United States
Department of
Agriculture

Marketing and
Regulatory
Programs

Animal and
Plant Health
Inspection
Service

Wildlife
Services

Washington State
Office

720 O'Leary Street
Olympia, WA 98502

(360) 753-9884
(360) 753-9466 Fax

Summary Environmental Monitoring Review of the "Predator Damage Management in Washington" EA and Supplement to the EA

United States Department of Agriculture (USDA)
Animal and Plant Health Inspection Service (APHIS)
Wildlife Services (WS)

February 2010

Summary Environmental Monitoring Review

I. Introduction

This summary report and supplement to the "Predator Damage Management in Washington" Environmental Assessment (EA) are two separate analyses; however, to simplify Wildlife Services (WS) environmental processes, reduce the volume of paper, and better facilitate public comment; the analyses are combined into a single record. The summary report pertains to the analyses of Washington WS' predator damage management activities from FY02 through FY08. The supplement pertains to the addition of raccoon (*Procyon lotor)* and opossum (*Didelphis virginiana*) damage management, as requested, to the current predator damage management program, and to issues that have been identified since completion of the EA.

In 1997, the Washington WS program completed an EA (USDA 1997a) which addressed the need to reduce human/predator conflicts and the potential impacts of five alternatives for responding to predator damage in Washington. The EA analyzed the Washington WS program as it involves conflict resolution with predatory species[1], such as coyotes (*Canis latrans*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos horribilis*), gray wolves (*Canis lupus*), cougar (*Puma concolor*), red fox (*Vulpes vulpes*), bobcats (*Lynx rufus*), badgers (*Taxidea taxus*), feral/free ranging dogs (*Canis familiaris*), and ravens (*Corvus corax*). The Washington WS program conducts conflict reduction activities using various methods, as analyzed in the EA, on various land classes[2], as requested. A thorough analysis of the anticipated effects of the alternatives as they related to the issues is described in Chapter 3 of USDA (1997a). The issues considered in this supplemental analysis, that amends the current program as described in USDA (1997a), have also been analyzed in relation to the current program. The five alternatives analyzed in detail in the Washington Predator Damage Management EA were and continue to be the five alternatives for this supplement:

Alternative 1: Current Program Alternative was the "No Action" alternative[3]. Activities included WS operational management and technical assistance (TA) provided on a case-by-

[1] Of the ten species analyzed in the EA, WS only conducted management actions on six species (*i.e.*, cougar, coyote, bobcat, badger, feral dog, and common raven) between FY2002 and FY2008.

[2] Current program activities are conducted on private and municipal lands throughout Washington, on State lands which are leased for livestock grazing and managed by the Southeast or Northeast Regions of the Washington Department of Natural Resources (WDNR), on U.S. Department of Defense lands, and on the U.S. Fish and Wildlife Service (USFWS) wildlife refuges where agreements are in place. The WDNR lands are generally interspersed with or adjacent to private ranch lands and are managed, in part, for livestock grazing.

[3] No action alternative was in this case, is no change from the original program.

case basis using or recommending the most appropriate, effective, and biologically sound methods available to resolve damage caused by predators. Under this alternative, WS receives requests for assistance and/or entered into Cooperative Agreements with private landowners, livestock managers, municipalities, wildlife management agencies, such as the US Fish and Wildlife Service (USFWS) and Washington Department of Fish and Wildlife (WDFW), and other land management agencies, such as the Washington Department of Natural Resources (WDNR).

Alternative 2: Technical Assistance Alternative only allows WS to provide TA or advice on the use of lethal and nonlethal methods. WS would demonstrate or advise requesters on the use of methods available under Alternative 1, except the M-44, DRC-1339, and aerial gunning.

Alternative 3: Nonlethal Before Lethal Methods Alternative requires 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, 2) WS 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.

Alternative 4: No WS Program Alternative did not allow predator damage management by WS; no TA or operational assistance would occur.

Alternative 5: Expanded Program (the Proposed Alternative) was similar to the Current Program and allowed for the use of the same activities and methods, however, predator damage management efforts could occur statewide under this alternative. WS would continue to use the WS Decision Model (Slate et al. 1992) and provide TA and operational management under this alternative. Alternative 5, the "Expanded Program Alternative" was selected and a Finding of No Significant Impact (FONSI) was issued and a Decision signed October 27, 1997. The EA and FONSI are available from the Washington WS State Office, USDA, APHIS, WS, 720 O'Leary Street NW, Olympia, WA 98502.

II. Background

WS is authorized by Congress and directed by law to reduce damage caused by wildlife (Act of March 2, 1931, as amended [46 Stat. 1468; 7 U.S.C. 426-426c], and the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988, as amended [Public Law 100-202, Stat. 1329-1331][4]). The alleviation of damage or other problems caused by or related to the behavior of wildlife is termed wildlife damage management and recognized as an integral component of wildlife management (The Wildlife Society 1992). WS uses an adaptive Integrated Wildlife Damage Management (IWDM) approach (WS Directive 2.105[5]), commonly known as Integrated Pest Management, where a combination of methods may be used or recommended to reduce wildlife 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 and the informed judgment of trained personnel (Slate et al. 1992). Wildlife damage management is not based on punishing offending animals but is a means to reduce future damage. The imminent threat of damage or loss of resources is often sufficient for actions to be initiated and the need for predator damage management, or the reduction of human/predator conflicts, is derived from the specific threats to resources.

WS is a cooperatively funded, service-oriented program. Before any WS action is taken, a request must be received and an Agreement for Control must be signed by the landowner/administrator or other

[4] Therefore, WS is directed by Congress to respond to and attempt to reduce damage caused by wildlife, when funding allows.

[5] The WS Policy Manual provides WS personnel guidance in the form of program directives. Information contained in the WS Policy Manual and its associated directives (http://www.aphis.usda.gov/wildlife_damage/WS_directives.shtml) have been used in preparation of this report, but have not been cited in the Literature Cited.

comparable documents must be in place. When requested, WS cooperates with land and wildlife management agencies to effectively and efficiently reduce human/wildlife conflicts in compliance with all federal and applicable state and local laws, regulations, policies, orders, and procedures (WS Directive 2.210). None of WS' human/predator conflict reduction activities have resulted in habitat modifications.

Currently, Washington WS conducts predator damage management where agreements are in place throughout the state[6] to alleviate and prevent depredation to livestock, agriculture, commercial timber, property, natural resources, and reduce risks to human health and safety (HHS). WS conducts activities only at the request of private individuals, state or local governments, resource managers/owners, or other federal agencies. The majority of requests for management are for predatory species whose populations are relatively high or are considered "anthropogenic abundant[7]" (Conover 2002) and have caused damage.

WS' activities to reduce threats associated with predators in Washington are regulated by all federal laws and applicable state, and local laws and regulations, as appropriate. WS' authorities and those of federal, state, and local entities, for the supplemental activities will remain as addressed in the EA.

III. Purpose of this Review

The purpose of this review is to: 1) evaluate WS predator damage management activities in Washington[8], species take, and methods used by Washington WS between FY2002 and FY2008, 2) facilitate planning and interagency coordination, 3) streamline program management, 4) ensure WS' activities remain within the scope of analyses contained in the EA and determine any need for a supplement to the EA, and 5) clearly communicate to the public the analysis of individual and cumulative impacts of the current program since 2002. This summary report ensures WS' actions comply with the National Environmental Policy Act (NEPA), with the Council on Environmental Quality (40 CFR 1500), and with APHIS' NEPA implementing regulations (7 CFR 372). All predator damage management is conducted consistent with: the Endangered Species Act of 1973, Executive Order (EO) 12898[9], EO 13045[10], and EO 13112[11], and other applicable federal, state, and local laws, regulations, and policies.

IV. Affected Environment

Actions under the current program could be conducted on private, federal, state, tribal, and municipal lands in Washington to protect resources from predator damage, as requested. The affected environment includes, but is not necessarily limited to, areas in and around agricultural and industrial areas, livestock facilities, rural and urban areas, and airports wherever predators are found to be causing damage to resources or posing threats to HHS. Areas may include federal, state, county, city, private, or other lands, where WS' assistance has been requested by a landowner or manager to reduce predator damage. The

---

[6] Washington WS had active agreements to work on approximately 493,000 acres, or about 2.7% of the State's total acreage. Approximately 5% (25,000 acres) of the total acres under agreement were WDNR lands. Municipal lands also included only a small fraction of the lands under agreement (Management Information System 2008).

[7] Anthropogenic abundant species are those that have benefited from the presence of humans (Conover 2002).

[8] WS will continue to coordinate with the WDFW to ensure WS' activities are considered as part of management objectives established by the WDFW.

[9] Executive Order 12898 promotes the fair treatment of people of all races, income levels and cultures with respect to the development, implementation and enforcement of environmental laws, regulations and policies.

[10] Executive Order 13045 ensures the protection of children from environmental health and safety risks since children may suffer disproportionately from those risks.

[11] Executive Order 13112 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, 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, promote public education on invasive species.

areas affected by the current program may also include property adjacent to identified sites where predation or threats to HHS could occur.

V. Scope of Analysis

USDA (1997a), this summary review, and the supplemental analysis evaluate WS predator damage management activities in Washington. The scope consists of the range of actions, alternatives, and impacts considered in USDA (1997a) and supplemental information (40 CFR §1508.25) to reduce damage and threats to protected resources. The scope of USDA (1997a) and supplement recognize that USDA-APHIS is tasked with protecting American agriculture and WS' mission goes beyond that to include property, HHS, and natural resources when requested. The supplement analyzes additional activities as a result of Washington WS receiving requests for assistance with raccoon and opossum damage/threats.

VI. Actions Analyzed

The EA, this summary report, and the supplement analyze the potential impacts of predator damage management activities conducted by Washington WS, when requested. WS uses a Decision Model (Slate et al. 1992) which involves evaluating each damage/threat situation, taking action, evaluating, and monitoring results of the action(s) (USDA 1997a, 1997b[12]). WS' personnel use the Decision Model to develop the most appropriate strategy to reduce damage and to determine potential environmental effects from damage management actions (Slate et al. 1992, USDA 1997a, 1997b).

The summary report analyzes actions conducted by Washington WS since the FONSI was signed. The summary report evaluates WS' activities to ensure the FONSI is still appropriate and that activities conducted pursuant to the Decision do not warrant the preparation of an Environmental Impact Statement.

The supplemental analysis evaluates WS' activities to reduce damage caused by raccoons and opossums, as requested, and issues that have arisen since completion of the EA. The actions analyzed in the supplement do not replace, but are in addition to those activities described under the proposed action of USDA (1997a).

VII. Scope of Predator Damage

The need for action remains as stated in the EA, that the adverse effects of predation on livestock and other resources can be serious for individuals[13]. Livestock production in Washington is a sizeable industry, and predation on livestock represents a large financial loss to livestock producers (NASS 2005, 2006). Coyote predation on cattle totaled 51.1% of all depredation, whereas cougar and black bears were reported to have killed 1,400 cattle/calves during 2005 (NASS 2006). The most recent reports on cattle and sheep loss to predation documented a $1,719,000 loss to Washington's livestock industry (Table 1). Between FY 2002 and FY 2008, WS received reports of $1,915,222 in total damages from the species identified in USDA (1997a) (MIS 2008). During FY 2007 alone, WS verified $156,025 in losses/damages from coyotes and in FY 2006, $18,500 in damages from ravens (MIS 2008[14]). Table 2 shows the amount of damage by species for this review period.

---

[12] Slate et al (1992) provides more detail on the processes used in WS' Decision Model. USDA (1997b) provides more detail and examples of how the model is used.

[13] Predator damage totaled $92.7 million in losses to ranchers nationwide in 2005 (NASS 2006).

[14] The damage data is not conclusive, as many damages do not get reported to WS, but is representative of a problem facing livestock producers in Washington.

Nationwide, farmers and ranchers spent $199 million on nonlethal methods to prevent predation, with fencing being the most popular, followed by night penning and lamb sheds (NASS 2006). Washington sheep producers were well above the national average in the percentage of ranchers using nonlethal methods to reduce damage (Table 3). The producer implemented proactive, nonlethal methods increase the validity for taking further, possibly lethal, action to alleviate damage from predators when predation losses continue to occur.

Table 1. Cattle and Sheep Losses to Predators during a 1-Year Period in Washington and Associated Financial Losses (NASS 2005, 2006).

Livestock Species	Adult	Calves/Lambs	Cost of Damage
Cattle (2005)	900	1600	$1,527,000
Sheep(2004)	900	1400	$192,000
Totals	1800	3000	$1,719,000

Table 2. Value of Predator Damage Reported to or Verified by Washington WS for FY2002 through FY 2008.

