lands consistent with MOUs and policies of WS, the USFS and BLM, and this EA. Any work plans developed for WDM, pursuant to this EA and associated Decision, will be consistent with the direction provided in the Land and Resources Management Plans (LRMPs) for the National Forests and the Resource Management Plans (RMP) for BLM administered lands found in Wyoming. These plans include provisions for the protection of special land classes including wilderness and wilderness study areas. On USFS and BLM managed lands, public safety, environmental concerns, and the specific needs of areas with unique characteristics are adequately mitigated through jointly developing work plans with WS-Wyoming. The Forest Service and BLM may, at times, restrict predator damage management because of concerns for public safety or resource values. All predator damage management will be conducted in a manner consistent with the ESA and the Section 7 Consultation with the USFWS.

We do not concur that annual work plans and case-by-case consultations with land management agencies are inadequate to address special management areas. The land and resource management plans for these sites include NEPA analysis and public involvement processes. While some of the resources and issues of concern may be fixed over time, many may change over the life of the agency resource management plan. For example, sensitive species range may change, additional species of concern may be identified, livestock grazing authorizations may shift to different areas, special events and patterns of public use may also change. Use of the annual work plan process in combination with the public planning process of the land management agencies and the NEPA process for this EA allow the agencies to meet the need to include the public in the planning process while retaining the flexibility needed to adapt to a dynamic environment.

37. We received several comments regarding WDM in Special Management Areas (SMAs), including Wilderness Areas (WAs) and Wilderness Study Areas (WSAs). Commenters opposed WDM in SMAs, or asserted that the EA fails to adequately consider potential impacts on SMAs. Some commenters asserted that the EA should have included site-specific analyses for each SMA in Wyoming. Other commenters asserted that the presence of wolves is part of the unique characteristics of SMAs including WAs and that these unique characteristics would be harmed by wolf removals on adjacent lands, so an EIS must be prepared.

We understand that some individuals will not agree with the use of WDM in special management areas (SMAs), such as Wilderness Areas (WAs) and Wilderness Study Areas (WSAs). We considered an alternative to not conduct WDM in WAs or WSAs in Section 2.10.24. This alternative was not considered in detail for the reasons provided therein. Alternatives 1 and 2, which include the possibility of WDM in

WAs, were analyzed in detail in Sections 4.3.1 and 4.3.2, and we determined that they would not result in any significant impact on the environment.

Consistency with agency land management plans is addressed in Section 3.3.5 which has been augmented to address issues from public comments. We disagree that the inclusion of site-specific analyses for all SMAs in Wyoming would be reasonable. Due to the infrequent and sporadic nature of WS-Wyoming's WDM work in SMAs, analyses for each SMA in Wyoming would be uninformative. NEPA requires an analysis of the impacts by looking at the issues as implemented under each alternative. WS-Wyoming conducted this analysis at the statewide level. It is redundant and adds nothing to the analysis to conduct the same analysis of the same issues and alternatives at a smaller scale because an analysis conducted at the statewide scale is more informative.

We have provided a list of special management areas in Wyoming in Appendix E. For each area we have provided a notation regarding the likelihood that WDM would be conducted on or near the site, notes as to the methods which may or may not be used and some of the other restrictions on methods used that may apply to the site. Review of the material in Appendix E indicates that WS-Wyoming is unlikely to conduct WDM on most of these areas. Measures to protect the unique characteristics of these areas are established in work plans that are available to the public upon request or during project specific consultations with the applicable land management agency (Appendix E). We have expanded Section 3.3.5 to provide greater detail. Analysis in EA chapter 4 indicates that wolf removals for WDM by WS-Wyoming, individually, are not of sufficient magnitude or extent to significantly impact the wolf population. The Wyoming wolf population increased in range and size during the period while wolves were federally protected under the ESA and WS-Wyoming conducted wolf removals for WDM under the direction of the USFWS. Individually, WS-Wyoming actions are unlikely to have substantive lasting impacts on wolves in SMAs. Population reductions and opportunities to view wolves could decline as the state works to manage cumulative impacts on the wolf population to achieve state wolf population management objectives which are at or lower than current wolf population levels. This EA cannot change state management decisions and impacts are likely to occur independent of WS-Wyoming involvement in WDM. Similarly, wolves may be taken in SMAs for protection of livestock by entities other than WS-Wyoming and some areas including WAs are open to hunting and trapping. WS-Wyoming involvement in WDM may help to reduce impacts on SMAs through provisions of work plans established with the land management agency and because WDM would be conducted by trained professionals.

38. The EA lacks support for the claim that most wolf predation on livestock occurs in spite of nonlethal efforts. NASS data is not adequate because there is no connection between operations using nonlethal and operations reporting damage. Furthermore predator loss stats show only a low proportion of producers are using any one method, or indeed any methods. Therefore there is substantial opportunity for WS to increase producer use of nonlethal methods through operational assistance. WS-Wyoming's records also provide little evidence that the program has provided technical assistance with nonlethal methods. Proposed alternative should include a protocol to document and report use of nonlethal tools by producers and WS and the result of use of nonlethal methods. There is an error in how WS used National Agriculture Statistics Service data on use of nonlethal methods. Percentages reported were not for all producers they were only for producers who actually reported using a nonlethal method.

We agree that data on producer use of nonlethal methods are less than ideal. The surveys mentioned by the commenter reflect methods used statewide including substantial portions of the state where wolves do not occur. Our observations indicate that use of nonlethal methods is higher among producers who request WS-Wyoming assistance. To improve information on this issue, WS-Wyoming will add records of producer-implemented methods to the database that records program activities. This information will be reviewed in annual work plans and used when considering options for encouraging use of nonlethal

methods. Similarly, during the EA process, it became apparent that WS-Wyoming employees took providing advice to producers on methods they may employ to reduce damage as a matter of course and did not diligently record these conversations in the program database. WS-Wyoming is working with employees to ensure technical assistance recommendations are adequately represented in the system.

The error has been corrected. The EA has also been updated with current information on livestock losses to wolf predation.

39. Reasons for not considering the reasonable nonlethal before lethal alternative in detail are not valid.

Commenters assert that the "Reasonable Nonlethal before Lethal Alternative" (Section 3.5.10) differs substantially from Alternative 1 because it would include increased WS-Wyoming proactive and reactive operational assistance with implementation of nonlethal methods unlike Alternative 1 that only provides limited technical assistance and only reactively after damage has occurred. Additionally, Alternative 1 does not ensure that all reasonable measures are implemented before using lethal and because WS currently does not invest significant time and resources to directly assist producers with purchasing, acquiring, or installing nonlethal measures. Commenters also assert that the proposed alternative differs from Alternative 2 because Alternative 2 would only increase technical assistance and not operational assistance with nonlethal methods. The "Reasonable Nonlethal before Lethal Alternative" has WS substantially increasing on the ground assistance with WDM.

Reasons for not considering the "Exhaust Reasonable Nonlethal before Lethal Alternative" are presented in Section 3.5.10. We do not concur with the depiction of Alternative 1 and Alternative 2 as limiting WS-Wyoming to reactive technical assistance with nonlethal methods. Under both alternatives, WS-Wyoming may provide proactive and reactive operational and technical assistance with nonlethal methods within the constraints of available resources. At present, all WDM field work in Wyoming (technical and operational assistance) is paid for by WGFD or the ADMB. In the WTGMA, WS provides WDM assistance on a case-by-case basis only as requested by WGFD. WGFD rarely requests WS-Wyoming operational assistance with nonlethal WDM methods, but WS-Wyoming does provide technical assistance on nonlethal methods as part of the process of preparing agreements for WDM assistance. Similarly, WS-Wyoming funding for WDM in the Predatory Animal Zone has been designated for direct technical and operational assistance to individuals experiencing conflicts with wolves and wolf depredation on livestock. While funds may be made available for demonstration projects on nonlethal methods, the ADMB funds are not currently designated to help individual producers pay for WDM materials or livestock guarding animals (Albert 2018). Under both alternatives, WS-Wyoming could increase proactive and reactive technical and operational assistance with nonlethal WDM methods if resources become available.

40. Is it appropriate to reject the Compensation Only alternative because WS does not have the authority to implement the program?

The Compensation Only alternative is addressed in Section 3.5.8, and was not rejected for further analysis simply because WS lacks the authority to establish a program of this nature. There are several difficulties associated with compensation programs that make them unsuitable for exclusive use in resolving conflicts with wildlife. Additional details have been added to section 3.5.8 for clarity.

41. Is WS incorporating findings from research? Despite research at the Utah field station, WS methods have not changed much.

Research is an important component of WS' IWDM strategy (Section 3.3.2.3). NWRC has been instrumental in helping to develop and improve use of nonlethal methods that may be used or recommended by WS-Wyoming under Alternatives 1 and 2 including fladry, and electrified fladry (Lance et al. 2010). Ongoing research is working to identify and improve the use of livestock guarding dogs to

address conflicts with larger predators such as wolves, bears and lions (Marlow 2016). See Section 3.4 for discussion of WDM methods that could be used or recommended by WS. WS-Wyoming is also working with NWRC to evaluate an automated radio-collaring system that could help facilitate monitoring of wolf populations and use of nonlethal methods like the RAG that require placing a transmitter collar on wolves.

42. WS needs to direct its efforts to promoting use of nonlethal methods. WS producer workshops that exist in a number of states are an excellent example of efforts that should be continued and increased.

WS agrees that producer workshops can be a helpful means of providing information on nonlethal methods for WDM and WS-Wyoming has participated in workshops in the past. WS-Wyoming could participate in this type of program under Alternatives 1 and 2. In the event that there was interest by livestock groups to hold one of these meetings, WS-Wyoming would certainly be willing to organize and cooperate in these in the future. In the interim, WS-Wyoming is able to provide technical assistance to individual producers, including use of educational materials prepared by WS and the WGFD.

43. The EA failed to consider a reasonable range of alternatives. The EA must consider all reasonable alternatives.

The Council on Environmental Quality guidance to agencies states, "When there are potentially a very large number of alternatives, only a reasonable number of examples, covering the full spectrum of alternatives, must be analyzed and compared… What constitutes a reasonable range of alternatives depends on the nature of the proposal and the facts in each case." (Council on Environmental Quality 1981). We have considered a reasonable range of alternatives ranging from no WS-Wyoming involvement to WS-Wyoming use and recommendation of the full range of practical, effective and legally-available WDM methods. We have provided reasoning for not considering other alternatives in detail in Section 3.5.

44. Reasons for not considering the Natural Resources Defense Council alternative in detail in the EA are flawed. Why is this alternative considered in detail in some EAs but not others? The NRDC alternative is viable and differs significantly from proposed reasonable nonlethal before lethal alternative because it offers a more circumscribed step-wise approach to responding to conflicts with less focus on operational support for preventive lethal methods.