Species	Damage
Badger	0
Black Bear	$68,397
Grizzly Bear	0
Bobcat	$1,000
Coyote	$1,726,360
Cougar	$29,460
Feral Dog	$23,105
Raven	$66,300
Red Fox	$0
Wolf	$600
TOTAL	$1,915,222

Some predators also negatively affect property and other agricultural resources. For example, each spring, black bear damage 20-25 year-old conifer trees in timber plantations by stripping bark to feed on the cambium. One black bear can peel up to 70 trees per day and completely destroy a young Douglas-fir plantation in 6 years (Zeigltrum 2006), and damage to timber ranges between $5-6 million annually in Washington (Zeigltrum, Washington Forest Protection Association, 2007, pers. comm.). Bears are also attracted to apiaries where they break open bee hives to access and consume the honey, oftentimes killing or dispersing the bee colonies. Coyotes and badgers occasionally damage ditch banks and other irrigation lines and structures, field crops, and unimproved roads while excavating dens or digging for rodents. Ravens and coyotes sometimes damage silage storage bags by pecking and digging at the fabric in search of insects and rodents. This activity causes spoilage of livestock feed.

Table 3. Comparative Use of Nonlethal Techniques in Sheep Production in WA and the National Average in Percents. (NASS 2005)

State	Fencing	Guard Dog	Llama	Donkey	Lamb Shed	Herding	Night Penning	Fright Tactics
WA Average (%)	65.8	25.0	16.4	6.7	35.4	2.4	36.6	2.0
US Average (%)	52.5	31.8	14.0	9.1	30.8	5.7	32.9	2.2
Difference (%)	13.3	-6.8	2.4	-2.4	4.6	-3.3	3.7	-0.2

HHS (*i.e.*, reducing predator threats) is another important responsibility of WS. Although attacks are rare, black bear, cougars, and coyotes occasionally pose safety threats when they habituate to urban or residential locations or recreation areas used for picnicking, hiking, or camping (Loven 1995, Baker and Timm 1998, Riley 1998, Cougar Management Guidelines Working Group 2005, Beier 1991, CDFG 2006, CDOW 2006). WDFW is the lead agency responsible for human/wildlife conflicts involving black bear and cougar; however WS may assist WDFW, upon request, by responding to safety and nuisance incidents. WS also works cooperatively with WDFW to respond to coyote complaints and threats to HHS.

Other HHS issues occur at airports when coyotes, fox, feral dogs, or ravens frequent airfields. The Federal Aviation Administration (FAA) regulations require public airports (*i.e.*, certificated airports) to provide for safe aircraft operations with regard to wildlife hazards, and through a 2005 Memorandum of Understanding, FAA authorizes WS to assist airports to reduce those hazards. Wildlife strikes cost the commercial air transport industry in the United States an estimated $490 million annually in structural damages alone (Linnell et al. 1996) and have killed more than 200 people.

VIII. Major Issues Analyzed in Detail

USDA (1997a) identified and analyzed the issues deemed relevant to the analysis in the EA. These issues were consolidated into the following:

Impact on Target Species
Impact on Non-target Species, Including T&E Species
Impact on Public Safety
Humaneness of Control Techniques
Effectiveness of the WS Program and Methods

Impacts on Target Species

Washington predator damage management targets specific species or individuals and cumulative effects are analyzed to determine the relative significance of impacts. In addition, management direction from the WDFW is a determining factor. The analysis herein indicates predator populations are not impacted to the point of causing any substantial decline. The methods used in each damage situation depend on the species causing the damage and other factors including location (public versus private lands), weather, and time of year.

Between FY2002 and FY2008, a total of 3,273 predators, averaging 468 animals annually, were taken using methods analyzed in the EA (Table 4). During this time, WS conducted management action on six (*i.e.*, cougar, coyote, bobcat, badger, feral dog, and common raven) of the 10 species analyzed in USDA (1997a).

Table 4. WS Take of Target Species Under Predator EA for FY2002 through FY2008 (MIS 2008)

Species	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	Average per Year
Badger	2	0	0	0	0	0	0	0.3
Black Bear	0	0	0	0	0	0	0	0
Grizzly Bear	0	0	0	0	0	0	0	0
Bobcat	0	0	0	0	1	0	0	0.1
Coyote	679	292	153	114	585	608	322	393.2
Cougar	0	0	0	0	0	0	1	0.1
Feral Dog	0	0	0	0	1	0	0	0.1
Raven	185	174	37	28	83	3	5	73.6
Red Fox	0	0	0	0	0	0	0	0
Wolf	0	0	0	0	0	0	0	0

<u>Badger</u>. WS takes badgers on an infrequent basis and on a very limited scale. The range of the badger extends from the Great Lakes to the Ohio Valley and westward into the Great Plains and along the Pacific coast. However, badgers are not found in the Eastern States or in certain areas of Oregon and Washington west of the Cascade Mountains (USDA 1997b). The badger population in Washington is estimated to be about 20,000 animals (USDA 1997b). The take of two badgers during this analysis period for the protection of irrigation systems and agricultural property is biologically insignificant and is within the low magnitude of impact (Boddicker 1980).

<u>Bobcat</u>. WS takes bobcats on an infrequent basis and on a very limited scale. Bobcat density ranges between 0.1 and 7 per mi^2 and they may live up to 14 years, with annual mortality is as high as 47% (Rolley 1985). The sustainable harvest level for bobcats has been established at 20% of the population (Rolley 1985, USDA 1997b). One bobcat was removed by WS in FY 2006 in an unusual instance of ongoing predation of trout at an aquaculture facility. In 2008, private trappers removed 399 bobcats in the state. WS' take of one bobcat during this review period is biologically insignificant and within the low magnitude of impacts to the species (USDA 1997b).

<u>Cougar</u>. Cougar are a state managed species with a regulated harvest. Currently, the best available estimate of statewide abundance is about 1,900 to 2,100 animals (excluding kittens) (WDFW 2008a).

WDFW reports a harvest of about 200 cougars per year from hunting efforts, depredation events, and control measures to safeguard HHS (WDFW 2008b). WS took one cougar during 2007, in cooperation with WDFW that was frequenting an elementary school playground; the cougar was removed to protect HHS. Several studies of cougar population dynamics provide insights into sustainable harvest levels. The sustainable annual harvest level for cougar populations, determined by USDA (1997b) was 30%. Ashman et al. (1983) found for their study in Nevada that under "moderate to heavy exploitation of 30%-50% removal," the cougar population had the recruitment capability of rapidly replacing annual losses. Logan et al. (1996) determined the rate of increase in a New Mexico study varied from 8-11% in an unhunted, uncontrolled population to 21-28% in a population where harvest and control was simulated by removing half of the cougars from the study area. The take of one cougar by WS during this review period represents and a low magnitude of impact on the population and environment.

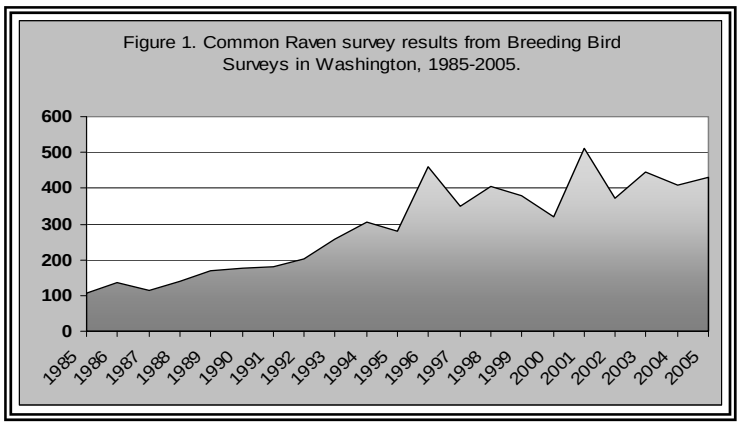
Coyote[15]. With conservative population estimates at about 50,000 coyotes in the state (WDFW 2007, D. Martorello, WDFW 2007 pers. comm.) the combined take of 839 coyotes in FY 07 by both WS (*i.e.*, 608) and private trappers (*i.e.*, 231) represents 1.7% of the estimated population, which is well below the level of take that would adversely affect coyote populations (Pitt et al. 2001). In a coyote population dynamics model, Pitt et al. (2001) did not observe a decrease in the population until more than 60% of the individuals were removed annually, all populations recovered within 1 year and the population recovered within 5 years when 60-90% of the population was removed. These findings are consistent with an model developed by Connolly and Longhurst (1975), and revisited by Connolly (1995) which indicated that coyote populations could withstand an annual removal of up to 70% and still maintain viability. This conclusion is also consistent with the U.S. General Accounting Office (1990) assessment that coyote populations in the western United States are not adversely affected by WS and that coyotes can reoccupy vacant territories rapidly (Windberg and Knowlton 1988). While removing animals from small areas at the appropriate time can protect vulnerable livestock, immigration of coyotes from the surrounding area replaces the animals removed (Stoddart 1984). Even if WS would take more than 1,500 coyotes (approx. 3% of estimated population) per year, this is still well below the 60% point where the population may be adversely affected. Based on this information, WS' impact on the coyote population in Washington, even with possible under-reporting of "Other Harvest", would not affect the coyote population because the "Total Take" of coyotes is far below 60% of the estimated population. Based on the above analysis, the cumulative harvest of coyotes in Washington is a low magnitude of impact.

Feral Dog. State, county, and municipal governments are responsible for the control of feral or free-ranging dogs. However, on an infrequent basis, WS is asked to assist in the capture or removal of feral dogs. WS took one feral dog during this analysis period; the dog was removed for the protection of HHS and aviation. Feral dogs are domestic dogs that are free-ranging in the wild but are not considered or managed as a wildlife species. Take of feral or free-ranging dogs by WS is considered to have little impact on the human environment since feral dogs are not owned by anyone nor an an indigenous component of ecosystems in Washington. Therefore, no analysis of population impacts is provided; the removal of feral free-ranging dogs by Washington WS is consistent with state law and local ordinances and this number is consistent with the analysis in USDA (1997a).

Common Raven. WS removed an average of 74 ravens annually for the protection of HHS and aviation. Between 1985 and 2005, common ravens in Washington experienced a population growth rate of approximately 300%, averaging about 14% annually (Figure 1) (USGS 2007). According to Partners in Flight, the breeding population of common ravens in Washington is about 21,000 (0.1% of the global

[15] During the calendar year (CY) 1997 sport trapping season, the WDFW reported 1,606 coyotes captured by private trappers. For CY2005, WDFW reported only 253 coyotes were captured by private individuals. This represents an 84% decrease in trapping effort/success, likely due to State Initiative 713's restrictive trapping regulations (D. Martorello, WDFW, 2007 pers. comm.), and resulted in an increase in damage complaints received by WS.

population) and during this analysis period, WS and other known removal is biologically insignificant and within the low magnitude of impacts to the species.



Impacts on Non-target Species

A common concern among members of the public and wildlife professionals, including WS personnel, is the effect of wildlife damage management on state and federally designated threatened and endangered (T&E) species and other species of special concern. To help ensure no adverse effect to listed species, WS consulted with the USFWS (USDI 1992, USDA 1997a). This consultation determined that, under USDI's (1992) reasonable and prudent measures, WS take was not likely to occur and would not jeopardize the continued existence of the listed species. USDI (1992) also outlines the circumstances under which consultation would be reinitiated and reporting procedures for potentially affected listed species. A review of USDA (1997a) Section 7 consult during this review determined that the analysis of potential impacts is still applicable. WS also consulted with WDFW to ensure no adverse effects to state listed species. WDFW concurred that the proposed action is unlikely to adversely affect state listed species. WDFW's response stipulated that consultation be reinitiated should new information reveal that adverse effects may occur. WS took no state or federally listed T&E species during the period analyzed.

WS also tracked non-target species[16] take during this analysis period (Table 5). Non-target take, for those species not listed as target species in USDA (1997a), was very low with not more than one incident per species per year, for a total of six non-target animals taken in this analysis period. This represents 0.02% of WS total take for the review period and is biologically insignificant based on species abundance and the analysis in USDA (1997a). This also demonstrates the professional ability of WS personnel and the selectiveness of the techniques used in the field when applying the WS Decision Model.

Table 5. WS Non-Target Take under Predator Damage Management Methods for FY 02 – FY 08 (MIS 2008)

Species	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	7-Year Total
Raccoon	1	0	1	0	0	0	1	3
Bobcat	0	1	0	0	0	0	0	1
Feral Dogs	0	0	0	0	0	1	0	1
Opossum	0	0	0	0	0	0	1	1

Analysis of T&E Species Potentially Affected by the Current Program

Fisher. Since the USDA (1997a) consultation, the fisher (*Martes peninanti*) was added to the state endangered list (Hayes et al. 2006). This species "utilizes forests with a high percentage of canopy closure, abundant large woody debris, large snags and cavity trees, and under-story vegetation", and "has likely been extirpated in Washington" (Hayes et. al. 2006). A search of WS records, from 1991-present, reveals that Washington WS has not taken any fisher. WS predator damage management activities are not generally requested in fisher habitat and the likelihood of encountering a fisher is extremely low due to their low numbers and that WS generally does not conduct activities in fisher habitat; WS has had no effect on fisher.

[16] Those species listed in the EA as target species may have been reported as non-target take where they were not being actively targeted. The take, while inadvertent, is analyzed and described in USDA (1997a).

Canada Lynx. From October 1, 2001 to present, Washington WS' management activities conducted in the analysis areas were performed under the 2000 Interim Policy Guidelines for Canada lynx (*Lynx canadensis*) since a Biological Opinion or other administrative guidance has not been issued by the USFWS. No lynx were taken by WS during this review period nor has WS conducted any predator damage management in lynx habitat. Therefore, WS has had no effect on lynx and there was no change in this status after designation of critical habitat for lynx (USFWS 2009).

Gray Wolf. As of February 8, 2007, those wolves found in the eastern ⅓ of Washington were included in the Northern Rocky Mountain (NRM) Distinct Population Segment (DPS) (50 FR 72, 6101-6139). The same rule also proposed delisting the NRM DPS in February 2008 when states in the DPS had adequate management plans that would maintain long-term conservation of the species.

In September 2007, WS confirmed the first wolf depredation of livestock in recent history, and at the request of and in cooperation with USFWS and WDFW, attempted to capture the offending wolf under the Wolf Response Interagency Guidelines (USFWS et al. 2007) and the Section 7 consultation conducted in 1997. These attempts were unsuccessful and no non-target species were captured. Wolves are expected to re-colonize Washington from populations in Canada and Idaho, and in 2007, there were confirmed sightings of wolves in eastern Washington. In 2008-2009, two packs of wolves were confirmed in Washington, and individuals in both packs were radio-collared by WDFW biologists. WS closely follows the status of wolves and continues to cooperate with the USFWS and WDFW, and adapts management efforts to accommodate new laws and regulations as necessary. Washington WS has not captured, killed or relocated any wolves and has had no effect on the gray wolf; therefore the analyses in the EA and Section 7 consult remain valid. However, as wolf recovery continues and statewide populations expands, WS will continue to partner with USFWS and WDFW and may be requested to capture or remove depredating wolves under USFWS and/or WDFW management regulations and plans.

Grizzly Bear. The USFWS listed the grizzly bear under the ESA in 1975 with grizzly bear distribution in two areas of Washington (*i.e.*, northern Cascades and the Selkirk area). Grizzly bears have a wide habitat tolerance, but currently exist in expansive, undisturbed mountainous habitat (USFWS 1993). This habitat is not the typical location for predator damage management and Washington WS activities do not overlap current grizzly bear habitat. WS has not targeted grizzly bears or had any non-target capture of the species. Therefore, Washington WS' predator damage management activities are having no effect on grizzly bears. Should Washington WS need to operate in occupied grizzly bear habitat, WS would consult with appropriate authorities.

Impacts on Public Safety

Between FY02 and FY08, 3,289 animals, averaging about 470 animals annually, (Table 4 and Table 5) were taken using methods analyzed in USDA (1997a) and there were no known reports of injury to domestic pets or the public from predator damage management methods used by Washington WS personnel. WS activities positively affected HHS by reducing wildlife-human-domestic animal conflicts.

WS Specialists are trained and supervised by wildlife biologists who provide guidance on methods and safety procedures based on state and federal rules, regulations, and policies as well as from field experience. Specialists routinely receive extensive training on firearm use, trapping techniques and other issues deemed important to maintaining and enhancing personal and public safety. Methods used by WS in Washington are implemented in a safe and responsible manner.

Humaneness of Control Methods

Humaneness, in part, is a person's perception of harm or pain and, as such, is a very complex concept. WS discussed and assessed "humaneness" in USDA (1997a, 1997b). This discussion remains valid. WS

seeks to use the most humane and effective methods available and continues to improve on existing methods as well as seek and investigate new methods of wildlife damage management.

Effectiveness of the WS Program in Washington

WS is largely cooperator funded; therefore, the measure of "effectiveness," to a great extent, lies in the satisfaction of those who request WS assistance. Documentation of the value of resources protected is largely unavailable due to the subjective/arbitrary nature of such estimates. Although "cost effectiveness" is important, it is not the only goal of the WS program. Environmental protection, humaneness, and land management goals often reduce effectiveness, but are critical elements of the WS predator damage management program. Nonetheless, cost effectiveness appears to be relatively high. In a recent cost effectiveness study of the California WS program, which is similar to Washington WS program, Shwiff et al. (2005) reported a benefit-cost ratio of 3.9:1. A similar study of cost effectiveness in Wyoming found that a predator damage management program benefitted the state by $9.5 to $14.0 million annually with livestock death loss rates being three times higher without predator management (Taylor 2007).

IX. WS' Programmatic Environmental Impact Statement

WS developed a Final EIS[17] that addresses the need for wildlife damage management in the United States (USDA 1997b) and contains detailed discussions of potential impacts to the human environment from wildlife damage management methods used by WS. Pertinent information in USDA (1997b) has been incorporated by reference into USDA (1997a), this summary report, and the supplemental information for the current program.

X. Site Specificity

USDA (1997a) and this supplement analyze the potential impacts of predator damage management that could occur in Washington on lands under cooperative agreement or other comparable document, and in cooperation with the appropriate public land management agencies. It also addresses the impacts of damage management activities on areas where additional agreements may be signed in the future. Because the proposed action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, USDA (1997a) anticipated this potential expansion and impacts of such efforts as part of the proposed alternative. Because livestock production and human activity occurs throughout Washington and predators are found in every county in Washington, it is conceivable that WS' activities could occur anywhere in the State.

USDA (1997a) and supplement emphasize major issues as they relate to specific areas whenever possible; however, many issues apply wherever predator damage, or potential predator damage 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 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 reduce damages and detrimental environmental effects from damage management actions (USDA 1997a, Section 2.1). The Decision Model (Slate et al. 1992) and WS Directive 2.105 describe the site-specific thought process used by WS.

Planning for the reduction of human/predator conflicts is conceptually similar to other agencies' 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

[17] Copies of WS' Programmatic FEIS are available from USDA/APHIS/WS-Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

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 predator damage will occur can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. USDA (1997a) and this supplement emphasize major issues as they relate to specific areas whenever possible, however, many issues apply wherever predator conflicts and resulting management occurs, and are treated as such. The analyses are intended to apply to any action that may occur *in any locale* and at *any time* within Washington. In this way, WS believes we meet the intent of NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with NEPA, be able to meet needs for assistance with predator damage management in a timely fashion and accomplish its mission. Decisions made using this thought process will be in accordance with minimization measures and Standard Operating Procedures described in USDA (1997a) established as part of any FONSI. This supplement adds to the analysis in USDA (1997a) and Decision and all information and analyses in USDA (1997a) remains valid unless otherwise noted.

XI. Public Involvement

Availability of a pre-decisional EA was announced on August 11, 1997 through publication of a Notice of Availability (NOA) for three consecutive days in three newspapers with circulation throughout Washington; WS provided a 30-day public comment period. Following consideration of comments, a FONSI was issued with a Decision signed October 27, 1997. A NOA was again published in the same three major newspapers on November 10, 1997 informing the public of the availability of the Decision. The NOA stated that copies of the EA and Decision were available from the Washington WS State Office, 720 O'Leary St NE, Olympia, WA 98502.

As part of a public review and comment process, the Summary Review and supplement was made available through a NOA published for 3 consecutive days, starting April 1, 2009 in *The Olympian*, the paper used for legal notices by WS in Washington (Fed. Reg. 72:13237-13238, March 21, 2007). Comments were received and considered and this document is being reissued to further address those comments. The Summary Review and supplement was also available at http://www.aphis.usda.gov/regulations/pdfs/nepa/ and notices were mailed to known interested parties. These notices stated that WS was providing an opportunity for public review and comment for 30-days and copies of USDA (1997a), Summary Report and supplement may be obtained from the USDA-APHIS-WS, Washington State Office, 720 O'Leary St NE, Olympia, WA 98502.

XII. Compliance and Monitoring

The WS program in Washington reviews program activities to ensure that program activities are within the scope of analysis contained in USDA (1997a). If WS' activities identified during monitoring are outside the scope of the analyses in USDA (1997a) or if new issues are identified from available information, further analysis will occur and USDA (1997a) will be supplemented to the degree as identified by those processes pursuant to NEPA. WS' predator damage management has been conducted in a manner consistent with all applicable environmental regulations, including the ESA and NEPA. WS representatives will continue to consult with WDFW, USFWS, and WDNR regarding the conduct of wildlife damage management. Substantial changes in the scope of work or changes in relevant guidance documents or environmental regulations may trigger the need for further analysis.

XIII. Summary of Cumulative Impacts

Based on this analysis and evaluation, effects of implementing the current program have been consistent with the effects analyzed in USDA (1997a) and are not having a significant impact, individually or cumulatively, on the quality of the human environment, and the affected environment remains essentially unchanged. No significant cumulative environmental impacts have been identified from the

implementation of the current program during FY 2002 through FY 2008, nor are any expected from activities considered under USDA (1997a) and the supplement to the current program. Under the current program, activities to alleviate predation using an adaptive integrated approach employing both nonlethal and lethal methods would not have significant impacts on wildlife populations in Washington. WS continues to coordinate activities with federal, state, and local entities to ensure activities do not adversely impact wildlife populations or other resources. No risk to public safety is expected when WS' activities are conducted pursuant to the proposed action or the supplement to the current program. While the analysis in USDA (1997a) remains valid, the current program is supplemented with an analysis of the addition of raccoon and opossum damage management, as requested by the resource owner(s) who are suffering damage. Therefore, the analysis in USDA (1997a) remains valid. Moreover, the supplemental analysis to the current program (attached) provides additional information and analysis for the Washington predator damage management program. These discussions and analyses of additional issues and their potential environmental effects related to the Washington WS predator damage management program support WS' selection of the Proposed Alternative and continued implementation of an adaptive integrated predator damage management program in the State of Washington.

Literature Cited

Ashman, D., G. C. Christensen, M. C. Hess, G. K. Tsukamoto, and M. S. Wichersham. 1983. The Mountain Lion in Nevada, Nevada Department of Wildlife, Reno, Nevada.

Baker, R. O. R. M. Timm. 1998. Management of conflicts between urban coyotes and humans in southern California. Proc. Vertebr. Pest Conf. 18: 299-312.

Beier, P. 1991. Cougar attacks on humans in the United States and Canada. Wildl. Soc. Bull. 19:403-412.

Boddicker, M. L. 1980. Trapping Rocky Mountain Furbearers. Colorado Trapper's Association Training Manual, 181pp.

CDFG (California Department of Fish and Game). 2006. Verified Mountain Lion Attacks on Humans in California (1890 through 2006). State of California, Department of Fish and Game.

CDOW (Colorado Division of Wildlife). 2006. Draft reported lion attacks on humans, 1990 to present.

Connolly, G. E. 1995. The effects of control on coyote populations: another look. Pages 23-29 *in:* D. Rollings, C. Richardson, T. Blanenship, K. Canon, and S. Henke, eds. Coyotes in the Southwest: A compendium of our knowledge. Texas Parks and Wildlife Department, Austin, TX, USA.

Connolly, G. E., and W. M. Longhurst. 1975. The effects of control on coyote populations. Div. of Agric. Sci., Univ. of Calif. Davis. Bull. 1872. 37 pp.

Conover, M. 2002. Resolving human-wildlife conflicts: The science of wildlife damage management. CRC Press Company, Lewis Publishers, New York, New York, USA.

Cougar Management Guidelines Working Group. 2005. Cougar Management Guidelines. Wild Futures, Bainbridge Island, Washington, USA. 77 pp.

Hayes, G. E., and J. C. Lewis. 2006. Washington State Recovery Plan for the Fisher. Washington Department of Fish and Wildlife, Olympia. 62+ viii pp.

Linnell, M.A., M.R. Conover and T.J. Ohashi. 1996. Analysis of bird strikes at a tropical airport. J. Wildl. Manage. 60: 935–945.

Logan, K. A., L. L. Sweanor, T. K. Ruth, and M. G. Hornocker. 1996. Cougars of the San Andres Mountains, Colorado. Final Report. Federal Aid Wildl. Restor. Project W-128-R. New Mexico Dep. Game and Fish, Santa Fe. 280 pp.