This is the "Ongoing Nonlethal before Lethal" alternative discussed in EA Section 3.5.7. Alternatives considered in each WS EA or EIS are developed based on species and area-specific needs and applicable laws, regulations and management plans. Consequently there may be substantial variation in the alternatives considered in detail. WS does not have the authority to set regulations and policies governing when and how lethal methods may be used to resolve conflicts with resident wildlife. Each state wildlife management agency, after consultation with the citizens of the state and their elected representatives, establishes its own plans and priorities for wolf damage management. In Oregon and Washington, wolves have only recently returned to the states and wolves are still federally-listed as Endangered in portions of these states. As a result, and in response to state citizen preferences, the Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife, the agencies with regulatory authority for wolf management in areas where wolves are not federally protected under the ESA, established step-wise procedures for responding to livestock predation that require documentation that nonlethal methods have been attempted before lethal methods. Consequently, the alternatives analyzed in detail by WS in these states include an alternative similar to "Ongoing Nonlethal before Lethal" and "Reasonable Nonlethal before Lethal" alternatives discussed in Sections 3.5.7 and 3.5.10. The State of Wyoming, in establishing split state status for wolves, has made very different WDM decisions and the alternatives considered in detail in our EA reflect this difference. Sources of funding used for WDM also impact the alternatives which may be considered. A wider range of management alternatives may be

considered in situations where there is substantial federal funding from WS for implementation of wildlife damage management because WS has increased discretion in allocation of resources for projects. WS-Wyoming is not proposing to conduct preventive lethal WDM in either management zone.

45. WS-Wyoming should not say that it does not have a responsibility to provide operational assistance with nonlethal methods. The EA needs to clarify when WS-Wyoming may be involved in providing operational assistance with nonlethal WDM.

WS does not assert that we do not have a responsibility to provide operational assistance with WDM. It is likewise not correct to state that WS defers implementation of all nonlethal methods to cooperators. In general, operational assistance with nonlethal or lethal methods may be provided when a problem cannot practically be resolved through technical assistance from WS-Wyoming or cooperator-implemented measures (Section 3.3.2.2). WS has identified some methods which require ongoing effort and/or regular (e.g., daily), or sustained presence with the livestock for extended periods of time (e.g., some livestock management practices, guarding and hazing, range riders, care of livestock guarding animals) as impractical for WS-Wyoming to implement for producers. Given the dispersed nature of WS-Wyoming service recipients (WS received requests for assistance in 6 counties in 2018) and current resource limitations, WS-Wyoming simply doesn't have the ability to provide full operational assistance with implementation of these types of methods. It is most practical for these types of actions to be implemented by the resource owners/managers who are already with the livestock on a regular basis. Similarly, actions such as construction of permanent fencing may be most efficiently and economically handled by the land manager, or a private business that specializes in fence construction. Consequently, WS-Wyoming does not generally provide this type of assistance. WS-Wyoming's primary role involving these techniques is to encourage livestock producers and resource owners/managers to use these methods, and to provide guidance (technical assistance) on the safe and effective implementation of these methods and sources of supplies for WDM materials.

Some concerns on this issue appear related to confusion regarding what does and does not constitute technical assistance. Technical assistance includes site visits which may address nonlethal methods currently implemented or tried by the cooperator and ways to optimize use of nonlethal methods, and suggestions of any additional practical and effective nonlethal methods. Technical assistance may also include providing information on sources for nonlethal WDM supplies (e.g., livestock guarding animals, frightening devices).

46. The EA fails to include information regarding the amount of PDM that will be conducted in context of the number of requests for service anticipated, methods used to take wolves or in the number of wolves that might be taken or harmed by WS actions.

Information on the extent to which each lethal WDM method is used to take wolves has been added to Section 3.2.1.4. Information on the number of wolves taken per year was already provided in Section 4.3.1.2 Table 4-1. The number of request for WS assistance range substantially among years and between projects and is an unreliable indicator of program impacts. In general, we do not anticipate that requests for WS-Wyoming WDM assistance will change substantially from current levels. We believe the information provided in the EA on wolf and nontarget species take and the cap on projected WS annual take of wolves provides a useful indicator of program impacts. The cap on WS-Wyoming projected annual take of wolves takes into consideration any potential increases in requests for WS-Wyoming assistance that might result from any expansion of the wolf population in the Predatory Animal Zone.

47. WS-Wyoming should not conduct preventive lethal removal of wolves in the Predatory Animal Zone.

After review of issues and analyses in the EA and public comments, we concur and have adopted this policy. Restricting use of proactive to nonlethal methods and use of lethal methods to corrective actions

provides the best balance of the need to address conflicts with wolves in Wyoming while also minimizing adverse impacts on the state wolf population.

48. WS-Wyoming may not have financial resources to provide certain tools or fund long-acting strategies such as herders or guard dogs. WS-Wyoming should collaborate with partners including federal and state agencies and NGOs to provide these tools and assistance.

We concur. This type of collaboration is possible under Alternatives 1 and 2. See also Response 45.

49. WS' assertion that establishing a threshold for initiating control is inappropriate because even the Decision Model says there is a threshold (i.e., damage has been reduced to an acceptable level).

We do not concur. The "acceptable level" noted in the decision model varies on a case-by-case basis depending on cooperator needs and perspectives. The threshold proposed in public comments was taken to mean a universal threshold applicable to all situations (e.g., lethal methods would not be used unless producer had sustained losses of X% or higher).

50. Is there sufficient evidence to support the conclusion that other entities could make up for lethal WDM services provided by WS-Wyoming under Alternatives 2 and 3? Could other entities get resources and authorization to conduct activities like aerial operations on public lands and use of radio collars?

We have added additional information on the actions which are and may be conducted by other entities to the description of the alternatives in Section 3.2. Based on the information presented in this section, we conclude that there is sufficient evidence to support our assertion that lethal WDM could be conducted by non-WS entities at levels similar to that proposed for WS in Alternative 1. The potential consequences of non-WS entities having variable levels of skill and experience in implementing WDM is addressed for each of the issues in detail in Chapter 4.

51. The EA needs to acknowledge that some annual operating instructions include specific conditions on implementation of nonlethal methods designed to reduce conflicts such as mandatory night penning behind electric panels.

Specific restrictions or requirements for WDM are addressed in work plan meetings. We have reviewed the example provided and consulted with the applicable land management agency. The commenter has misinterpreted the provisions of the document. The operating instructions were prepared to provide guidance to the permittee on acceptable use of fladry in the event that the permittee chose to use this method. It did not require use of fladry.

52. WS should consider the Blackfoot Challenge.

The Blackfoot Challenge is a landowner-based group that coordinates management of the Blackfoot River, its tributaries, and adjacent lands. It is organized locally and known nationally as a model for preserving the rural character and natural beauty of a watershed. The mission of The Blackfoot Challenge is to coordinate efforts that conserve and enhance the natural resources and rural way of life in the Blackfoot River Valley for present and future generations (http://blackfootchallenge.org/). Although establishment of this sort of system is outside the scope of WS-Wyoming authority, WS-Wyoming could participate in such a program under Alternatives 1 and 2.

53. WS should consider the Greater Yellowstone Coalition Wild Neighbors program.

Guidance on strategies to reduce conflicts with wolves similar to those provided by the Wild Neighbors program is part of the technical assistance that could be provided by WS-Wyoming under Alternatives 1 and 2.

54. WS needs to consider the Greater Yellowstone Coalition Alternative.

Discussion of this alternative has been added to Section 3.5.12 and for reasons presented in that section will not be addressed in detail.

55. WS needs to consider an alternative that would not use lethal WDM on public land. It is not sufficient to dismiss this alternative from detailed consideration because someone else will do similar work. The EA does not provide adequate evidence that other entities could do similar work.

This alternative is addressed in EA Section 3.5.13 and for reasons presented therein, will not be considered in detail. We do not concur that there is insufficient evidence to conclude that other entities would conduct WDM at levels similar to WS-Wyoming – See Response 50.

AFFECTED ENVIRONMENT

56. Does the EA fail to consider baseline conditions? Should the baseline be the status of the environment in the absence of, or even with lower levels of WDM, if others "would likely" conduct the action in the absence of WS-Wyoming?

CEQ provides two distinct interpretations of "no action" for the purposes of NEPA analyses. In the first case, for new projects which have not been initiated, "no action" refers to situations in which the proposed action would not take place. The second interpretation involves ongoing conditions such as WDM in Wyoming and may be defined as "'no change' from current management direction or level of management intensity." (Council on Environmental Quality 1981). Wolf removals for damage management have been used in Wyoming since shortly after wolf reintroduction (Section 1.4.5). An environment with no WS-Wyoming in it would be a choice that changes baseline conditions and has been analyzed in this EA as such (Alternative 3). CEQ also states that when a choice of "no action" by the agency (in our case – no WDM by WS-Wyoming) would result in predictable actions by others, this consequence of the "no action" alternative should be included in the analysis. As noted in Response 50, WS believes there is sufficient reason to conclude that lethal WDM actions by entities other than WS-Wyoming under Alternatives 2 and 3 would be similar to lethal WDM actions by WS-Wyoming under Alternative 1.

57. Does the EA fail to adequately describe WS-Wyoming PDM actions? The EA needs to provide information on how often it will employ each method.

We disagree with the assertions that the EA fails to adequately describe Alternative 1. Alternative 1 is thoroughly described throughout Sections 3.2.1, 3.3 and 3.4. The APHIS-WS Decision Model is described in detail in Section 3.3.3, including Figure 3-1 and in (Slate et al. 1992). We have provided information on the extent to which each lethal method is used to Section 3.4.1. The inclusion of information on how often various methods will be used, where each method will be used, and which methods will be used in each situation is not feasible due to the unpredictable and sporadic nature of many predator damage incidents.

58. Does providing lethal PDM for free incentivize producers to not take action to prevent predation or even result in producers allowing animals to be killed in order to have predators killed as indicated in an article presented in comments?

We believe the material cited by (Bergstrom et al. 2014) represents an extreme opinion and does not reflect the attitudes or behavior of the industry as a whole. WS does not believe a reasonable producer would work to induce predation on livestock in a situation where no predation is occurring just to trigger lethal PDM. Such activity defies reason, is economically unjustified, and would be a poor business practice. WS-Wyoming is not aware of any producers who avoid taking predation action or allow animals to be killed in order to trigger lethal WDM.

The WS-Wyoming WDM program is not "free" to livestock producers. Producers contribute to the cost of the program via brand inspection fees on the sale of livestock.

59. Why are bounties less likely to be specific for the target animal than WS-Wyoming actions?

Bounties generally offer a cash reward for evidence that an animal has been lethally removed (e.g., tail, ears, or whole carcass). However, there is usually no reasonable way to confirm that the animal taken was removed from the area of interest instead of being removed from another site where location and removal of animals may be more convenient. See Response 28 above for information on specificity of WS-Wyoming actions for depredating wolves.

60. The assessment of impacts on the wolf population needs to include additional details on direct, indirect and cumulative impacts of WDM. Commenters also expressed concerns that cumulative impacts on the wolf population could jeopardize population recovery.