Loven, J. E. 1995. Coyotes in urban areas: a status report. Sym. Proc. Coyotes in the Southwest: a compendium of our knowledge. Dec. 13-14, 1995San Angelo, TX

MIS (Management Information System). 2008. Washington program data (Unpubl. Draft). United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Olympia, Washington, USA.

NASS (National Agricultural Statistics Service). 2005. Sheep and Goat Predator Loss. Washington D.C. 18 pages. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1628

NASS. 2006. 19 pages. Cattle Death Loss. U.S. Dept. Agric., Natl. Agric. Statistics Serv., Washington, DC. http://usda.mannlib.cornell.edu/usda/current/CattDeath/CattDeath-05-05-2006.pdf

Pitt, W. C., F. F. Knowlton, and P. W. Box. 2001. A new approach to understanding canid populations using an individual-based computer model: preliminary results. Endangered Species Update 18:4.

Riley, S. J. 1998. Integration of environmental, biological, and human dimensions for management of mountain lions (*Puma concolor*) in Montana: A dissertation presented to the faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for A PhD.

Rolley, R. E. 1985. Dynamics of a Harvested Bobcat Population in Oklahoma. J. Wildl. Manage. 49: 283-292.

Schwiff, S. A., R. T. Sterner, K. N. Kirkpatrick, R. M. Engeman, and C. C. Coolahan. 2005. Wildlife Services in California: Economic Assessments of Select Benefits and Costs. National Wildlife Research Center, 4101 La Porte Avenue, Ft. Collins, Colorado 80521.

Slate, D.A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Trans. North Amer. Wildl. Nat. Res. Conf 57:51-62.

Stoddart, L. C. 1984. Relationships between prey base fluctuations and coyote depredation on sheep on the Idaho National Engineering Laboratory (INEL), 1979-1982. Unpublished Research Work Unit Report. Denver Wildl. Res. Cent. 16 pp.

Taylor, D. T. 2007. Preliminary Estimates of the Economic Benefits of Predator Management in Wyoming. University of Wyoming. Department of Agricultural and Applied Economics, Dept. 3354, Agriculture Cuilding, 1000 E. University Ave, Laramie, WY, 82071.

The Wildlife Society. 1992. Conservation policies of The Wildlife Society: A stand on issues important to wildlife conservation. The Wildlife Society, Bethesda, Maryland, USA.

USDA. 1997a. Predator Damage Management in Washington. USDA-APHIS-WS, 720 O'Leary Street, NW, Olympia, WA 98502

USDA. 1997b (revised). Animal damage control program, final environmental impact statement. USDA-APHIS-ADC [WS] Operational Support Staff, 4700 River Road, Unit 87, Room 2D-07.3, Riverdale, Maryland, USA.

USDI. 1992. Biological Opinion. Animal Damage Control Program U.S. Fish and Wildlife Service, Washington D.C.

USFWS. 1993. Grizzly Bear Recovery Plan. Missoula, MT. 181 pp.

USFWS. 2009. Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx. Federal Register 74(36): 8616- 8702.

USFWS, WDFW, WS. 2007. Response Guidelines for Reported Gray Wolf Activity in Washington State. Jan 23, 2007.

USGS. 2007. Online. North American Breeding Bird Survey Trend Results: Common Raven. http://www.mbr-pwrc.usgs.gov

U.S. Government Accounting Office. 1990. Wildlife Management: Effects of Animal Damage Control Program on Predators. U.S. GAO Report to the Hon. Alan Cranston, U.S. Senate. GAO/RCED-90-149. 31 pp.

WDFW. 2008a. 2008-2015 Game Management Plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA.

WDFW. 2008b. Online. Hunter Harvest Reports. http://wdfw.wa.gov/wlm/game/harvest/2006/index.htm.

WDFW. 2007. Online. http://wdfw.wa.gov/wlm/living/coyotes.htm.

Windberg, L. A. and F. F. Knowlton. 1988. Management implications of coyote spacing patterns in southern Texas. J. Wildl. Manage. 52:632-640.

Ziegltrum, G. 2006. Cost-effectiveness of the black bear supplemental feeding program in western Washington. Wildl. Soc. Bull. 34:375-379.

SUPPLEMENT TO THE PROPOSED ACTION of the PREDATOR DAMAGE MANAGEMENT IN WASHINGTON EA:

I. Introduction

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program prepared an environmental assessment (EA) to evaluate potential impacts to the quality of the human environment from the implementation of a predation damage management program in Washington (USDA 1997a). USDA (1997a) analyzed potential impacts of the WS program as it involves conflict resolution with predatory species, such as, coyotes (*Canis latrans*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos horribilis*), gray wolves (*Canis lupus*), cougar (*Puma concolor*), red fox (*Vulpes vulpes*), bobcats (*Felis rufus*), badgers (*Taxidea taxus*), feral/free ranging dogs (*Canis familiaris*), and ravens (*Corvus corax*). The Washington WS program conducts conflict reduction activities with various methods, as analyzed in the EA, on various land classes[18], as requested. USDA (1997a) evaluated the need for damage management and the relative effectiveness of five alternatives analyzed in detail to meet that proposed need, while considering the potential environmental effects of those activities. WS' proposed action evaluated an adaptive integrated damage management program in the State to address the need for resolving predation damage while minimizing impacts to the human environment. Alternative 5, the "Expanded Program Alternative" was selected as the Preferred Alternative and a Finding of No Significant Impact (FONSI) was issued and a Decision signed October 27, 1997. The WS predator damage management program has limited effects on the human environment. Evaluations conducted in USDA (1997a), showed there are no effects on soils, silvacultural practices, water, cultural resources, air quality, prime or unique farmlands, floodplains, wetlands, or riparian zones. There have been no changes to those analyses. Copies of USDA (1997a) and FONSI are available from the Washington WS State Office, USDA, APHIS, WS, 720 O'Leary Street NW, Olympia, WA 98502.

II. Scope and Purpose

The scope and purpose of this supplement to USDA (1997a) remains as addressed in Chapter 1 of USDA (1997a). This supplement analyzes issues that have been identified since completion of USDA (1997a) and Washington WS' conduct of raccoon (*Procyon lotor)* and opossum (*Didelphis virginiana*) damage management, as requested, and the potential impacts to the human environment. It is understood that the new issues and their potential effects are applicable to the alternatives listed in USDA (1997a) to the extent they are applicable and appropriate to this supplement.

III. Need for Action

A description of the need for action to address predation threats in Washington is provided in USDA (1997a). The need for action addressed in USDA (1997a) remains applicable to this supplement, that the adverse effect of predation on resources or human health and safety (HHS) can be serious (Table 1 and 2). The damage data is not conclusive, as many damages do not get reported to WS, but is representative of a problem facing livestock producers, organizations and individuals in the State of Washington.

VI. Supplement to USDA (1997a)

Addition of Raccoons and Opossums to the Analysis

[18] Current program activities are conducted on private, municipal, and tribal lands throughout Washington, on State lands which are leased for livestock grazing and managed by the Southeast or Northeast Regions of the WDNR, on U.S. Department of Defense lands, and on the USFWS wildlife refuges where agreements are in place. The WDNR lands are generally interspersed with or adjacent to private ranch lands and are managed, in part, for livestock grazing.

USDA (1997a) evaluated the need for predator damage management to protect livestock, property, natural resources, and threats to HHS along with issues and alternatives to protect those resources. WS continues to receive requests for assistance to reduce damage and threats to livestock, property and to protect HHS from predators in the State. During this analysis period, WS has received requests to reduce damage or potential damage from raccoons and opossum found in Washington and WS provided technical assistance (TA) and operational assistance to those requesters resulting in take (Table S-1). This, in turn, has lead to an increase in requests for assistance from individuals for raccoon and opossum damage management services. The supplement to the current program evaluates impacts to raccoon and opossum populations found in Washington and the likely increase in requests for assistance, primarily associated with damage and threats to property and HHS. This supplement evaluates the current program as it relates to raccoon and opossum damage management in the State, which could include an annual take of up to 150 individuals of each species as part of an adaptive integrated damage management approach as described in the proposed action in USDA (1997a).

Table S-1. Take and Damage Data for Raccoons and Opossums.

	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008
Raccoon Take	7	17	53	17	31	44
Opossum Take	5	7	14	3	64	9
Raccoon Damage	$1,680	$22,600	$1,289	$6,320	$3,595	$10,180
Opossum Damage	$576	$0	$910	$350	$1,550	$200

Potential Impact from Raccoon and Opossum Damage Management

As stated previously, the supplement evaluates potential impacts related to the need for the reduction of damage and threats associated with raccoons and opossums in the State. WS will continue to use methods in an adaptive integrated approach to effectively reduce threats and damages as described under the current program. Methods available to WS as part of an integrated approach are evaluated and discussed in detail in USDA (1997a, Appendix 2).

Raccoons and opossums are classified by WDFW as “small game and furbearer” and “unclassified” (WDFW 2008), respectively, and are considered “anthropogenic abundant” (Conover 2002). According to Duda et al. (2008), 29% of Washington residents experienced conflicts with wildlife. The most common species were coyotes, raccoons, and deer. According to the WDFW Game Management Plan 2009-2015, “the abundance of individual small game animals, furbearers, and unclassified wildlife is largely unknown. However, because these animals typically have high population growth rates and often experience compensatory mortality, the risk of over-exploitation is low” (WDFW 2008).

Impact on Raccoons and Opossums

Raccoons

The raccoon is a member of the family *Procyonidae* that includes ringtails and coatis in North America. Raccoons are highly omnivorous, feeding on carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, a wide variety of grains, various fruits, other plant materials, and foods prepared for human or animal consumption (Sanderson 1987). The majority of requests stem from urban areas where raccoons pose a threat to HHS or the safety of pets or livestock. According to WDFW (2008), raccoons in Washington may carry canine distemper and round worms, will kill poultry, damage gardens, and occasionally enter homes or get stuck in chimneys. Raccoons often become a nuisance by digging through garbage cans and spreading litter through neighborhoods. Duda

et. al. (2008) stated 53% of Washingtonians support raccoon population reduction for the protection of HHS and 54% support population reduction to protect livestock or pets.

Raccoon Population Impact Analysis

Sanderson (1987) stated that absolute population densities of raccoons are difficult, if not impossible, to determine. Twichell and Dill (1949) reported one of the highest densities after they removed 100 raccoons from a winter denning area on 101 acres of a waterfowl refuge in Missouri. Other studies have documented raccoon densities that ranged from 9.3 to 80/mi^2 (Yeager and Rennels 1943, Urban 1970, Sonenshine and Winslow 1972, Hoffman and Gottschang 1977, Rivest and Bergeron 1981).

The sustainable harvest level for raccoons in USDA (1997b) was established at 49% of the total population. Washington WS raccoon take is minimal (Table S-1) and WS removal of up to 150 raccoons will not have an adverse impact on the population (D. Martorello, WDFW, 2007 pers. comm.).

Opossums

The opossum is the only native marsupial in North America, are a non-native species in Washington, and are state designated as "unclassified.[19]" They can be hunted or trapped year round with no bag limit. WDFW does not track harvest of opossums (WDFW 2008). They are generally reported to damage property/gardens, injure pets/livestock, or be a nuisance by defecating and living under houses (MIS 2008).

Opossums are omnivorous, feeding on insects, fruits, crustaceans, and mammals (Gardner 1982, Seidensticker et al. 1987). Female opossums are capable of breeding from five to seven times throughout the season (Reynolds 1952, Jurgelski and Porter 1974) which extends from January through November (Gardner 1982). If the female loses her young, she will go into estrus 2 - 8 days later (Reynolds 1952). Although they are capable of breeding numerous times, female opossums are capable of raising two litters per year (Gardner 1982, Seidensticker et al. 1987) with a mean litter size of 8.5 for earlier litters and 6.6 for later litters (Llewellyn and Dale 1964). The female has functional nipples for 13 young (Gardner 1982) and it is capable of producing 15 (Seidensticker et al. 1987), 16 or even 17 young (Gardner 1982). Opossums are primarily associated with three habitats: 1) wet, shrubby thickets with small trees and abundant ground cover, 2) forest edges removed from water sources with a variety of trees and tree sizes, and 3) areas near water with many small trees, a few large ones, and an open canopy (Seidensticker et al. 1987). High mortality and rapid population turnover are characteristic of opossums (Hunsaker 1977, Gardner 1982). The life expectancy of an opossum is one year with only 8% of the males and 5% of the females surviving for longer (Seidensticker et al. 1987).

Opossum Population Impact Analysis

Harvest data alone will not predict future population trends of opossums; environmental conditions during the reproductive season preceding the harvest must also be considered (Seidensticker et al. 1987). Because the reproductive season is limited to one year for >90% of females, the survival of the species in an area primarily depends on how predictable the availability of food resources will be from one year to the next (Seidensticker et al. 1987). WS removal of up to 150 opossums will not have an adverse impact on opossums inhabiting Washington (D. Martorello, WDFW, 2007 pers. comm.).

[19] WDFW reports an objective of creating a web-based reporting system for unclassified wildlife in its 2008 Game Management Plan (WDFW 2008) which may help analyze WS future impacts.

WS expects to continue the current trend for raccoon and opossum take, which will not adversely affect their populations or the human environment. WS will monitor the activities under the guidelines in USDA (1997a) and will consult with the WDFW or reanalyze activities, if necessary.

Methods Proposed for Use

WS' primary methods proposed for use and used for capture of raccoons and opossums are cage traps and padded foothold traps. Technical assistance may be provided as well. A detailed description of the wildlife damage management methods that could be used or recommended by Washington WS to reduce raccoon and opossum damage or threats of damage is provided in USDA (1997A, Appendix 2) and USDA (1997b, Appendix J). Since the completion of USDA (1997a), no additional methods are being proposed for use as part of an adaptive integrated damage management strategy by WS.

Impacts on Non-target Species

Non-target take for the Washington WS predator damage management program during this analysis period was very low with not more than one incident per species per year. This represents 0.02% of WS total take for the review period and is biologically insignificant based on species abundance and the USDA (1997a) analysis and the non-target take is not anticipated to increase with the inclusion of raccoon and opossum damage management into the current program.

Impacts on T&E Species

To help ensure no adverse effect to listed species, WS consulted with the USFWS (USDI 1992, USDA 1997a). This consultation determined that under the reasonable and prudent measures outlined in USDI (1992), WS activities would not jeopardize the continued existence of listed species. A review of the 1997 ESA Section 7 consultation determined that the analysis of potential impacts is still applicable. WS also consulted with WDFW to ensure no adverse effects on state listed species. WDFW concurred with the conclusion that the proposed action is unlikely to adversely affect state listed species. To date, WS has not taken any state or federally listed T&E species and the inclusion of raccoon and opossum damage management is not anticipated to increase the risk of take or the take of listed species, as cage traps will be the most frequently used method for raccoon and opossum damage management.

Impacts on Public Safety

Between FY02 and FY08 there were no known reports of injury to domestic pets or the public from predator damage management methods used by WS personnel. WS Specialists are trained and supervised by wildlife biologists who provide guidance on methods and safety procedures based on state and federal rules, regulations, and policies as well as from field experience. Specialists routinely receive extensive training on firearm use, trapping techniques and other issues deemed important to maintaining and enhancing personal and public safety. Methods used by WS in Washington are implemented in a safe and responsible manner. Further, Washington WS activities positively affected public safety by reducing damage or threats to human and pet health and safety.

Humaneness of Control Methods

Humaneness, in part, is a person's perception of harm or pain and, as such, is a very complex concept. WS discussed and assessed "humaneness" in USDA (1997a, 1997b). This discussion remains valid. WS uses the most humane and effective methods available and continues to improve on existing methods as well as seek and investigate new methods of wildlife damage management. Humaneness of methods would not change with the inclusion of raccoon and opossum damage management into the current program.

Effectiveness of the WS Program in Washington

WS is largely cooperator funded; therefore, the measure of "effectiveness," to a great extent, lies in the satisfaction of those who request WS assistance. As stated earlier, environmental protection issues, humaneness, and land management goals often reduce effectiveness, but are nonetheless important parts of the WS damage management program. The effectiveness to reduce HHS risks are very difficult to determine because the value of threats or diseases averted is difficult to determine, but HHS or damage threats require action to resolve the situation.

Comparison with the other Alternatives Analyzed in USDA (1997a)

The effects of raccoon and opossum damage management conducted under the other alternatives analyzed in detail in the EA are:

Alternative 1- Continuation of the Current Washington PDM program in the State (No Action). The analysis of impacts showed that Alternative 1 would have low magnitude impacts on raccoon and opossum. The effectiveness, however, is determined to be less than the Expanded Program since WS would not be available to respond to increased requests for assistance. Cumulative impacts were determined to be low.

Alternative 2 - Technical Assistance Program. Under this alternative, WS would not provide any operational damage management assistance to persons or agencies experiencing raccoon and opposum damage problems, but would instead provide only advice, recommendations, and limited technical supplies and equipment. Control activities could be conducted by persons with limited experience and training, and with little oversight or supervision. Risks to the public could be greater, and effectiveness and selectivity would probably be lower. Cumulative impacts on raccoon and opossums would be low.

Alternative 3. The Nonlethal Before Lethal Alternative Nonlethal Damage Management Required Prior to Lethal Control – Under this alternative, no standard exists to determine diligence in applying nonlethal methods nor are there any standards to determine how many nonlethal applications are necessary before initiation of lethal damage management. WS is authorized and directed by law to reduce damage caused by wildlife. Alternative 3 would not allow WS to: 1) respond to all requests, 2) assist the WDFW or USFWS in meeting wildlife management objectives, and 3) immediately address HHS requests. Cumulative impacts on raccoon and opossums would be low.

Alternative 4. No Federal APHIS-WS Program - No Federal Predator Damage Management Program. This alternative would not allow WS to conduct any raccoon or opossum management activities, nor comply with its statutory responsibilities, and risks to the public would be greater. The lack of availability of WS expertise would result in reduced effectiveness and selectivity, and increased amounts of damage. Cumulative impacts on raccoon and opossum populations would be low.

V. New Issues Identified Since Completion of the Predator Damage Management EA

The Washington WS predator damage management program has limited effects on the human environment as analyzed in USDA (1997a, 1997b). Issues were identified during preparation of USDA (1997a) and some were analyzed in detail under each of the alternatives in USDA (1997a). Those issues were also used to identify minimization measures and to develop SOP's for reducing or eliminating the likelihood of adverse environmental effects from implementation of the current program. Other issues, however, did not receive detailed analyses because Washington WS' activities related to the issue would not have an adverse affect on the legal, social, economic environment or the quality of the human environment. The following issues or concerns, identified (either locally or nationally) since completion of USDA (1997a) and the

previous release of this document, did not have an adverse affect on the legal, social, economic or the quality of the human environment.

1. Potential for Lethal Predator Damage Management to Cause Increased Predation and Increased Predation through Compensatory Reproduction
2. WS Focuses almost all Resources on Lethal Methods.
3. Use of Reproductive Inhibitors or Sterilization
4. Effects of Predator Damage Management on Aesthetic Enjoyment of Predators
5. Predator-prey Relationships
6. WS' Affect on Biodiversity
7. Cost - Benefit Analysis
8. Federal Direction to provide Predator Damage Management
9. Providing Public Education and Outreach
10. Aerial Gunning Impacts
11. Effects on Wildlife from WS Gunshot Noise
12. American Indian and Cultural Resource Concerns
13. Effects from Use of Lead (Pb) Ammunition in Washington

1. Potential for Lethal Predator Damage Management to Cause Increased Coyote Populations and Increased Predation through Compensatory Reproduction

Washington WS does not manage populations, but targets problem individuals/groups in areas that experience damage/depredation to alleviate or prevent further damage. Two studies (Connolly et al. 1976, Gese and Grothe 1995) investigated the predatory behavior and social hierarchy of coyotes, and determined that the more dominant (alpha) animals (*i.e.*, breeding animals) were the ones that initiated and killed most of the prey items. Connolly et al. (1976) concluded from pen studies, with known aged coyotes, that the proclivity of individuals that attacked livestock seemed related to their age and relationship with conspecifics. The coyotes that attacked sheep most frequently were the dominant males and females, with the males responsible for the majority of the attacks and kills. Gese and Grothe (1995) concluded from observing wild coyotes that the dominant pairs (*i.e.,* breeding pairs) were involved in vast majority of predation attempts. Till and Knowlton (1983) and Till (1992) observed that the coyotes most likely to kill sheep are the coyotes raising pups. By removing dominant/territorial animals, the likelihood of transient coyotes reoccupying vacated territories and establishing their own territories in time to produce pups is greatly reduced, thus reducing the likelihood of livestock predation during that particular grazing season (Wagner and Conover 1999).

Further, coyotes are monestrous with generally only the dominant breeding pair producing a single litter per territory each spring (Kennelly and Johns 1976); beta females rarely produce offspring (Gese et al. 1996). Crabtree and Sheldon (1999) suggested that litter size at birth (among coyotes) appears relatively invariant with respect to changes in prey abundance, and that litter size at birth appears largely unaffected by levels of human exploitation. Because stable populations require that on average breeding adults only recruit enough surviving offspring into the breeding population to replace themselves, normally less than 10% of the young from a given pair of coyotes need to survive and reproduce to maintain the population (Knowlton et al. 1999). The other 90% may reproduce successfully, contributing to population growth in an area of occupation, or die. Available food, especially in winter (Weaver 1979, Gese et al. 1996), is often considered the major factor regulating coyote abundance (Gier 1968, Clark 1972). Connolly and Longhurst (1975) and Pitt et al. (2001) demonstrated that coyote populations in exploited and unexploited populations do not increase at significantly different rates and that an area will only support a population to its carrying capacity.

2. WS Focuses Almost all Resources on Lethal Methods.

Washington WS applies the WS Decision Model (Slate et al 1992) as described in USDA (1997a, 1997b), and nonlethal methods are preferred when deemed effective (WS Directive 2.101). WS provides TA recommendations for the use of nonlethal methods to landowners who may or may not implement the methods based on each method's merit or other factors that pertain to the situation. According to a National Agricultural Statistics Service (NASS 2005) survey on cattle losses, nationwide farmers and ranchers spend $199.1 million annually on nonlethal methods to reduce predation. According to a GAO (2001) *"...although nonlethal methods have helped reduce losses, they have not brought them to levels that most clients believe are economically viable. For livestock producers who are already operating on a small profit margin, the addition of even a low percentage of losses could drive a business into deficit."* Implementation of nonlethal methods often occurs simultaneously with lethal methods as part of an integrated and adaptive approach and as directed by use of the WS Decision Model. Recommendations are provided prior to operational management by Washington WS, and nonlethal method use is primarily the responsibility of the landowner.

2a. WS' goal is to reduce damage not to remove as many animals from an area as possible.

The WS' mission is to, "provide federal leadership and expertise to resolve wildlife conflicts and create a balance that allows people and wildlife to coexist peacefully." Further, WS' goal is to reduce damage not "*to remove as many animals from an area as possible."* Washington WS uses carefully chosen methods which are selective, effective, legally available and has implemented those methods as humanely as possible in an adaptive integrated wildlife damage management strategy. WS takes as few animals as necessary to reduce damages to an acceptable level.

3. Concern that WS will use Reproductive Inhibitors or Sterilization

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

Potential environmental concerns with chemical sterilization would still need to be addressed, including safety of genetically engineered vaccines to humans and other wildlife. At this time, chemical sterilization is controversial among wildlife biologists and many others. Should chemical sterilants become registered in the State of Washington in the future, WS could consider them among the methods to be used in the program. Any additional NEPA or other analyses deemed necessary at that time would be conducted.

These methods were not analyzed in detail in USDA (1997a) because: (1) surgical sterilization would require that each animal be captured and sterilized by licensed veterinarians and would therefore be extremely labor intensive and expensive; and (2) there are no federally or state approved contraceptive measures currently available for operational use in predator damage management.

3a. WS conducts research on new management methods including sterilization and reproductive inhibitors.

WS studies reproductive inhibitors and sterilization along with many other management methods and strategies at the National Wildlife Research Center (NWRC), headquartered in Fort Collins, Colorado. Washington WS receives no funding and has not been involved in any reproductive inhibitor research, although WS routinely incorporates new methods of wildlife damage management that are developed by NWRC and approved by the regulatory agencies.

4. Effects of Predator Removal on the Public's Aesthetic Enjoyment of Predators.

Aesthetics is the philosophy dealing with the nature or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful and possibly the resources at risk. Wildlife generally provides economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exist is a positive benefit to many people. Some members of the public have expressed concerns that predator damage management could result in the loss of aesthetic benefits to the public, resource owners, or local residents. However, the knowledge that predators affect livestock and pets has a negative effect on many people, too.

WS predator damage management has occurred in a relatively limited portion (*i.e*., 2.7%) of the total area in Washington and the proportion of predators removed through WS predator damage management activities is typically low (*i.e*.1.7% of the estimated coyote population). In localized areas where WS removes a portion of the predator population, dispersal of predators from adjacent areas typically contributes to repopulation of the area within a few weeks to a year, depending on time of year, habitat, prey base, the level of predator removal, predator population levels in nearby areas, as well as other factors. Most of the species targeted by WS predator damage management are relatively abundant, but are not commonly observed because of their secretive and largely nocturnal behavior (Conover 2002). The potential to see or hear a predator in some localized areas could be temporarily reduced as a result of WS predator damage management, but because there is already a low likelihood of seeing a predator and management generally occurs on private land with limited public access, this temporary local reduction in public viewing opportunity would not likely be noticeable in most cases. Private landowners request WS' assistance to reduce damage and would limit the public access to their property if it would mean that predator management could not occur. Effects on overall predator populations are relatively minor (*i.e.,* 1.7% of the estimated coyote population) and opportunities to view, hear, or see evidence of predators would still be available if interested persons would go to the 98.3% of land where Washington WS does not conduct activities. Therefore, WS does not have a substantial effect on the public's ability to enjoy the aesthetics of seeing or hearing predators in Washington.