We received requests to add additional information on impacts of lethal WDM on pack structure and stability, increases in stress hormones and reproductive hormones in wolves and other direct and indirect impacts on wolf population. Commenters referenced a Washington wolf plan statement that excessive removals could jeopardize wolf recovery. We have augmented the analysis of impacts on the wolf population, especially in Section 4.3.1.2, to address these issues and other research subsequently identified by the agency, provide greater detail on impacts in the WTGMA and Predatory Animal Zone and more clearly delineate direct, indirect and cumulative impacts. Analysis of impacts on the wolf population in the EA indicate that, given the protective measures established by the state and this EA, the cumulative impacts from the proposed action are not of sufficient magnitude, or extent to jeopardize wolf population recovery. These conclusions are consistent with the findings made by the USFWS when it delisted the NRM DPS of gray wolves, a decision upheld by the federal courts.

61. Will cumulative impacts on the wolf population adversely impact population genetics, connectivity and the ability of the wolf population to expand into new areas?

Genetics and connectivity issues for the NRM wolf population are addressed in EA Sections 1.6, 1.6.3, 1.6.6, 4.3.1 and in Section 4.3.1.2. Analysis in the USFWS proposals to delist wolves, and in this EA indicate that given agency commitments to population monitoring and management, the proposed wolf removals will not have a significant adverse impact on wolf population connectivity or genetics in the NRM wolf population. Analysis of impacts of the proposed action on the potential for NRM wolf population indicate that although wolf hunting seasons and wolf removals for damage management occur in Idaho, Montana and Wyoming, the wolf populations in these states remain well above thresholds for delisting and the gray wolf population in the western United States continues to expand into new states and regions, with breeding packs now in Washington (Washington Department of Fish and Wildlife et al. 2018), and Oregon and California (Oregon Department of Fish and Wildlife 2018).

62. Is the EA's Section 4.3.1.2 statement that, "The USFWS 2015 post-delisting review of the Northern Rocky Mountain gray wolf population indicated that none of the factors that would trigger a status review had been met and that the NRM wolf population continued to exceed recovery goals (Jimenez 2016)." and statement in Section (The GYA is expected to continue to support large populations of ungulates, and Wyoming will continue to maintain ungulate populations at densities that can support a recovered wolf population well into the foreseeable future (76 FR 61782)." warranted given that CWD has been moving into the state?

WGFD has a management plan for CWD in the state. The plan indicates that while early models of CWD predicted catastrophic impacts on affected ungulate populations, more recent modeling indicates more moderate impacts and that some populations may be able to persist through a combination of disease-driven natural selection and modifications to hunting seasons (Wyoming Game and Fish Department 2016). Given the population monitoring and adaptive management strategy outlined in the state

management plan and the findings of recent research like that of Robinson et al. (2012) and Williams et al. (2014), we believe these statements are still appropriate reflections of current and anticipated future conditions and agency commitments. Annual monitoring conducted for this EA would enable the program to monitor the status of the state wolf population and adjust management actions and the EA as needed if prey limitations appear to be adversely impacting the state wolf population.

63. The EA needs to consider additional information on the indirect impacts of wolf removals on trophic cascades, mesopredator release, and the positive ecological impacts of wolf reintroduction.

We received numerous suggestions for publications to be considered in the EA. We have reviewed the recommended material and additional publications that have recently become available and have augmented Sections 1.4 and 4.3.1.6 to address these issues. The new information improves our understanding of the role of wolves in ecosystems and the mechanisms by which wolves may impact prey populations and trophic cascades, but does not change the nature of WS proposed action or our conclusions regarding the magnitude, duration, frequency or extent and duration of impacts from wolf removals.

64. The EA needs to provide greater detail on results of T&E species consultations.

We have provided summaries of key points from the Section 7 consultation in Section 4.3.1.6. This information has not changed the conclusion of the consultation or WS consideration of WDM impacts under the 3 alternatives. Although these sections provide additional information on the WS and USFWS thought process and protective measures, they do not change the conclusions presented in the pre-decisional EA. Copies of WS-Wyoming Section 7 consultations are available through FOIA request.

65. WS needs to consider the issues presented in the 2013 Petition for Rulemaking submitted by the Center for Biological Diversity, Project Coyote, Animal Welfare Institute and Animal Legal Defense Fund regarding the national WS program.

Strictly speaking, petitions for nationwide program action involving all types of wildlife damage management are outside the scope of the analysis. Nonetheless, WS prepared a detailed response to each of the concerns presented in the petition and we are incorporating those responses by reference herein.

66. WS should consider Washington programmatic Section 7 consultation.

While we appreciate the suggestion, WS ESA Section 7 consultations are developed to meet the individual needs and proposed activity for the area addressed. We believe the consultations conducted for the WS-Wyoming activities are best suited to meet program needs and protect federally-listed species in the state.

67. Is the EA conclusion that most WDM work will not be conducted in occupied grizzly bear habitat correct? Won't wolves and grizzly bears be attracted to concentrations of cattle in the upper green grazing operations?

The consultation in question covers all WS-Wyoming wildlife damage management activities in the state including predator damage management activities addressed in USDA Wildlife Services (1997;1998). We agree that WDM may be conducted in areas where grizzly bears occur and Section 4.3.1.6 provides details of protective measures established in consultation with the USFWS to reduce risks to grizzly bears from the proposed action.

68. WS should not be allowed to kill nontarget coyotes captured during WDM activities. This is giving the program permission to kill coyotes whenever it comes upon them regardless of need. If the program is going to kill coyotes without proof of depredation then WS needs to analyze the impacts of the removal on the ecological role of coyotes.

It is not unusual for properties where WS is requested to conduct WDM for wolf damage to also have a history of conflicts with coyotes. Coyotes caught in WDM equipment may be euthanized if the property has ongoing conflict with coyotes or a history of coyote conflicts that would otherwise trigger a need for proactive coyote damage management at the site as described in USDA Wildlife Services (1997;1998). Information in Section 4.3.1.6 has been corrected accordingly. WS incidental take of coyotes associated with WDM activities is negligible relative to other known sources of coyote mortality discussed in EA Section 4.3.1.6 and does not warrant the detailed analysis noted by the commenter.

69. WS's other programs will add to cumulative adverse impacts on nontarget species including risks to federally protected species such as grizzly bear and lynx. The EA fails to consider cumulative impacts of its PDM program to kill other species such as bears.

WS Section 7 consultations referenced in the EA address all WS-Wyoming wildlife damage management activities including WDM and, as such, represent cumulative impacts on the population. As noted in Section 4.3.1.6, WS-Wyoming unintentional take of nontarget species is extremely low relative to known species population size and range and does not contribute substantially to cumulative impacts from other WS-Wyoming wildlife damage management activities or other known sources of mortality such as licensed hunting and trapping (Section 4.3.1.6 and Table 4-3). For species which may also be targeted for wildlife damage management, cumulative take from all known sources of mortality is considered.

70. WS needs to consider Treves et al. (2017) Predators and the Public Trust.

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

Many of the issues addressed by (Treves et al. 2017) are outside the scope of this EA (e.g., appointment of public trustees for natural resources, the role of agencies, courts and regulations in framing wolf management policy). Other issues, such as the role of lethal methods for wolf management in changing public attitudes are addressed herein. Within the constraints of WS-Wyoming decision-making, we believe that the proposed EA works in good faith to preserve wolf populations and their role in ecosystems for current and future generations. The USFWS has approved the WGFD wolf management plan as a viable strategy for preserving the state wolf population for future generations in accordance with requirements of wolf recovery under the ESA and consistent with the mission and direction of the WGFD. WS-Wyoming monitoring of program actions will help to ensure that new information on wolf biology, the role of wolves in ecosystems, efficacy of nonlethal and lethal WDM methods, and the human dimensions of wolf management are considered and included in program decision-making, as appropriate.

71. WS needs to consider Bergstrom et al. 2013, Bruskotter et al. 2015b, Bruskotter et al. 2015a, George et al. 2016, and Chapron and Treves 2016 regarding scientific and social controversy regarding the role of WDM in enhancing public tolerance of wolves. The EA fails to consider opposing opinions that challenge the efficacy of lethal predator control. Where scientific uncertainty is present WS-Wyoming must openly analyze the reputable opinions contrary to its proposed action - an EIS is needed to fulfill this consideration.

(Bruskotter et al. 2015a) survey results suggest that 82% and 81% of Ohio and U.S. residents, respectively, consider wildlife to have intrinsic value. The varied human values and attitudes towards wildlife including the belief that wildlife have intrinsic value are addressed in EA Section 3.2.4. (Bruskotter et al. 2015b) questions the premise that use of lethal methods can improve tolerance of some species. Key information relative to this assertion comes from studies of public attitudes towards wolves in Wisconsin and estimates of poaching in Wisconsin (Treves et al. 2013, Chapron and Treves 2016a). The findings of (Treves et al. 2013) are addressed in the EA at Section 3.2.3, and indicated that negative attitudes towards wolves had increased over time. However, inferences regarding the role of WDM programs that include access to lethal WDM methods in Wisconsin are confounded by the changing political, regulatory and legal issues surrounding wolf management in the state (Olson et al. 2015).

Chapron and Treves (2016a) conducted an assessment of wolf population trends in Wisconsin and concluded that poaching increased during periods when lethal methods were permitted for WDM. (Chapron and Treves 2016a;b) concluded that changes in Wisconsin wolf population growth rates that they detected were attributable to variations in poaching resulting from policy changes that allowed for lethal wolf removal. Their conclusions were counter to the commonly held belief that effective WDM, including integrated use of nonlethal and lethal management strategies is necessary to improve tolerance of wolves and wolf population recovery. There has been considerable debate in the literature over the conclusions found in (Chapron and Treves 2016a;b). NWRC concerns regarding the publication have subsequently been published (Pepin et al. 2017) along with critical reviews by other authors (Olson et al. 2017, Stien 2017) and rebuttals by Chapron and Treves (Chapron and Treves 2017a;b). In this EA, discussion of the impact of WDM on individual behavior is limited to consideration of the likelihood that livestock producers and other individuals experiencing conflicts with wolves may resort to inappropriate, ineffective or illegal solutions for their wolf conflicts that could have more impacts than if assistance was provided by WS-Wyoming. We are concerned that Chapron and Treves (2016a, b) provides insufficient information regarding which individuals are poaching to make informed determinations regarding factors that influence an individual's choice to poach. Most poaching in Wisconsin appears to occur during the deer and bear hunting seasons. There is no direct link between WDM actions and perceptions of hunters, especially in Wisconsin where WDM is not conducted for the enhancement of game species populations, and substantial portions of hunters may be from outside the area impacted by WDM. An alternative hypothesis could include that the inferred difference in poaching rates was attributable to individual determinations regarding the relative legal risk of poaching, instead of a short-term, reversible, change in attitudes towards wolves. Under this hypothesis, legal risks associated with poaching may be perceived as lower during periods when protections under the ESA were reduced and lethal WDM was permitted.