4a. WS' recognition of the benefits of native wildlife to the ecosystem as a whole.

WS recognizes the benefits of predators to the environment and coordinates actions with the WDFW and USFWS to insure no adverse effects to native species. Washington WS has effectively described their activities, detailed take (*i.e.,* 1.7% of the estimated coyote population), report that take to the WDFW and analyzed impacts and issues surrounding predator damage management. Due to the relatively small geographic area where WS provides assistance, the small percentage of predators removed from the environment, and the temporary natural of any population reduction that occurs, the impacts on the benefits that native wildlife provide to the ecosystem would be small.

WS operates according with all federal and applicable state laws and regulations enacted to ensure species diversity and viability and WS recognizes that wildlife is a public resource held in trust and managed by state and federal agencies (WS Directive 1.201). Government agencies, including WS, strive to conserve and manage wildlife while being responsive to the public desires, views and attitudes. By its very nature, wildlife is a highly dynamic and a mobile resource that can cause damage to agriculture and property, pose risks to HHS, and negatively affect industrial and natural resources. WS' predator damage management is not conducted to eradicate or devalue any native wildlife population but rather to reduce damage or potential damages.

4b. Distribution of wildlife in Washington

The distribution of species found in Washington can be found at: http://wdfw.wa.gov/wlm/gap/dataprod.htm. The analyses in USDA (1997a) and supplemental analysis cover Washington WS activities wherever requested and coordinated with WDFW and/or USFWS.

4c. Washington WS' take of federally-protected species

Federal agencies are required to consult where there is the possibility for federal action to adversely affect listed species. Washington WS consults with USFWS and WDFW as necessary to avoid unintentional take of any listed species. Washington WS disclosed all take for the 7-year reporting period. No federally or state listed T&E species were taken by Washington WS during this review period. The Section 7 consult was reviewed during the preparation of this Summary Report and found to be current and accurate. Take of other federally or state protected species by Washington WS is conducted under authority of licenses and/or permits issued by the appropriate wildlife management agency (*e.g*., USFWS, WDFW).

Comments regarding the WS program in other states are outside the scope of this analysis; however WS nationwide operates in accordance with federal and applicable state laws and regulations. WS, on the national and state levels, conducts Section 7 consultations with the USFWS and state wildlife agencies when appropriate to insure that WS actions do not adversely affect any listed species.

4d. WS should review the aesthetics of aerial gunning.

Washington WS' aerial gunning operations only occurred on private and leased state lands for individuals or managers that requested WS' assistance to reduce predator damage. Private landowners that request WS' assistance to reduce damage would limit the public access to their property if it would mean that predator management (*i.e*., aerial gunning) could not occur. The areas where these activities occurred only totaled 0.4% of the area of the state and averaged less than 10 minutes spent per square mile. WS worked only where agreements were in place and work was requested by and coordinated with the land owner or leasee.

5. Predator-Prey Relationships

The relationship between predators and prey populations (predator-prey relationship) has been summarized in USDI (1979). Prey populations normally fluctuate in multi-year cycles with two basic schools of thought as to the factors responsible for these fluctuations. One is that prey populations are self-regulated through behavior (*i.e.*, changes in reproductive capacity due to stress, or genetic changes (Chitty 1967, Myers and Krebs 1971), or those populations are regulated by environmental factors such as food and predation (Pitelka 1957, Fuller 1969)).

Keith (1974) concluded that: 1) during cyclic declines in prey populations, predation has a depressive effect and as a result, the prey populations may decline further and be held at relatively low densities for some time, 2) prey populations may escape this low point when predator populations decrease, and 3) since most prey populations increase at a faster rate than predator populations, factors other than predation must initiate the decline in populations.

Wagner and Stoddart (1972) and Clark (1972) independently studied the relationship between coyote and jackrabbit *(Lepus califoricus)* populations in northern Utah and southern Idaho. Both noted that coyote populations increased as jackrabbit numbers increased, but with a 1-2 year delay, suggesting that the prey population controlled the predator population. However, when a broad range of prey species are available, coyotes will generally feed on all species available; therefore coyote populations may not vary with changes in the availability of a single prey species (Knowlton 1964, Clark 1972). Wagner (1988) reviewed literature on predator effects on prey populations and concluded that such impacts vary with the locale. In some ecosystems, prey species such as snowshoe hares (*L. americanus*) increase to the point that vegetative food sources are depleted despite predation. In others, (*e.g.,* jackrabbits in the Great Basin), coyotes may limit jackrabbit density and evidence indicates food shortages do not appear to limit jackrabbit abundance. Wagner and Stoddart (1972) reported that coyote predation was a major source of jackrabbit mortality and may have caused a decline in jackrabbit numbers in the Curlew Valley in Utah.

Henke (1992) determined that rodent diversities may change because of intense coyote removal (more intensive than Washington WS predator removal efforts) on a short term basis (≤6 months). Rodent biomass, however, did not vary when compared to areas where intensive predator removal was conducted and areas with no removal. This diversity change was only noted in areas of intensive predator removal and was short-lived; returning to pre-removal levels after removal was stopped. In two studies conducted in south Texas (Beasom 1974, Guthery and Beasom 1977), intensive short-term predator removal was employed to test the response of game species to reduced coyote abundance. At the same time, rodent and rabbit species were monitored. A marked reduction in coyote numbers apparently did not affect the populations of rabbits or rodents in either study[20]. Similarly, Neff et al. (1985) noted that reducing coyote populations on their study area in Arizona to protect pronghorn antelope (*Antilocapra americana*) fawns did not affect the rodent or rabbit population.

Ballard et al. (2001) summarized predator-prey relationships especially as it relates to deer management. Predators may have a depressing effect on deer herds, especially when deer populations are substantially below vegetative carrying capacity. In research studies summarized in that paper, predation management was shown to be beneficial when conducted under certain circumstances (*e.g.,* depressed deer herds, predators were a limiting factor, predator removal could be conducted at an effective level, etc.). Washington WS assists in the protection of federally endangered Columbian white-tailed deer (*Odocoileus virginianus leucurus*). In years when coyote management was implemented, a marked increase in fawn survival was observed compared to years without coyote management (P. Meyers, USFWS 2008 pers. comm.). Washington WS may be requested by state or federal wildlife agencies to conduct predator management for the protection of other species in the future.

The Washington WS program removes a relatively small number of coyotes when compared to estimated populations, and WS' effect on predator prey relationships is nonexistent when compared to natural events.

5a. Consider predator-prey relations from other ecosystems as models for potential effects in Washington

Many examples of predator-prey relations were reviewed by Washington WS in the preparation of this supplement. They included a summary of the benefits of wolves in Yellowstone National Park, climate change effects on white pine availability to threatened species, impacts of predators on natural prey populations, effects of bear and coyote removal on Canadian caribou populations, and cougar depredation on deer while pregnant, along with others. Even though some of these studies were not completely relevant to the situation in Washington, they were considered in the preparation of the supplement. The proposed action would have no significant effect on predator abundance in Washington and the information in the studies reviewed by WS does not impact the analysis of predator damage management effects on predator-prey relationships in Washington. WS reviews new literature and consults with other wildlife management agencies in monitoring program activities and the predator damage management program in Washington is adjusted, as necessary.

6. WS' Affect on Biodiversity

WS' predator damage management is not conducted to eradicate any native wildlife population. WS operates according to federal and applicable state laws and regulations enacted to ensure species diversity and viability. Henke (1992) noted that coyote density returned to pre-removal levels within 3 months following intensive coyote removal efforts. Henke (1992) also determined that rodent diversities may change because of intense predator removal on a short term basis (≤6 months). This diversity change was short-lived and only noted in areas of intensive predator removal--more intensive than any predator damage

[20] In general, it appears that predators prolong the low points in some prey population cycles and spread the duration of the peaks. It is more likely that prey abundance controls predator populations. The USDI (1979, p. 128) concluded that "WS Program activities have no adverse impacts to populations of rodents and lagomorphs."

management in Washington. Any reduction of a local predator population would be temporary because migration from adjacent areas and/or reproduction would replace the animals removed (Pitt et al. 2001), mitigating any potential effect that WS predator damage management may have on biodiversity.

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

As analyzed in USDA (1997a), Washington WS would have a little or no impact on predator populations. However, predator damage management has been demonstrated to be effective in reducing predation on protected species for 3 to 6 months (Wagner 1997). In addition, WS predator activities were conducted on only about 2.7% of Washington's land area. At the relatively low levels of predator removal occurring and the limited areas WS conducts predator damage management, it is unlikely that biodiversity would substantially change in response to predator removal. The impacts of the current WS program on biodiversity are not significant nationwide or statewide (USDA 1997a, USDA 1997b). Therefore, there appears to be no evidence to suggest that Washington WS predator damage management, as conducted, would have adverse affects on biodiversity.

Washington WS may be requested to work in any part of the state at any time, although areas where humans are not present are not likely areas where management actions would be needed due to lack of human-wildlife conflict. As a point of fact, Washington WS only works on 2.7% of land in Washington. Agencies such as USFWS, WDFW, and land management agencies are incorporated in an interagency approach when new work sites are identified through consultation or permitting processes.

6a. WS' impact on biodiversity by removing large numbers of coyotes.

As presented and analyzed, coyote take by Washington WS and others is unlikely to have any negative effects overall biodiversity. The combined take of 839 coyotes in FY 07 by both WS (*i.e.*, 608) and private trappers (*i.e.*, 231) represents 1.7% of the estimated population, and WS' take only occurs on 2.7% of the land area of Washington. This is well below the level of take that would adversely affect coyote population as determined by Pitt et al. (2001) or biodiversity.

6b. WS' site-specific and cumulative impact analysis.

The primary purpose for preparing a NEPA document is to inform and provide the federal agency decision maker and the public with an environmental review and analysis of any potential environmental impacts associated with the proposed federal agency action. USDA (1997a) was prepared to determine if WS' actions could have a significant impact on the quality of the human environment. Planning for the reduction of predator damage or any other wildlife damage must be viewed conceptually similar to other agencies' actions whose missions are to stop or prevent adverse consequences from future events for which the actual sites and locations where the events 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, etc. Some of the sites where predation or threats of predation could occur can be predicted, but all specific locations or times where such damage will occur cannot. The standard WS Decision Model (Slate et al. 1992) provides the site-specific procedure for individual actions conducted by Washington WS. The Decision Model and WS Directive 2.105 describe the thought process that guides WS though the analysis and development of the most appropriate individual strategy to reduce damages and detrimental environmental effects from damage management actions (Slate et al. 1992). Decisions made using the model would be in accordance with plans, goals, and objectives of WS, WDFW, USFWS and/or public land management agencies. A more detailed and more site-specific level of analysis would

not substantially improve the public's understanding of the proposal, the analysis, the decision-making process, and pursuing a more site-specific and more detailed analysis might even be considered inconsistent with NEPA's emphasis on reducing unnecessary paperwork (Eccleston 1995).

USDA (1997a), Summary Report, and supplemental analysis analyzed the potential impacts of predator damage management as conducted by Washington WS and addressed potential activities on all lands in Washington under MOUs, Cooperative Agreements, and in cooperation with public land management agencies, as appropriate. The analysis also addressed the impacts of predator damage management on areas where agreements may be signed in the future; any additional requests for services are anticipated to be small. Because the proposed action is to reduce damage, and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional requests could occur. WS' analyses are intended to apply to actions that may occur in any locale at any time in Washington State. In this way, WS' believes it meets the intent of NEPA with regard to site-specific analysis.

7. Cost-benefit Analysis.

WS is not required to perform a cost-benefit analysis under NEPA, but has provided examples of value because livestock represent a large economic commodity in the U.S. and the livelihood of many Americans, including communities in Washington. Per CEQ regulations, "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" (40 CFR §1502.23).

WS is authorized by Congress to reduce damage from wildlife and focuses on efficiency, humaneness, and appropriateness of methods. However, the availability of funds to provide such wildlife services determines the extent of action(s) that WS can provide. Because Washington WS activities are largely cooperator funded, and the benefits may vary between individuals due to differences in the damage circumstances, and each cooperator decides if WS provides cost effective service.