WS remains committed to responding to wolf damage in the most ecologically sound and effective ways possible. Non-lethal methods, where effective and reasonably economical, are always preferred. In cases requiring the lethal removal of individual wolves, every effort is made to conduct WDM aimed at the specific wolves involved, to resolve specific depredation problems, however we recognize that the predatory behavior of packs and shared use of prey means that more than one individual from a pack will likely be involved in depredation events. WS takes concerns over potential population-level effects very seriously. However, the conclusions on the effect of lethal wolf control on wolf population health reported by (Chapron and Treves 2016a) have been criticized by several prominent authors (Olson et al. 2017, Pepin et al. 2017, Stien 2017), and these criticisms have in turn been refuted (Chapron and Treves 2016b;2017b;a). WS understands this is how the scientific process works and that progress on this issue

will likely continue into the future. However, given the concerns stated above regarding the link between WDM and the individuals who may engage in poaching and in the absence of consensus on this important matter, WS does not believe that a change in strategy is warranted at this time. As always, WS will continue to monitor relevant research and respond accordingly to relevant findings.

Bergstrom et al. (2014) discuss concerns regarding the national WS program and the programs use of lethal WDM methods including questioning the efficacy of lethal WDM methods. However, conclusions made by Bergstrom et al. (2014) regarding the efficacy of lethal methods were based on the mistaken conclusion that long-term reduction of predator populations is the goal of all modern WDM programs. Under this premise, Bergstrom et al. (2014) contend that WS lethal removals of wolves are ineffective because they are not of sufficient intensity to cause long-term population reductions. As stated throughout the EA, the goal of WS-Wyoming WDM actions is to reduce damage, not to cause long-term reductions in the wolf populations.

Bergstrom et al. (2014) made several recommendations they felt would improve the WS program including emphasizing nonlethal methods for reducing conflicts, sparing use of lethal methods that are species-specific, discontinuing lethal control in federal wilderness areas and discontinuing use of lethal methods to help enhance game species. As noted in the EA, under the proposed action, WS-Wyoming would continue to provide technical support on practical and effective nonlethal methods that can be used to resolve conflicts with wolves and operational assistance within the constraints of available resources. Consultation with the land management agency and minimum tools assessments would be conducted before conducting WDM in wilderness areas. WS-Wyoming will not be involved in WDM to enhance game species populations. (Bergstrom et al. 2014) also expressed concerns regarding the impact of predator removals on ecosystem function. This issue was already addressed in Section 4.3.1.6.

NEED FOR AN EIS

72. Do the alternatives have significant costs warranting the preparation of an EIS?

No, implementation of the preferred alternative would not result in significant costs warranting preparation of an EIS. All field expenses for WS-Wyoming WDM are paid by WGFD and the Wyoming Animal Damage Management Board which are committed to providing WDM assistance to citizens of the state. Decisions to allocate resources for WDM by these entities are not subject to NEPA review.

73. Is an EIS needed to address the profound impacts of livestock grazing because WS-Wyoming WDM activities are connected actions essential for livestock grazing on public lands?

No, an EIS is not needed. Determinations to allow livestock grazing on public lands and the manner in which livestock grazing is managed on public lands have been made by Congress and State legislatures, and the applicable state and federal land management agencies, not WS. WS lacks jurisdiction to allow, direct or prohibit livestock grazing on public lands. Because it has no ability to control livestock grazing, NEPA's rule of reason does not require WS to analyze the impacts of livestock grazing as a connected action. Environmental impacts of livestock grazing on federal lands are already addressed by the applicable land management agency. Although WDM is important to individual livestock producers, only a small proportion of producers are impacted by wolf predation. As noted in the discussions of Alternatives 2 and 3, producers are not required to use WS-Wyoming assistance with WDM. Consequently, WDM assistance by WS-Wyoming is not a necessary connected actions for all livestock grazing on public lands. See Also Response 15.

74. Is an EIS needed because the proposed action will have significant individual, indirect and cumulative impacts on the state and regional wolf population? An EIS would be needed because WS take would be more than 10% of the population, and that's a significant impact.

No, an EIS is not needed. Analysis in the EA indicates that during the period while wolves were federally-listed the wolf population in the state and NRM DPS increased in size and range despite lethal removal of wolves for damage management in Idaho, Montana and Wyoming (EA Section 4.3.1.2). A review of cumulative impacts of the alternatives indicates that states are managing cumulative impacts on wolf populations in accordance with delisting requirements set by the USFWS to ensure the continued recovery of the species and in accordance with state wolf management plan. We acknowledge that in some states, wolf populations have declined but note that these declines are consistent with state management goals and that states are adjusting rates of licensed harvest or relaxing requirements for take (e.g., the Wyoming Predatory Animal Zone) so that cumulative impacts achieve the desired results. Analysis in Sections 4.3.1.2, 4.3.2.2, and 4.3.3.2 indicates that there would likely be similar cumulative impacts in the absence of WS-Wyoming involvement in WDM. Given that WDM actions similar to the proposed action did not impair recovery of wolf population and that WS-Wyoming involvement in WDM will have little impact on the cumulative consequences for the wolf population now that wolves are delisted, we conclude that the proposed action is not of sufficient magnitude, extent or duration to result in a significant impact on the wolf population. We understand that some people object strongly with the current state of wolf management policies and objectives, but these issues cannot be remedied by WS through the NEPA process.

75. Is an EIS needed because the proposed action could result in unintentional take of ESA listed threatened grizzly bear or Canada lynx?

No, an EIS is not needed because an EA might result in unintentional take. As with all other impacts, the magnitude, duration, frequency and geographic extent of the impact must be considered. Biological Opinions from the USFWS concluded that it was possible for WS-Wyoming wildlife damage management actions (all actions combined) to result in the incidental take of grizzly bears and Canada lynx. The USFWS determined that the potential incidental take would not result in jeopardy to the grizzly bear population when considered individually and in context of all other impacts on the species populations. Section 7 consultations with the USFWS help identify risks to listed species but they also help agencies identify measures which may be implemented to reduce risks. WS implements all reasonable and prudent measures and terms and conditions for the protection of Canada lynx and grizzly bears identified by the USFWS. There has been no take of Canada lynx by WS Wyoming in the last 20 years and only one take of Canada lynx by WS operations within the range where lynx are federally-listed as threatened over the same interval. Over the period from 1992 through 2018, WS-Wyoming has unintentionally captured 7 grizzly bears during wildlife damage management activities with the last instance of incidental take of a grizzly bear in 2012. All but one of the captured animals were in good enough condition that they could be released on site. During this period, the Greater Yellowstone Ecosystem Population of the grizzly bear has increased in size and range (82 FR 30502-30633). Consultation with the USFWS indicates the proposed action may affect but is unlikely to adversely affect or will have no effect on all other ESA listed species in the state. Given this information, WS impact on T&E species is not of sufficient magnitude, frequency, duration or extent to constitute a significant impact and warrant preparation of an EIS.

76. The EA does not contain sufficient documentation to support assumptions and put public on notice as to how much WDM might occur which results in serious unknown risks associated with the highly uncertain programming scheme of Wyoming WS. WS does not estimate capture injury or death of non-target animals. WS fails to estimate the number of wolves or coyotes that would be killed by program. An EIS is needed because of this uncertainty.

We do not agree that there is significant uncertainty associated with the proposed action warranting preparation of an EIS. The EA delineates the procedures that will be used to determine the WDM action to be taken in the WTGMA and the Predatory Animal Zone including a detailed description of the WS Decision Model. The EA provides a limit on the number of wolves which may be taken as a percentage of the population, so that WS-Wyoming take will adjust to increases and decreases in the state wolf population. We have provided information on WS-Wyoming take associated with past activities and provided information indicating that future risks would be similar to past actions. WS-Wyoming take of most nontarget species associated with the proposed action is extremely low and not of sufficient magnitude, duration, frequency or geographic extent to substantially impact nontarget species populations or contribute in a substantive way to cumulative impacts from any other source of mortality. WS-Wyoming take of coyotes is also low, but higher than other forms of take. WS-Wyoming has analyzed cumulative impacts on the coyote population from all WS-Wyoming wildlife damage management activities and estimates of public take and determined that cumulative impacts would have a moderate but not significant impact on the state coyote population.

77. Killing predators is highly uncertain and controversial - both scientifically and socially

The failure of any particular organization or person to agree with every act of a federal agency does not create controversy regarding effects. Dissenting or oppositional public opinion, rather than concerns expressed by agencies with jurisdiction by law or expertise and/or substantial doubts raised about an agency's methodology and data, is not enough to make an action "controversial." The EA provides a detailed analysis of the differences in public perceptions and values relative to wolves in Sections 4.3.1.4 and 4.3.1.5 including a discussion of the findings of George et al. (2016). See Response 71 above for discussion of Bergstrom et al. (2014), Bruskotter et al. (2015a), Bruskotter et al. (2015b), and Chapron and Treves (2016a).

78. The important role of wolves in ecosystems cannot be adequately addressed in an EA - an EIS is needed. There is substantial uncertainty because one may never be able to determine or quantify the negative consequences that result from wolf removal and loss of ecological benefits.

We do not agree. A number of studies are presented in the EA that quantify the impact of wolves on ecosystems. The analysis in the EA has been augmented to address the impacts on the potential role of wolves in native ecosystems in detail. See EA Sections 1.5 and 4.3.1.6. Sufficient information exists on the direct and indirect effects of wolf removals on wolf populations and their associated function in ecosystems to reasonably predict the consequences of the alternatives presented. The WGFD wolf management plan includes adequate provisions for the preservation of a healthy and sustainable wolf population in the state including monitoring the age and sex of wolves taken through hunter harvest and management actions, data on the size of wolf packs, and information on the number of wolves, breeding pairs and packs in the WTGMA. The State of Wyoming has determined that the Predatory Animal Zone is not well suited to supporting the sustained presence of wolves and is managing the state wolf population accordingly. Although we understand that some individuals may desire greater wolf presence and wolf role in ecosystems in the Predatory Animal Zone, WS-Wyoming lacks the authority to direct the wolf management policies of the State of Wyoming.

79. The EIS is needed because the program may and likely will have significant direct and cumulative effects including beneficial and adverse impacts. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

We do not agree. The program has not been broken down into small component parts. Impacts to the wolf population are addressed at the Management Zone, State and Regional level. In EA section 4.2, we note that the significance of an impact must be assessed in terms of its magnitude, duration, frequency and geographic extent. The temporal nature of WS-Wyoming WDM actions is relevant, particularly in context of the high proportion of cooperators (80% in the WTGMA and 70% in the Predatory Animal Zone) who have only requested WS-Wyoming assistance with lethal WDM once over the period of 2013-2018.