7a. Opportunity costs associated with the Predator Damage Management in Washington.

WS is not proposing to eliminate, eradicate, or exterminate any species of native wildlife and would only conduct activities to reduce damage or potential damages in areas where requests for assistance have been received and when a need exists (USDA 1997a). Government agencies, including WS, strive to conserve and manage wildlife while being responsive to public needs, views and attitudes. WS management of predators, such as coyotes and ravens, occurs in limited instances in which cooperators have specifically requested assistance to minimize negative impacts associated with these predators. In all cases of predator management, WS seeks to minimize the opportunity costs associated with its actions and weigh these against the opportunity costs of non-action.

Typical opportunity costs associated with decreased wildlife include loss of viewing or photography opportunities, decreased aesthetic enjoyment and diminished consumptive uses (*i.e.*, hunting). However, in relation to WS management of predators such as coyotes and ravens in Washington, the impacts to wildlife-related opportunity costs are extremely limited for numerous reasons. First, Washington WS predator damage management activities do not impact predator populations in the state, as WS removes only 1.7% of the estimated coyote population and on 2.7% of the land area of the state, and about 0.36% of the raven population. Second, most of the predator management occurs on private land which is unavailable to the general public for viewing, photography, hunting and other uses. Lastly, both of these species are prolific across the state and public opportunities to view, photograph, hunt or otherwise enjoy these species are not diminished in these areas by WS management of predators occurring on private lands.

Numerous significant opportunity costs exist in relation to WS not conducting requested predator damage management, including financial and mental stress on livestock producers whose livelihoods are jeopardized by predator damage to livestock, health or safety risks to the general public and companion animals through injury and disease transmission from predators, and decreased viewing opportunities for the public who enjoy viewing prey species that may be reduced or exhibit a behavioral change due to predators. In the case of HHS, the opportunity cost of not conducting predator damage management may be the life or health of humans. Because WS uses an adaptive, integrated approach to predator damage management, including risk assessments, careful method selection, interagency consultations, and highly trained specialists, costs and benefits of predator damage management are weighed on a case-by-case basis and a course of action is selected using the best available information. WS conducts all activities in accordance with federal and applicable state laws and regulations enacted to ensure species diversity and viability.

7b. Society's willingness to pay for WS activities.

The distribution of funds by Congress is outside the scope of this analysis. Congress and the President are responsible for approving and allocating operating funds to federal agencies. WS is congressionally authorized to use these funds to provide assistance to the public. WS solicits public involvement through the NEPA process and coordinated activities with federal and state wildlife and land management agencies. The Washington WS program is cooperatively funded, receiving only 25% of funding from federal allocations.

7c. A commenter said "Resources spent on non-lethal methods are not detailed in the document".

WS uses the WS Decision Model (Slate et al. 1992) to evaluate each damage situation and selects appropriate management tools from those tools analyzed in Appendix 2 of USDA (1997a), and Washington WS gives preference to nonlethal management when deemed effective (WS Directive 2.101). However, the vast majority of nonlethal management actions are implemented by the resource/land owner after receiving TA from WS (*i.e.*, placement of guard dogs, purchase and placement of scare devices, animal husbandry, etc.). TA is provided by Washington WS free of charge (USDA 1997a, page 8). Use of nonlethal methods is not tracked the same way as lethal methods, because cooperator-implemented methods are the responsibility of the cooperator, not WS.

For further information on resources expended by WS, readers are referred to WS' Annual Tables at the following website: http://www.aphis.usda.gov/wildlife_damage/prog_data/prog_data_report.shtml. This data is broken-down by species and by the types of educational and technical assistance resources provided.

8. Federal Direction to Provide Predator Damage Management

WS programs reflect policy decisions made by Congress or state legislatures directed to serve the public interest as defined through the legislative process. Additionally, wildlife damage management is an appropriate government sphere of activity since wildlife is publicly owned and management is a government responsibility.

WS was established by Congress as the program responsible for providing wildlife damage management to the people of the United States (Act of March 2, 1931, as amended 46 Stat. 1486; 7 USC 426-426c). Federal, state, and local officials decided that wildlife damage management should be conducted by appropriating funds. Private livestock producer funds and cooperating agencies funds may be applied to the Washington WS program under Cooperative Agreements. Additional funds are received from requesters for individual or special projects and used to provide services as requested.

Although the Washington WS' predator damage management program supports ranching and farming operations, WS personnel also provide technical and operational assistance towards developing effective

wildlife damage management practices for anyone requesting such assistance. WS serves urban, suburban, public, and industrial interests by reducing wildlife damage to property, assisting with the protection of the health and safety of aviation and airline passengers at airports, helping to deter the spread of wildlife-borne diseases, and for the protection of T&E species. As the requests for assistance change, the mix of services provided by the WS program will change accordingly. The protection of livestock will always be conducted a public agency or the private sector. The WS program not only provides a service to the livestock producers but also protects property, natural resources, and HHS, while conducting an environmentally and biologically sound program in the public's interest (Schueler 1993).

8a. A commenter stated, "WS should disclose the number and species of animals WS proposes to kill, by what method, in what areas."

As stated under *6b*, planning for the reduction of predator damage or any other wildlife damage must be viewed as conceptually similar to other agency actions whose missions are to stop or prevent adverse consequences from future events for which the actual sites and locations where the events 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, etc. Some of the sites where predation or threats of predations could occur can be predicted, but all specific locations or times where such damage will occur cannot be predicted.

The Summary Report discloses take for FY02-FY08 and potential impacts are described and discussed in USDA (1997a) and Summary Report. WS anticipates that take will be similar in the reasonably foreseeable future as the predator damage management program is not proposed to substantially change. The only take change analyzed in the supplemental analysis is the inclusion of opossum and raccoons as part of the predator damage management program. Their take is anticipated to be small based on requests for past assistance and take. As described in USDA (1997a) and the supplemental analysis, the analysis area includes all of Washington State, but WS only works where requested by landowners/managers. Currently, Washington WS only works on 2.7% of land in Washington.

9. Providing Public Education and Outreach

Education is an important element of WS' program because it allows some problems to be avoided before they arise. Education and outreach also allows WS to find a balance between the needs of people and wildlife. This is extremely challenging, as nature is in continual flux. In addition to the dissemination of educational materials and recommendations to individuals or organizations sustaining damage, lectures and demonstrations are provided to ranchers, homeowners, and other interested groups. WS frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies.

10. Aerial Gunning Impacts[21]

In preparing the Summary Review and this supplement, WS conducted an extensive literature review. Scientific studies indicate that infrequent, low decibel aerial activities, such as those conducted by Washington WS during aerial gunning, have no lasting negative effect on wildlife. Pepper et al. (2003) concluded that there may be some correlation between aircraft noise and negative impacts to human and wildlife. However, Pepper et al. (2003) also states that while "Some cause-and-effect evidence

[21] WS evaluated aerial gunning impacts by conducting a comprehensive review of the literature, and taking a hard look at site specific and cumulative impacts. The detailed evaluation is documented in USDA (2005) which found that no significant impacts on wildlife or recreation are expected from WS aerial gunning.

exists…such evidence is weak and often generated with a limited number of studies, with relatively small sample sizes."

10a. Washington WS Aerial Gunning Activities

Aerial gunning is an important method of predator damage management in Washington, is used in response to depredation, and is only conducted on those areas where the landowner or lessee has signed an "Agreement for Control" and funding is provided. There were minimal aerial gunning activities conducted on public lands in Washington. The use of aircraft increases the cost effectiveness of the predator damage management, and in one study the cost per coyote removed decreased from $893 to $185 (Wagner and Conover 1999). This reduction of cost was accompanied by a reduction in necessity for subsequent predator damage management (Wagner and Conover 1999), which further eliminates potential impacts, making aerial gunning the most efficient and cost effective tool available for certain situations. Aerial gunning is conducted with fixed-wing aircraft, primarily in eastern Washington between the months of January and April.

The amount of time spent aerial gunning varies depending on the severity of losses experienced by the cooperators and on the weather. Low-level aerial activities are restricted to visual flight rules and are impractical in high winds or at times when predators are not easily visible. Washington WS spent a total of 457.3 hours aerial gunning in Washington from FY02 - FY08, averaging 67.9 hours per year (Table S-2) and conducted aerial gunning on less than 0.4% of the State in any year. Thus, WS aerial gunning activity is minor in terms of geographic scope because 99.6% of the land area in the State is not exposed to any such activity. Of the hours flown in this analysis period, nearly 100% occurred over private lands. The average time spent flying over the properties was about 10 minutes per mi^2 per year. Therefore, on the small proportion of the landscape exposed to aerial gunning only a very small fraction of the time in an entire year is generally exposed to aerial gunning overflights.

10b. Aerial Overflight Disturbance to Wildlife

A number of studies have looked at responses of various wildlife species to aircraft overflights. The National Park Service (1995) reviewed the effects of aircraft overflights on wildlife and suggests that adverse impacts could occur to certain species. In general though, it appears that the more serious potential adverse effects occur when low-level overflights are chronic (*i.e.,* they occur daily or more often over long periods of time). Chronic exposures generally involve areas near commercial airports and military flight training facilities. WS aerial gunning operations rarely occur in the same areas on a regular, daily basis and, as previously noted, little time is actually spent flying over any one area (*i.e.,* WS aerial gunning occurred on less than 0.4% of the land area in the State with the average flying time over the properties was about 10 minutes per mi^2 per year).

The effects on wildlife from military-type aircraft have been studied extensively as shown in the information presented in this section and in ANG (1997a, 1997b), and were found to have no expected adverse effects on wildlife. Washington WS uses small fixed-wing aircraft; helicopters have not been used in the Washington WS program in the last 10 years. The fixed-wing aircraft used by WS are relatively quiet whereas helicopters are somewhat noisier. The noise level of the Supercub (Piper PA-18) is reported by FAA to be 65 dBA when measured directly underneath the airplane flying at 500 feet above ground level (AGL) (FAA 2008). Put in perspective, that noise level is similar to "normal conversation at 5 feet" (CDC 1985). In comparison, most military jet aircraft noise levels at 500 feet AGL range from 97 to 125 dB at various power settings and speeds (U.S. Coast Guard 1999). To experience the same level of noise by common military aircraft as one would experience directly beneath a flying Supercub, a listener would have to be nearly 2 miles away from an F-16 and more than 3.7 miles away from the B-1B flying at 200 to 1000 feet AGL (ANG 1997a).

The fact that WS conducted aerial gunning on less than 0.4% of the land area of the State with an average time spent flying over the properties at about 10 minutes per mi^2 per year indicates that potentially 99.6% of wildlife populations are not exposed[22] to WS aerial gunning overflights or exposed for only a very short duration. Further lessening the potential for any adverse impacts is that such flights occur only a few days per year. The below research indicates the wildlife species/groups studied are relatively unaffected by aircraft overflights, including overflights by military aircraft which produce much higher noise levels than the small aircraft used by WS. Therefore, WS aerial gunning flights have little or no potential to adversely affect the wildlife species/groups below and WS' determination of potential impacts from aerial gunning overflights are described.

Birds

Waterbirds and Waterfowl. Low level overflights of 2-3 minutes in duration by a fixed-wing airplane and a helicopter produced no "drastic" disturbance of tree-nesting colonial waterbirds, and in 90% of the observations, individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance and concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse impacts. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "time-activity budgets" of the species.

WS aerial gunning activities are not conducted over wetland habitats, federal refuges, or State or federal Waterfowl Management Areas at this time. If requested, these flights may be conducted for the protection of nesting birds from predators and would result in increased waterfowl production. No WS management would be conducted without consent from the managing agency. Thus, there is little to no potential for any adverse effects on these types of birds.

Raptors. The ANG (1997a) analyzed and summarized the effects of overflight studies conducted by numerous federal and state government agencies and private organizations. These studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (Ellis 1981, USFS 1992, Fraser et al. 1985, Lamp 1989). A study conducted on the impacts of overflights to bald eagles (*Haliaeetus leucocephalus*) suggests that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). Evidence also suggests that golden eagles (*Aquila chrysaetos*) are not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Awbrey and Bowles (1990) found that eagles were particularly resistant to being flushed from their nests. Therefore, there is considerable evidence that eagles would not be adversely affected by WS aerial gunning overflights.