80. Significant beneficial impacts to WS-Wyoming service recipients is sufficient cause to prepare an EIS.

As noted in Section 1.4 of the EA, wolf predation on livestock and other conflicts with wolves are only one of many challenges facing livestock producers. Only a small proportion of livestock producers in the state experience wolf predation. Consequently, although WS-Wyoming assistance can be important for individual producers, it is not of sufficient magnitude, frequency, duration or geographic extent to have a significant impact on the livestock industry in the state. See Response 15 above.

81. An EIS is needed to provide details on the types of actions which may be conducted on different federal land classes.

WS does not agree. Land management plans of the respective state and federal agencies are developed with public involvement, including analysis pursuant to the NEPA for actions on federal lands. WS-Wyoming conducts annual consultations with these agencies to identify areas of concern and protective measures that may be needed to protect sensitive species and their habitats, human and pet safety, minimize conflicts with recreational activities and address other resources of concern. WS-Wyoming will not conduct WDM actions on public lands without ensuring the action is consistent with the applicable land and resource management plans, as well as land management agency regulations and policies. See Responses to issues 35-37.

5.2 ISSUES ALREADY ADDRESSED IN THE EA

- **Are wolves a native or introduced species?** Section 1.3
- **General comments about the importance of wolves in ecosystems and need to pick an alternative that preserves ecosystem benefits.** Ecological benefits of wolves are addressed in Section 1.5.3 and in analysis of nontarget species impacts in Sections 2.3.6, 4.3.1.5. 4.3.1.6, 4.3.2.5, 4.3.2.6, 4.3.3.5, and 4.3.3.6.
- **Comments noting that WDM was identified as important to wolf population restoration in 1994 USFWS 10j rule [at 50 CFR 17.84(i) (3) (vii)].** Section 1.4.3
- **EA needs to provide data on efficacy of individual management methods.** References to studies on the efficacy of key management methods is provided in EA Sections 3.4.1 and 3.4.2.
- **Differences in opinions regarding the humaneness and appropriateness of WDM methods including lethal methods**. Sections 4.3.1.4, 4.3.1.5, 4.3.2.4, 4.3.2.5, 4.3.3.4, and 4.3.3.5.
- **Need to resolve conflicts with exclusive use of nonlethal method. Please protect wolves.** EA analyzes a nonlethal only alternative in detail. Impacts on wolf population is considered for each of the alternatives analyzed in detail.
- **WS should use electric fences, shed-lambing, fencing, electronic sensors and noise-making devices [RAG devices], carcass removal, increased human presence, livestock guarding dogs and other such tools singly or in combination.** All of these methods may be used or recommended by WS-Wyoming under Alternatives 1 and 2. Section 3.4.

- **WS should exhaust all feasible nonlethal methods before resorting to lethal control.** Section 3.5.10.
- **General statements that the EA needs to consider sociological and ecological benefits of wolves.** Benefits to public as a whole are addressed in Section 1.5 and in associated review of impacts of the proposed action on nontarget species and sociological issues including recreation and aesthetic value.
- **Risk to nontarget species from traps and snares and the number of nontarget species that might be taken under each of the alternatives**. Addressed in EA 4.3.1.6, 4.3.2.6, 4.3.3.6.
- **Need to work to reduce risks to grizzly bears.** Section 7 consultation paraphrased in Section 4.3.1.6.

5.3 ISSUES OUTSIDE SCOPE OF ANALYSIS BECAUSE WOLVES ARE NO LONGER PROTECTED UNDER THE ESA

- **Appropriateness of using lethal methods to manage conflicts with a species protected under the ESA.**
- **Appropriateness of stating that the management agencies have not established requirements for nonlethal before lethal methods may be used.** USFWS had established requirement that lethal may only be used "only after other methods to resolve livestock depredation have been exhausted" 50 CFR 17.84(i)(3)(7).
- **Is removal of an ESA listed species on public land a violation of public trust?**
- **Information on the process used to get USFWS permission to use lethal methods for WDM while wolves were protected under the ESA**
- **An EIS is needed because WS-Wyoming is proposing to remove wolves from a population that has not met federal recovery goals in terms of size and range of the population.**
- **Absence of a USFWS-approved state wolf management plan.**

5.4 ISSUES OUTSIDE THE SCOPE OF THE ANALYSIS

- **Concerns that wolves are limiting specific elk populations.** See Section 1.4.
- **Issues of whether or not livestock grazing on public lands is or should be subsidized.** WS does not have authority for management of grazing on public lands.
- **Use of Nass (1977, 1980), Howard and Shaw (1978), Howard and Booth (1981) and O'Gara et al. (1983).** None of these publications were used in the EA.
- **Opinions regarding the use of toxicants including Livestock Protection Collars and M-44s.** There are no toxicants registered or proposed for WDM.
- **Management of wolves in states outside Wyoming.** WS-Wyoming has no authority for WDM or general wolf management decisions outside Wyoming. This EA does consider cumulative impacts of wolf take on the regional wolf population (Section 4.3.1.2, 4.3.2.2, and 4.3.2.3.).
- **Impact of livestock grazing on riparian zones.** Determinations to allow livestock grazing on public lands and the manner in which livestock grazing is managed on public lands have been made by Congress and State legislatures, and the applicable State and federal land management agencies, and not WS. WS lacks jurisdiction to allow or regulate livestock grazing on public lands.
- **Use of bear repellent for WDM –** No repellents are registered for use with wolves.
- **Circumstances under which livestock owners and other private citizens may legally take wolves.** Wolves are currently managed by the WGFD, WDA and tribes (Wyoming Game and Fish Commission 2011;2012). WS-Wyoming does not have the authority to dictate the terms and conditions of wolf management to the state or tribes. This issue is outside the scope of this EA.

- **Desire for or opposition to a hunting season for wolves.** WGFD and WGFC determine the nature and extent of any wolf hunting seasons in the WYO (Wyoming Game and Fish Commission 2011;2012). WS has no authority to either authorize or disallow hunting or trapping seasons for wolves. This issue is outside the scope of any decision that WS could make in conjunction with this EA.
- **Appropriateness of livestock grazing on public lands.** Regulating or authorizing livestock grazing on public lands is the responsibility of the respective public land management agency. The authority and regulation of livestock grazing on public lands is outside of WS' authority and therefore outside the scope of this EA.
- **Producers should pay all costs of lethal WDM.** All field operations for WDM are paid by the WGFD and ADMB. Decisions by these entities to fund particular WDM methods are outside the scope of WS-Wyoming authority.

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APPENDIX A

DEPREDATION INVESTIGATION FORM

The following form is used by the WGFD when investigating wolf depredation reports in the WTGMA. On the occasions when WGFD asks for WS-Wyoming assistance with wolf depredation investigations, WS-Wyoming also uses this form. The WDA has stated that it does not want a report for depredation investigations in the Predatory Animal Zone, but WS-Wyoming does record the conclusion of the investigation in the WS MIS database.

Wyoming Game and Fish Department/USDA-APHIS-Wildlife Services
LIVESTOCK DAMAGE AFFIDAVIT

DATE _____ 20_____

LOCATION _____

T _____ R _____ S _____

AND/OR UTM _____

The following domestic livestock damage was inspected:

LIVESTOCK TYPE _____
NUMBER _____
SEX _____
AGE _____
EAR TAG _____
BRAND _____
CAUSE OF DEATH _____

EVIDENCE USED TO DETERMINE CAUSE OF DEATH/DAMAGE:

_____

_____

_____

_____

NAME OF LIVESTOCK OWNER/AGENT

_____

WY GAME AND FISH EMPLOYEE and/or WILDLIFE SERVICES SPECIALIST

_____

ACTION TAKEN: _____

DISPOSITION OF PARTS: _____

Any landowner, lessee or agent whose property is being damaged by any trophy game animal shall, not later than fifteen (15) days after the damage is discovered by the owner of the property or the representative of the owner, report the damage to the Game Warden or Regional Wildlife Supervisor. Wildlife Services personnel will not be considered the agent of the landowner nor the representative of the landowner and shall not have the responsibility to notify the Game and Fish Department of damage by trophy game animals.

WHITE to WGFD; YELLOW to Livestock Owner; PINK to USDA-APHIS-WS

COPY TO: _____ DATE: _____

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APPENDIX B

AUTHORITY AND COMPLIANCE

Authority of Agencies[19] in Wildlife Damage Management in Wyoming

USDA-APHIS-Wildlife Services

USDA is authorized and directed by law to protect American agriculture and other resources from damage associated with wildlife. The primary statutory authority for USDA is the *Act of March 2, 1931* and the *Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988 (7 USC 426-426c; 46 Stat. 1468)*, as amended in the Fiscal Year 2001 Agriculture Appropriations Bill, which provides that:

"The Secretary of Agriculture may conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program. The Secretary shall administer the program in a manner consistent with all of the wildlife services authorities in effect on the day before the date of the enactment of the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2001."

Since 1931, with the changes in societal values, APHIS, WS policies and programs place greater emphasis on the part of the Act discussing "bringing [damage] under control," rather than "eradication" and "suppression" of wildlife populations. In 1988, Congress strengthened the legislative authority of APHIS, WS with the Rural Development, Agriculture, and Related Agencies Appropriations Act. 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."

Under the Act of March 2, 1931, and 7 U.S.C. §§426c, APHIS may carry out these wildlife damage management programs itself, or it may enter into cooperative agreements with states, local jurisdictions, individuals and public and private agencies whereby they may fund and assist in carrying out such programs. Id. These laws do not grant any regulatory authority. Therefore, there are no regulations promulgated under these statutes for wildlife services or animal conflict management activities.

U. S. Fish and Wildlife Service (USFWS)

The USFWS has the statutory authority to manage federally-listed T&E species through the Endangered Species Act of 1973 (ESA) (16 USC 1531-1543, 87 Stat. 884). Authorization, under Section 10 of the ESA, permits the USFWS to manage T&E species damage in accordance with USFWS's plans and rule making (*i.e.*, Interim Wolf Control Plan, 50 CFR Part 17.84, USFWS 1994, 70 FR 1286, 73 FR 4720, 74 FR 15123, 76 FR 61782) and through MOU and Interagency Agreement. WS is authorized to assist the USFWS in reducing wolf predation to livestock on private and public land in Wyoming.

Wyoming Game and Fish Department

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 (Wyoming Statute 23-1-103, 302). By Wyoming statute and policy, the state provides for the conservation of lands, protection of natural resources, wildlife and public lands (Wyoming Statute 11-16-103). WGFD is also authorized to cooperate with WS and the WDA for controlling predatory animals (Wyoming Statute 11-6-104, 107, 108).

The Chapter 56 permit process authorizes the Chief Game Warden or his designee to take (kill) any wildlife in Wyoming when, in his judgment, the taking is necessary due to substantial damage to property or the creation of a human health and safety hazard. This regulation is promulgated by authority of Wyoming Statute 23-1-302(a)(viii)and(xxii).

Wyoming Department of Agriculture (WDA)

The WDA is authorized to enter into Cooperative Agreements with WS and local entities for reducing damage caused by predatory animals or to administer such programs (Wyoming Statute 11-6-104). The WDA is also responsible for the issuance of permits for aerial shooting per the Fish and Wildlife Act of 1956, as amended (Wyoming Statute 11-6-105). The WDA currently has an MOU, Cooperative Agreement, and Work Plan with WS. These documents establish a cooperative relationship between WS and WDA, outline responsibilities, and set forth annual objectives and goals of each agency for resolving wildlife damage management conflicts in Wyoming.

Wyoming Animal Damage Management Board

The Wyoming ADMB was created for the purposes of mitigating damage caused to livestock, wildlife, and crops by predatory animals, predacious birds, and depredating animals or for the protection of human health and safety (Wyoming Statute 11-6-303). The ADMB may adopt rules and regulations, and enter into cooperative agreements with boards of county commissioners, predator management districts, federal or state agencies, or other commissions, organizations or associations for these purposes, and shall maintain responsibility, and appropriate funds for, such activities (Wyoming Statute 11-6-304). The ADMB has entered into a MOU with the Wyoming Game and Fish Commission, the Wyoming Department of Agriculture, and WS-Wyoming for wildlife damage management. The ADMB also has a Cooperative Service Agreement with WS-Wyoming to investigate livestock depredations and conduct wildlife damage management activities to control damage caused by wolves in areas of the state where they are designated as predatory animals.

County Predatory Animal Districts

Each county in Wyoming is legislatively designated as a predatory animal district (Wyoming Statute 11-6-201) with the authority to hold property and be a party to suits and contracts. The individual districts have the responsibility to: *"exercise general supervision over the predatory animals that prey upon and destroy livestock, other domestic animals and wild game"* within the boundaries of the county (Wyoming Statute 11-6-205). Therefore, the individual County Predatory Animal District Boards determine how predator control is to be conducted within their respective domains, and administer funds collected from the brand inspection fees (and other sources) for that purpose (Wyoming Statute 11-6-210). Some choose to conduct their own programs with little or no WS-Wyoming involvement. Teton and Platte Counties have chosen not to establish Cooperative Agreements with WS-Wyoming and 8 counties (Sheridan, Johnson, Natrona, Campbell, Converse, Niobrara, Laramie and Crook) only have agreements for limited services (e.g. aerial operations).

U.S. Forest Service and Bureau of Land Management

The U. S. Forest Service and Bureau of Land Management have the responsibility for managing Federal lands for multiple uses, including livestock grazing, timber production, recreation and wildlife habitat, while recognizing the State's authority to manage wildlife populations. Both the USFS and BLM recognize the importance of managing wildlife conflicts on lands and resources under their jurisdiction, as integrated with their multiple use responsibilities. For these reasons, both agencies have entered into MOUs with WS to facilitate a cooperative relationship. Copies of these MOUs are available by contacting the WS State Director's Office, P.O. Box 67, Casper, WY 82602.

Wyoming Native American Tribes (Eastern Shoshone and Northern Arapaho)
Currently, WS has an MOU with the Eastern Shoshone and Northern Arapaho tribes on the WRR. Any WS activities conducted on tribal lands would only be conducted at the request of the tribe. Non-Indian-owned fee title lands within the Wind River Reservation would be subject to the WGFD management plan and relevant laws and regulations.

Compliance with Federal Laws, Executive Orders and Regulations
WS consults and cooperates with other federal and state agencies as appropriate to ensure that all WS activities are carried out in compliance with all applicable federal laws.

National Environmental Policy Act: All federal actions are subject to NEPA (Public Law 91-190, 42 U.S.C. 4321 et seq.). WS and the USFWS follow CEQ regulations implementing NEPA (40 CFR 1500 et seq.), USDA (7 CFR 1b), and WS follows 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 to significantly affect 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 40 CFR, 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 documents the analysis of a proposed impact resulting from federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to

ensure that the policies and goals of NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the proposed action. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Endangered Species Act: Under the ESA, all federal agencies are charged with a responsibility to conserve endangered and threatened species and to utilize their authorities in furtherance of the purposes of the ESA (Sec.2(c)). WS conducts Section 7 consultations with the USFWS to utilize the expertise of the USFWS to ensure that, "*Any action authorized, funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . .*" (Sec.7 (a) (2)). WS conducts formal Section 7 Consultations with the USFWS at the national level and consultations with the USFWS at the local level as appropriate (B. Kelly, USFWS Ecological Services letter to R. Krischke, WS, December 19, 2005 and USFWS Interagency Consultation).

Bald and Golden Eagle Protection Act (16 USC 668-668c), as amended: Populations of bald eagles showed periods of steep declines in the lower United States 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 (ESA) 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 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 United States Fish and Wildlife Service 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 would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

National Historical Preservation Act (NHPA) of 1966 as amended: The NHPA and its implementing regulations (CFR 36, 800) require federal agencies to initiate the section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects to historic properties. If the undertaking is a type of activity that does not have the potential to cause effects to historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106. None of the conflict management methods described in this EA that might be used operationally by WS causes major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves 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.

Noise-making methods such as propane exploders, pyrotechnics, or firearms that are used at or in close proximity to historic or cultural sites for the purposes of hazing or removing nuisance predators have the potential for audible effects on the use and enjoyment of a historic property. 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 the benefit of 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.

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

In Wyoming, permits for aerial shooting are issued to private pilots and gunners by the WDA. In 2018 there were permits for aerial shooting issued within Wyoming to 32 private pilots and 95 gunners to conduct aerial shooting operations, primarily for the removal of coyotes (K. Hart, WDA, pers. comm. 2018). WS-Wyoming does not need a permit because Section (b)(1) of the act states that the restriction on take does not apply to any person who is employed by, or is an authorized agent of, any State or the United States to administer or protect or aid in the administration or protection of land, water, wildlife, livestock, domesticated animals, human life, or crops.

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.

Environmental Justice and Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations: Environmental Justice has been defined as the pursuit of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Executive Order 12898 requires Federal agencies to make Environmental Justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies and activities on minority and low-income persons or populations. A critical goal of Executive Order 12898 is to improve the scientific basis for decision-making by conducting

assessments that identify and prioritize environmental health risks and procedures for risk reduction. Environmental Justice is a priority within USDA, APHIS, and WS. APHIS plans to implement Executive Order 12898 principally through its compliance with the provisions of NEPA.

WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS personnel use wildlife conflict management methods in as selective and environmentally conscious a manner as possible. WS assistance is provided on a request basis in cooperation with state and local governments and without discrimination against people who are of low income or in minority populations. The nature of WS' conflict management activities is such that they do not have much, if any, potential to result in disproportionate environmental effects on minority or low-income populations. Therefore, no such adverse or disproportionate environmental impacts to such persons or populations are expected.

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 status, 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 WDM is conducted using only legally available and approved conflict management methods where it is highly unlikely that children would be adversely affected at all, let alone in any disproportionate way.

Executive Order 13186 and MOU between USFWS and WS**:** EO 13186 directs federal 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 WS and the USFWS, in coordination with state, tribal, and local governments. A national-level MOU between the USFWS and WS has been drafted to facilitate the implementation of EO 13186.

Executive Order 13112 - Invasive Species**:** Authorized by former President Clinton, EO 13112 establishes guidance to federal 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 federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species.

The EO also established an Invasive Species Council (Council) whose members include the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the EPA. The Council shall be co-chaired by the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Council oversees: 1) the implementation of this order, 2) that federal agency activities regarding invasive species are coordinated, complementary, cost-efficient, and effective, 3) the development of recommendations for international cooperation in addressing invasive species, 4) the development, in consultation with the CEQ, of guiding principles for federal agencies, 5) the development of a coordinated network among federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health, 6) the establishment of a coordinated, up-to-date information-sharing system and 7) preparation and issuance of a national Invasive Species Management Plan.

APPENDIX C

DISCUSSION OF WIELGUS AND PEEBLES (2014) "EFFECTS OF WOLF MORTALITY ON LIVESTOCK DEPREDATIONS

When published, Wielgus and Peebles (2014) received extensive attention in the media and from wolf advocates and continues to be frequently mentioned in discussions regarding the utility of lethal WDM methods. Because of the potential importance of this study relative to WDM methods used by WS, WS requested its National Wildlife Research Center (NWRC) scientists to review the publication and provide feedback. Seven NWRC research scientists (all PhDs) from a variety of disciplines reviewed the article. Julie Young, PhD, a Supervisory Research Biologist at NWRC, compiled the comments and reported the results of NWRC's analysis via email on December 8, 2014. As detailed in the email, the NWRC reviewers found numerous flaws with the article's data analysis and conclusions. Julie Young was subsequently asked to expand upon NWRC's earlier review of the article. The memorandum at the end of this appendix is the culmination of both reviews, and this section serves to summarize NWRC's analysis and evaluate the applicability of the Wielgus and Peebles (2014) to wolf damage management in Wyoming.

The NWRC scientists do not recommend use of the Wielgus and Peebles article to support program decisions by Wildlife Services due to serious flaws in the data analysis methods selected and the authors' interpretation of the results. As detailed in the following memorandum, the article includes poorly associated spatial and temporal scales, fails to consider the concurrent growth of the wolf population throughout the region during the study period, and does not address other data uncertainties. Since the NWRC review was completed, there have been additional publications that question the methodology used by Wielgus and Peebles (2014) and associated conclusion. Bradley et al. (2015) used the same information but more appropriate temporal and spatial scales and concluded that lethal removal of wolves could be successful in reducing livestock predation. Poudyal et al. (2016) and (Kompaniyets and Evans 2017) both used the same dataset as Wielgus and Peebles (2014), but used different statistical analyses and spatial models to assess limitations in Wielgus and Peebles (2014). Neither group was able to replicate the findings of Wielgus and Peebles (2014). Because Wielgus and Peebles (2014) contains significant flaws, and because of other studies using the same dataset but more appropriate analyses have reached opposite conclusions, we do not consider Wielgus and Peebles (2014) to present credible new information that would be relevant to the environmental concerns presented in this EA.

Subject: *Effects of Wolf Mortality on Livestock Depredations*

(Wielgus and Peebles, 2014)

Date: October 2, 2015

To: File
From: Michael D. Foster, State Director, and USDA/APHIS/WS Wyoming.

On December 3, 2014, an article titled *Effects of Wolf Mortality on Livestock Depredations* (Wielgus and Peebles, 2014) was published by the journal PLoS ONE. Wildlife Services immediately requested its National Wildlife Research Center (NWRC) scientists to review the article and provide feedback. Seven NWRC research scientists (all PhDs) from a variety of disciplines reviewed the article. Julie Young, PhD, a Supervisory Research Biologist at NWRC, compiled the comments and reported the results of NWRC's analysis via email on December 8, 2014. As detailed in the email, the NWRC reviewers found numerous flaws with the article's data analysis and conclusions.

To further Wildlife Services' evaluation and consideration of the Wielgus and Peebles article, Julie Young was asked to expand upon NWRC's earlier review of the article. The attached memorandum is the culmination of both reviews, and this cover memorandum serves to summarize NWRC's analysis and evaluate the applicability of the Wielgus and Peebles article to wolf damage management in the State of Wyoming.

The NWRC scientists do not recommend use of the Wielgus and Peebles article to support program decisions by Wildlife Services due to serious flaws in the data analysis methods selected and the authors' interpretation of the results. As detailed in the attached memorandum, the article includes poorly associated spatial and temporal scales, fails to consider the concurrent growth of the wolf population throughout the region during the study period, and does not address other data uncertainties.

The NWRC scientists determined that the statistical tests and analyses selected for the article appear misleading. In addition, several peer-reviewed publications cited in the NWRC review questioned the use of these statistics for the authors' specific type of study.

At the spatial level, the authors clumped data for entire states into single data points. This very coarse analysis ignores critical information which occurs at the local level within individual packs and individual depredation scenarios. Due to the territorial nature of wolves, lethally removing a wolf from a pack in one area of the state may reduce livestock depredations in that area but likely would have no effect on wolf depredation events in other areas of the state which are hundreds of miles away.

The temporal scale also is too coarse to draw meaningful conclusions. The authors failed to describe the timing/length of control work (resulting in lethal removal) and when future depredations occurred. Moreover, because data was combined and analyzed on a calendar year basis, more than 12 months could have passed between the depredation events. For example, an

event occurring in January 2012 would be combined into 2012 data, and an event occurring in December 2013 would be combined into 2013 data. Even though these events are nearly 24 months apart, they would have been analyzed in the article as if they were only 12 months apart. Further, any future depredation may not even include any members of the initial pack, which further disassociates the relationship between events.

The conclusions were further confounded because the analysis ignored the effects of nonlethal control, mortality from sport hunting and trapping, and natural mortality, all of which are important variables. Finally, as explained by the NWRC research scientists, "there are many flaws to the Wielgus and Peebles article . . . Until these problems are addressed, using an article such as this to guide wildlife management could lead to faulty decisions."

I agree with NWRC's conclusion that the Wielgus and Peebles article is seriously flawed and could lead to faulty decisions. Moreover, the EA for Gray Wolf Damage Management in Wyoming already references and analyzes scientific articles recognizing the efficacy of lethal control as a tool to address depredation. (*See, e.g.*, EA Section 4.1.4 and response to public comments 11 and 14.). Because the Wielgus and Peebles article contains significant flaws, it does not present credible new information that would be relevant to the environmental concerns presented in the EA.

It is thus my determination that Wielgus and Peebles (2014) does not warrant supplementation of the 2015 EA for Gray Wolf Damage Management in Wyoming.

Attachment: July 8, 2015 Memorandum re: NWRC review of publication by Wielgus and Peebles (2014)

MEMORANDUM

To: Jason Suckow, Western Regional Director, Wildlife Services and Charlie Brown, Eastern Regional Director, Wildlife Services

From: Julie Young, Ph.D., Supervisory Research Wildlife Biologist, Wildlife Services, National Wildlife Research Center

Date: 8 July 2015

Re: NWRC review of publication by Wielgus and Peebles (2014)

This memorandum follows from my December 8, 2014 email to Steve Kendrot, Deputy Director, Operational Support Staff, and National Wildlife Research Center (NWRC) management relaying discussions by NWRC's scientists about scientific flaws in a 2014 journal article authored by R.B. Wielgus and K.A. Peebles (2014) entitled *Effects of Wolf Mortality on Livestock Depredations*. The article was published in the journal *PLoS ONE* on 3 December 2014. The article aims to test the efficacy of wolf removals to reduce livestock depredation in Idaho, Wyoming, and Montana. The authors used data from United States Fish and Wildlife Service's Interagency Annual Reports and found a positive relationship between wolf removals and the number of depredations in the following year, except when more than 25% of wolves were removed. At more than 25%, wolf removals correlated with declining depredations. A large group of NWRC scientists including Drs. Eric Gese, Stewart Breck, Alan Franklin, Kim Pepin, Brad Blackwell, Brian Dorr, and I reviewed the article. For the reasons presented below, we do not recommend the use of this article to support program decisions that rely on the best available science to draw conclusions on the merits of wolf damage management.

Our main concerns are the data analysis methods selected and the interpretation of results. More specifically, the spatial and temporal scales are too coarse to say anything meaningful about the relationship between lethal wolf removals and livestock depredation. We believe that several alternative data analysis techniques are available that would better fit the data. Moreover, the article fails to acknowledge or overlooked data showing the wolf population was increasing throughout the study period and that hunting became legal in many parts of the study area. These factors and other uncertainties in the data were not accounted for and may impact the authors' ultimate interpretation of the results.

<u>Specific Flaws in Data Analysis Methods:</u>

- Spatial Scale – The authors collapsed the data for each state (Idaho, Montana, and Wyoming) into one data point per year. The authors also clumped county data into state data. A basic scatterplot of the relationship between cattle populations and wolf populations at the county-level per year would help readers determine if the authors used a valid spatial scale or if the spatial scale should have remained at the level of county data. If the spatial scale is valid as analyzed, state (WY, ID, MT) could have been included as a random effect. By using state as a random effect, it would have enabled to the authors to draw conclusions about the population from which the observed units (states) were drawn, rather than about the states themselves. Instead, it appears that the authors ignore that removing wolves from one place may reduce livestock depredations in that specific place but would be unlikely to affect other locations in that state. Wolves are typically territorial and removals for depredation are typically specific to a pack or individuals at the specific location where the depredation occurred. If the authors had used a finer spatial scale, the results may have differed.

- Temporal Scale – It is unclear if it was appropriate to use a year lapse in analyzing the effects of wolf removals on depredations. There are no details on the timing of the control activities or on the length of time that passed until depredations occurred again. Because data were analyzed on the calendar year, some control events may have happened more than 12 months before another depredation event was documented and the data still would have been included as occurring in the next (calendar) year. If so, the analysis looked beyond the stated one-year time lag. During the majority of the study period, the wolf population was increasing in all states. We believe a finer temporal scale would likely be more accurate. For example, the authors could have evaluated depredation events within the first one to three months after removals to determine if there were real-time, immediate impacts.

Specific Flaws in Interpretation of Results

- Data analysis – It is highly likely that analyses done using a more appropriate spatio-temporal scale (mentioned above) and using improved analytical techniques to match the data quality would reveal results contrary to the findings reported here.
    - The article only uses control-based removals, as reported in the United States Fish and Wildlife Service's Interagency Annual Reports, and does not address how hunting removals or use of non-lethal methods impact the analysis. For example, in Idaho, one of the state's whose data were part of this article, 329 wolves were killed for harvest versus 73 wolves killed for control during 2012. Since hunting has become legal in some states such as Idaho, it is reasonable to expect more wolves were removed annually via hunting than from control actions. States and individual ranchers differ in the level of non-lethal methods used and how their use affects the decision to lethally remove wolves. The impacts of hunting and use of non-lethal methods on the analysis may be important but are not addressed in this article.
    - The authors do not account for (or mention how they accounted for) data uncertainty, data scales of dependent variables, and model selection uncertainty. It is misleading to present the raw data as fixed. We know these data have uncertainty associated with them, such as the number of livestock reported by National Agricultural Statistics Service, which provides a range of values, yet the authors did not account for data uncertainty and ignored model selection uncertainty by using forward selection regression methods. Model selection uncertainty could have been addressed using AIC weights, which can greatly facilitate the interpretation of the results[1]. Moreover, the dependent variables differed by orders of magnitude (e.g., 10,000s of cattle and sheep versus 100s of wolves), which can introduce scaling issues in the data. This explains why there are orders of magnitude differences in the coefficients. It would have been better to divide the number of cattle by 1,000 or 10,000 to make this variable more in line with the other variables (e.g., sheep counts) in terms of its magnitude.
    - The use of statistics is unclear. First, the authors claim to use forward selection regression methods. These methods are inappropriate for the analysis in this article. There are several peer-reviewed papers on why it is no longer an acceptable practice to use forward selection regression methods for these types of studies[2]. Forward selection regression methods are valid for strictly controlled experiments, where one has a full picture of how model variables relate. This article is not based on controlled experiments. Second, it does not appear that the authors actually used forward selection regression methods. Instead, the authors used negative binomial general linearized models (which actually should be referred to as generalized linear models) with no explanation for why these models were chosen.

Generalized linear models can perform poorly with data not distributed exactly as negative binomial. Given the data set used in this article, normal-based procedures may have been a better choice as they are very robust at handling departures from normality and outperform Poisson regression for data distributed as Poisson. Third, it is unclear how R^2 (coefficient of determination) for the covariate relationships was calculated and where the quadratic fit (a non-linear equation) comes from because there is no mention of fitting a non-linear model. Fourth, the models selected by AIC were not really used for inference. Instead, the authors relied on what seemed to be normal-based regressions with quadratic structures (details were not clear in methods) to make their points afterwards. These models were not included in the published model set. The models presented in Figures 1, 2, and 3 were never included in the model set examined with AIC (e.g., quadratic structures, including variables such as proportion of wolves killed). The proportion of wolves killed variable seemed more meaningful than just numbers killed so that any increase or decrease in wolf population size would have been considered and could have been included in the AIC model set.

  - The authors are unable to estimate proportion of variation in data explained by models, which is needed and can be done efficiently using a MLE (maximum-likelihood estimation) framework. AIC is only a relative measure, and AICc (AIC corrected for small sample size) should have at least been used instead. The manner in which AIC was used in this article suggests the authors were not very careful in their approach. For example, the authors state that their main effects for the best AIC models in Table 1 were all significant, yet CATTLE was not significant in any of them (see Table 2). Further, models 12 and 13 were the same as model 10, but with an uninformative interaction; however, the authors spend time discussing all three. Model selection through cross-validation would have been more appropriate to avoid overfitting the data.
  - The model needs an offset. As presented, the authors are assuming that there is equal opportunity for depredation in each state in each year. Difference in livestock numbers by state and year need to be accounted for. Along similar lines, the number of wolves removed seems irrelevant in the absence of the total number of wolves on the landscape. For example, it is relevant to know if there were five of 50 wolves removed or five of 50,000.
  - The data are likely confounded. For example, the number of breeding pairs does not always correlate with the number of packs (e.g., Idaho in final 5 years of study), which would confound those data. Further, wolf numbers, depredations, and removal numbers are likely to be serially correlated.

- Focus of results – First, the discussion and media coverage of this article have shown bias by focusing solely on the left side of the figures. This side illustrates killing equal or less than 25% of a population may increase subsequent year's depredations. However, one could just as easily focus on the right side of the figures, where removing more than 25% of the wolves does reduce livestock depredation in the subsequent year. Anti-wolf groups could easily point to the right side of the figures as a call to ensure additional wolves are killed each year and be equally justified. Second, the results suggest that more breeding pairs result in more depredation events. Yet, the discussion does not point out the potential conflict between this increase in wolf numbers and the percentage of wolves removed. Third, the authors note an immediate increase in compensatory reproductive output but they also argue that dissolution of pack territories is possible. Because there is a lack of temporal scale associated with the data (e.g., were wolves removed just before

breeding season when compensatory response is unlikely or in summer when a new pack may have had time to establish), it is unclear which point is valid.

Conclusion:

As highlighted here, there are many flaws to the Wielgus and Peebles article that are evident to NWRC scientists. Until these problems are addressed, using an article such as this to guide wildlife management could lead to faulty decisions. The best available science should be used instead.

[1]Explained in Wagenmakers & Farrell (2004) and references therein.

Wagenmakers, E. J., & Farrell, S. (2004). AIC model selection using Akaike weights. Psychonomic Bulletin & Review, 11(1), 192-196.

[2]See Whittingham et al. (2006) and references therein.

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APPENDIX D

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APPENDIX E

POTENTIAL WS-WYOMING ACTIVITIES ON AREAS OF SPECIAL CONCERN

This table provides information on the types of lethal WDM actions which could potentially be implemented on areas of special concern. WS-Wyoming could also provide technical assistance to producers and landowners/managers on nonlethal methods that they could implement to reduce damage and conflicts. Listing of a method in this table does not guarantee that it will be used, only that it may be used if a conflict is verified; the method is identified as appropriate for the specific situation using the WS Decision Model; the proposed action is consistent with applicable land use management plans, land management agency policies, and any special considerations noted by the land management agency; and is allowed under the management alternative selected based on this EA.

*** Chance of Work Legend:**		**Chance that work will be done within next 5 years:**	
EH	Extremely High	95 - 100%	Historical depredation - expect it to continue
H	High	66 - 95%	Historical depredation - most likely to continue
M	Medium	33 - 66%	Historical depredation nearby - probably continue
L	Low	2 - 33%	Historical depredation nearby - might continue
EL	Extremely Low	0 - 2%	No historical depredation - expect none to start
HHS	Human Health & Safety Only		Human Health & Safety Only

**** Control Strategies/Tools Definitions:**	
Yes	May be used in accordance with established work plans
Unlikely	Unlikely to be used and would require specific case by case approval, or be requested by the managing agency

Property Type	Property Name	Land Management Agency	Control Strategies/Tools Proposed				
			Traps	Aircraft	Shooting	Snares	Chance of Work*
Wilderness Areas (WA)	Absaroka-Beartooth	USFS	Yes	Unlikely	Yes	Unlikely	M
	North Absaroka	USFS	Yes	Unlikely	Yes	Unlikely	M
	Washakie	USFS	Yes	Unlikely	Yes	Unlikely	M
	Popo Agie	USFS	Yes	Unlikely	Yes	Unlikely	M
	Fitzpatrick	USFS	Yes	Unlikely	Yes	Unlikely	M
	Jedediah Smith	USFS	Yes	Unlikely	Yes	Unlikely	L
	Teton	USFS	Yes	Unlikely	Yes	Unlikely	L
	Gros Ventre	USFS	Yes	Unlikely	Yes	Unlikely	M
	Bridger	USFS	Yes	Unlikely	Yes	Unlikely	M
	Cloud Peak	USFS	Yes	Unlikely	Yes	Unlikely	L
	Huston Park	USFS	Yes	Unlikely	Yes	Unlikely	EL
	Encampment River	USFS	Yes	Unlikely	Yes	Unlikely	EL
	Savage Run	USFS	Yes	Unlikely	Yes	Unlikely	EL
	Platte River	USFS	Yes	Unlikely	Yes	Unlikely	EL
Areas of Critical Environmental Concern (ACEC)	Sheep Mountain Anticline	BLM Cody Field Office	Yes	Yes	Yes	Yes	L
	Brown/Howe Dinosaur Area	BLM Cody Field Office	Yes	Yes	Yes	Yes	L
	Carter Mountain	BLM Cody Field Office	Yes	Yes	Yes	Yes	M
	Five Springs Falls	BLM Cody Field Office	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Little Mountain	BLM Cody Field Office	Yes	Yes	Yes	Yes	L

Clarks Fork Canyon	BLM Cody Field Office	Yes	Yes	Yes	Yes	M
Paleocene, Eocene Thermal Maximum	BLM Cody Field Office	Yes	Yes	Yes	Yes	EL
Sheep Mountain	BLM Cody Field Office	Yes	Yes	Yes	Yes	L
Big Cedar Ridge	BLM Worland Field Office	Yes	Yes	Yes	Yes	EL
Red Gulch Dinosaur Tracksite	BLM Worland Field Office	Yes	Yes	Yes	Yes	EL
Spanish Point Karst	BLM Worland Field Office	Yes	Yes	Yes	Yes	EL
Upper Owl Creek	BLM Worland Field Office	Yes	Yes	Yes	Yes	EL
Welch Ranch	BLM Buffalo Field Office	Yes	Yes	Yes	Yes	EL
Pumpkin Buttes	BLM Buffalo Field Office	Yes	Yes	Yes	Yes	EL
Jackson Canyon	BLM Casper Field Office	Yes	Yes	Yes	Yes	EL
Salt Creek Hazardous	BLM Casper Field Office	Yes	Yes	Yes	Yes	EL
Alcova Fossil Area	BLM Casper Field Office	Yes	Yes	Yes	Yes	EL
Lander Slope	BLM Lander Field Office	Yes	Yes	Yes	Yes	M
Red Canyon	BLM Lander Field Office	Yes	Yes	Yes	Yes	M
Whiskey Mountain	BLM Lander Field Office	Yes	Yes	Yes	Yes	L
Beaver Rim	BLM Lander Field Office	Yes	Yes	Yes	Yes	L
East Fork	BLM Lander Field Office	Yes	Yes	Yes	Yes	EL
Green Mountain	BLM Lander Field Office	Yes	Yes	Yes	Yes	M
South Pass Historical Landscape	BLM Lander Field Office	Yes	Yes	Yes	Yes	M
Twin Creek	BLM Lander Field Office	Yes	Yes	Yes	Yes	L
Raymond Mountain	BLM Kemmerer Field Office	Yes	Yes	Yes	Yes	M

Bridger Butte	BLM Kemmerer Field Office	Yes	Yes	Yes	Yes	M
Special Status Plant Species Habitats may be designated on a case by case basis	BLM Kemmerer Field Office	Yes	Yes	Yes	Yes	EL
Cushion Plant Communities may be designated on a case by case basis	BLM Kemmerer Field Office	Yes	Yes	Yes	Yes	EL
Whoopup Canyon	BLM Newcastle Field Office	Yes	Yes	Yes	Yes	EL
Rock Creek	BLM Pinedale Field Office	Yes	Yes	Yes	Yes	EL
Beaver Creek	BLM Pinedale Field Office	Yes	Yes	Yes	Yes	EL
Como Bluff	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Sand Hills	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Jep Canyon	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	L
Shamrock Hills	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Upper Muddy Creek Watershed/Grizzly Area	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Blowout Penstemon	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Cave Creek Cave	BLM Rawlins Field Office	Yes	Yes	Yes	Yes	EL
Cedar Canyon	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL
Greater Red Creek	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL
Greater Sand Dunes	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL
Natural Corrals	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL

	Oregon Buttes	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	M
	Pine Springs	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL
	White Mountain Petroglyphs	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	L
	South Pass	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	M
	Special Status Plants	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	EL
	Steamboat Mountain	BLM Rock Springs Field Office	Yes	Yes	Yes	Yes	M
Wilderness Study Areas (WSA)	Adobe Town	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Alkali Basin/East Sand Dunes	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Alkali Draw	BLM High Desert District	Yes	Yes	Yes	Yes	L
	Bennett Mountain	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Buffalo Hump	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Devil's Playground	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Encampment River Canyon	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Ferris Mountain	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Honeycomb Buttes	BLM High Desert District	Yes	Yes	Yes	Yes	L
	Lake Mountain	BLM High Desert District	Yes	Yes	Yes	Yes	L
	Oregon Buttes	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Prospect Mountain	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Raymond Mountain	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Red Creek Badlands	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Red Lake	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Sand Dunes	BLM High Desert District	Yes	Yes	Yes	Yes	M

	Scab Creek	BLM High Desert District	Yes	Yes	Yes	Yes	L
	South Pinnacles	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Twin Buttes	BLM High Desert District	Yes	Yes	Yes	Yes	EL
	Whitehorse Creek	BLM High Desert District	Yes	Yes	Yes	Yes	M
	Fortification Creek	BLM High Plains District	Yes	Yes	Yes	Yes	EL
	Gardner Mountain	BLM High Plains District	Yes	Yes	Yes	Yes	EL
	North Fork	BLM High Plains District	Yes	Yes	Yes	Yes	EL
	Alkali Creek	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Bobcat Draw Badlands	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Bighorn Tack-On	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Cedar Mountain	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Copper Mountain	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Dubois Badlands	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Honeycombs	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Lankin Dome	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	McCullough Peaks	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Medicine Lodge	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Miller Spring	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Owl Creek	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Pryor Mountain	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL

	Red Butte	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Savage Peak	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Sheep Mountain	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Split Rock	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Sweetwater Canyon	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
	Trapper Creek	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	L
	Whiskey Mountain	Wind River/Bighorn Basin District	Yes	Yes	Yes	Yes	EL
National Trails - Reserves - Monuments - Parks - Sites - Wildlife Refuges	Yellowstone National Park	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Grand Teton National Park	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Fossil Butte National Monument	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Devils Tower National Monument	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Fort Laramie National Historic Site	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Flaming Gorge National Recreation Area	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Big Horn Canyon National Recreation Area	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Continental Divide Trail	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	California Trail	NPS	Can't use within one-half mile	Yes	Yes	Can't use within one-half mile	M

	Mormon Pioneer Trail	NPS	Can't use within one-half mile	Yes	Yes	Can't use within one-half mile	M
	Nez Perce (Nee-Me-Poo) Trail	NPS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Oregon Trail	NPS	Can't use within one mile	Yes	Yes	Can't use within one mile	M
	Pony Express Trail	NPS	Can't use within one-half mile	Yes	Yes	Can't use within one-half mile	M
	National Elk Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Cokeville Meadows National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Seedskadee National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Pathfinder National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Mortenson Lake National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Hutton Lake National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
	Bamforth National Wildlife Refuge	USFWS	Unlikely	Unlikely	Unlikely	Unlikely	EL
State Parks	Bear River State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Boysen State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Buffalo Bill State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Curt Gowdy State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS

	Edness K. Wilkins State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Glendo State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Guernsey State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Hawk Springs State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Hot Springs State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Keyhole State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Seminoe State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS
	Sinks Canyon State Park	WDSPHS	Unlikely	Unlikely	Unlikely	Unlikely	HHS