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

---

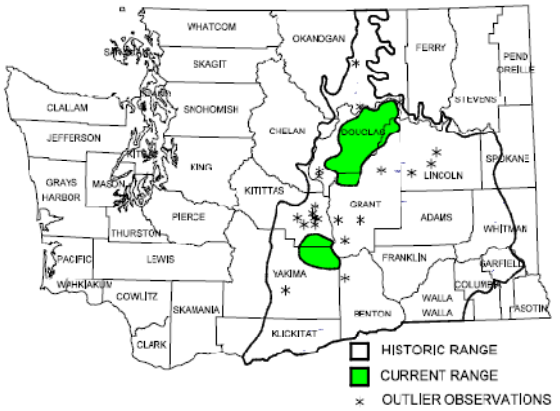
[22] It is recognized that wildlife are not uniformly distributed across the entire State, but that wildlife exist were habitat can satisfy specific wildlife needs. Even though coyotes are not distributed uniformly across Washington, WS conducts activities on a very small area of the State, coyotes can replace lost individuals relatively quickly, and coyotes are recognized as very adaptable animals and can occupy many different habitat types.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period; results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but found that ferruginous hawks (*B. regalis*) are sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco spp.*), and golden eagles 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. These studies and reviews indicate there is little or no potential for WS overflights to cause adverse effects to raptors.

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

Sage Grouse. Sage grouse (*Centrocercus urophasianus*) are a State threatened species and a candidate for federal protection under the ESA. There are two populations, one on the Yakima Training Center (YTC) and the other spaced in Douglas and Grant counties (Figure S-1) (Stinson et al. 2004). We could find no studies of the effects of overflights on sage grouse. State wildlife agencies routinely use aircraft to locate sage-grouse leks, so impacts are probably minor when overflights occur on an infrequent basis and care is taken to avoid leks (strutting grounds used by males during the breeding season). The USFWS reviewed available scientific and other information on threats to sage-grouse and did not identify aerial overflights as a concern, although they did identify other types of activities such as off-road vehicles and recreation as potentially having disturbance effects on breeding (USFWS 2005).

Figure S-1. Historic and Current Range of Sage-grouse in Washington (WDFW 2004).



WS has reviewed the current range and incidental sightings of sage grouse (Stinson et al. 2004) and does not conduct aerial gunning in the known range. As identified in the Recovery Plan (Stinson et al. 2004), predation accounts for 85% of non-hunting mortality and 79% of nest failures. Removal of coyotes may benefit sage grouse populations, as coyotes were identified as one predator of grouse in central Washington (Stinson et al. 2004).

Mammals

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

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

Regarding potential effects on livestock, the only persons likely to have concerns are livestock owners or managers. However, they are the ones requesting predator damage management assistance in most cases and are therefore more concerned about stopping or preventing predation on their livestock. Low level overflights of adjacent properties where aerial gunning has not be authorized are avoided.

The above studies indicate that most birds and mammals are relatively tolerant of aircraft overflights, even those that involve noise at higher decibels such as from military aircraft, and there is no obvious significant cumulative effect from aerial gunning activities on wildlife. Our analysis and the analysis of ANG (1997a, 1997b) show that no scientific evidence exists that indicates any substantive adverse effects on wildlife populations will occur as a result of low level or other overflights that do or may occur. It is apparent that WS' aerial gunning activities that have occurred, or may occur in the future, within the same areas as other flights are an inconsequential addition. This is because the evidence from available studies suggests adverse effects do not occur even when flights are far more frequent than private or WS aerial gunning activities in specific areas. Washington WS aerial gunning occurs in rangeland areas and not near commercial airports or military flight training facilities. Therefore, it is logical to conclude that the aircraft used in WS aerial gunning should have far less potential to cause any disturbance to wildlife than military aircraft because the 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 (ANG 1997a, 1997b). This fact provides qualitative support that there are no significant adverse effects on the quality of the human environment. Therefore, WS concludes that the aerial gunning program would not have an adverse effect on wildlife.

10c. Methods other than aerial gunning are not described in the EA.

All of the methods are analyzed in Appendix 2 of USDA (1997a) and in USDA (1997b, Appendix P). USDA (1997a, 1997b) is also incorporated by reference into the supplemental analysis. USDA (1997b) contains extensive analysis of many of WS' methods, although not all are used for predator damage management in Washington. All methods used by Washington WS were considered when analyzing impacts and effects, including minimization measures and SOPs used with those methods.

10d. Site-specific analysis of aerial-gunning program.

As described in USDA (1997a) and in this supplement, the State of Washington was chosen as the area of analysis because, in part, the WDFW has jurisdiction for wildlife statewide and take is reported to WDFW,

and state laws and regulations generally govern activities statewide. WS, as well as any other response agency, cannot anticipate where every request or action will occur, but even on properties where activities are conducted annually WS is not having any adverse impact to the environment or wildlife due to immigration, and reproduction (Pitt et al. 2001). Washington WS determined that there are no negative or cumulative effects from Washington WS aerial gunning activities when combined with other aerial operations in areas where predator damage management is conducted due to the infrequency and short duration of WS activities. A more detailed analysis of aerial gunning activities is analyzed below.

10e. Aerial gunning's impacts are exacerbated when combined with logging, development, and other cumulative impacts.

Cumulative impacts of aerial gunning with regards to these aspects were considered during the preparation of the supplemental analysis and were determined to have no significant impact due to: 1) the minimal amount of area where Washington WS aerial gunning activities occur (0.4% of the area of the State), 2) those activities occur almost exclusively on private lands, and 3) the amount of time Washington WS spends aerial gunning (approximately 67.9 hrs/year on those lands).

10f. Commercial and military flight hours in areas of the state and number of hours per allotment.

Remote areas of Washington, where aerial gunning activities occur, do not experience high noise levels from air traffic; no commercial airports are nearby and any aircraft flying in areas where WS conducts aerial gunning activities are generally at relatively high altitude and in a "cruising" mode. Therefore, high altitude commercial flights do not adversely affect wildlife. WS also recognizes that there are military training operations in Washington; however, no livestock are present on those training areas and therefore Washington WS does not conduct or anticipate any aerial operations in those areas. During the review period, aerial gunning was conducted on lands totaling 0.4% of the total acreage in Washington and a total average of 67.9 hours of aerial gunning per year; WS aerial gunning activities averaged only about 10 min/mi^2 per year. This average is inclusive of "ferry time," meaning the time it takes the aircraft to get from the airfield to the property. Ferry time consists of normal altitude flight that, in general, would not disturb wildlife. No aerial gunning operations were conducted on BLM or USFWS lands.

10g. Consequences of Aerial Gunning Accidents

Aerial gunning, like any other flying, may result in an accident. WS pilots and crew members are trained and experienced to recognize the circumstances which lead to accidents, and pilots have thousands of hours of flight time. The national WS Aviation Program emphasizes safety and has established and operates the WS Aviation Training and Operation Center (ATOC). ATOC provides annual recurring training for pilots, crewmembers, and agency staff. There have been no WS aviation accidents in Washington, but they could occur and the environmental consequences should be evaluated.

Because of the remote locations in which WS conducts aerial gunning operations, the risk to the public from aviation operations or accidents are extremely minimal. WS employees are trained in hazard recognition and shooting is only conducted in safe environments. The environment in which WS conducts aerial gunning is a higher risk environment than that for General Aviation. Low level flights introduce additional hazards such as power lines and trees. Additionally, the safety margin usually afforded by altitude is diminished during aerial gunning operations. Still, WS agency pilots and contractors are highly skilled pilots who are trained and certified by ATOC in flight environments encountered during aerial gunning activities.

Major Ground or Wild/Forest Fires: N. Wiemeyer (National Transportation Safety Board (NTSB), pers. comm. 2000) stated he had no recollection of any major fires caused by government aircraft while in his position between 1987 and 2000. ATOC confirmed that there have been no wildfires resulting from WS planes from FY93 – FY08 (R. Feivor, ATOC, 2010 pers. comm.)

Fuel Spills and Environmental Hazard from Aviation Accidents: The quantities of fuel contained in WS aircraft are small (36 gallons in a Piper PA-18). In some cases, little or none of the fuel would be spilled if an accident occured. The NTSB stated that aviation fuel is extremely volatile and will evaporate within a few hours or less to the point that even its odor cannot be detected (N. Wiemeyer, NTSB, 2000 pers. comm.). Thus, there should be little environmental hazard from un-ignited fuel spills. During FY02 through FY08, Washington WS aerial gunning activities did not result in any accidents, fuel spills, or fires and there were no reports of threats to HHS.

Oil and Other Fluid Spills: For privately owned aircraft, the aircraft owner or their insurance company is responsible to clean up spilled oils and other fluids if required by the owner or manager of the property on which the accident occurred. In the case of BLM, Forest Service, and National Park Service lands, the land managing agency generally requires soil to be decontaminated or removed and properly disposed. With the size of aircraft used by WS, the quantities of oil [*i.e.,* 6-8 quarts maximum for piston engines] capable of being spilled in any accident are small and insignificant with respect to the potential for environmental damage.

Petroleum products biodegrade through volatilization and bacterial action, particularly when exposed to oxygen (EPA 2000). Thus, small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities which would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, EPA guidelines provide for *"natural attenuation"* or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Therefore, even if oil spills in small aircraft accidents are not cleaned up, the oil does not persist in the environment or persists in such small quantities that there is no problem. Also, WS' accidents generally would occur in remote areas away from human habitation and drinking water supplies, so the risk to drinking water appears to be exceedingly low or nonexistent.

For these reasons, the risk of ground fires or fuel/oil pollution from WS aviation accidents is considered low. In addition, based on the history of aircraft accidents in the program, it appears the risk of significant environmental damage from such accidents is exceedingly low.

Human Health and Safety and Public Resource Risk: Beyond environmental consequences, there are other issues related to aviation accidents, including the loss of aircraft and risks to the public and crew members. ATOC oversees the Aviation Safety Program to support aerial activities and recognizes that an aggressive overall safety and training program is the best investment in accident prevention. While the goal of the aviation safety program is zero accidents, there remains some possibility that accidents may occur.

The safety program includes regular training for pilots and crew members as well as enhanced pilot training and evaluation. Based on the above information and analysis, it is reasonable to conclude that any WS' aerial gunning accident should not cause any significant adverse impacts.

11. Effects on Wildlife from WS Gunshot Noise

The time spent shooting at coyotes from aircraft is an exceedingly small portion of the total flying time. WS aerial gunning data for Washington show an average of 5.3 coyotes killed per hour of aerial gunning. A typical "pass", in which shots are taken, requires only a few seconds and usually involves 2 to 3 shots with a 12 gauge shotgun. It is estimated that on average no more than 30-45 seconds of every hour spent flying are involved in shooting (L. Burraston, WS 2005 pers. comm.) which means that only 1-2% of the time spent aerial gunning is actually spent shooting at target animals and generating gunshot noises.

Gunshot noise from WS aerial gunning activities probably has no discernible or at most only minor potential to adversely affect non-target wildlife because of the limited frequency of gunshot noise, duration of WS flights and the small proportion of geographic area involved in Washington (*i.e.*, 0.4%) which means only small proportions of non-target wildlife populations would hear noise from WS gunshots.

Pater (1981) reported that muzzle blast is louder in the direction toward which the weapon is pointed by up to 14 decibels. Additionally, shooting from an aircraft is usually at an extreme downward angle. Thus, shooting downward toward the ground serves to lessen the noise in lateral directions. WS personnel on the ground observing aerial gunning report that the gunshot noise heard at a distance of 150 yards or more sounds like a subtle "pop" (L. Burraston, WS 2005 pers. comm.). This indicates shotgun noise from the aircraft is minimal and is probably not loud enough to cause disturbance to non-target wildlife.

12. American Indian and Cultural Resource Concerns

The National Historic Preservation Act of 1966, as amended, requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and determine whether they have concerns for cultural properties in areas of these federal undertakings. In most cases, predator damage management activities have little potential to adversely affect sensitive historical and cultural resources. If an individual predator damage management activity with the potential to affect historic resources is identified, then site-specific consultation as required by Section 106 of the NHPA would be conducted, as necessary.

The Native American Graves and Repatriation Act of 1990 provides protection of American Indian burials and establishes procedures for notifying Tribes of any new discoveries. Senate Bill 61, signed in 1992, sets similar requirements for burial protection and Tribal notification with respect to American Indian burials discovered on state and private lands. If a burial site is located by a WS employee, the appropriate Tribe or official would be notified. Predator damage management activities on or involving tribal resources would only be conducted at the request of a Tribe or their lessee and, therefore, Tribes would be consulted on cultural and archeological concerns prior to the implementation of IWDM.

13. Effects from Use of Lead (Pb) Ammunition in Washington

The WS Program has tried various nontoxic (non-lead) shot loads to reduce the deposition of lead, but the use of some "non-toxic" shot (*i.e.*, steel shot) can cause serious human safety hazards from shot ricocheting off solid objects. In addition, the use of lead ammunition is permitted in the State of Washington, and is commonly used by hunters and recreational shooters. As part of the existing human environment, an estimated 195,000 persons participated in hunting in Washington in FY 08 and this number has remained relatively constant since 2002 (M. Meacham, WDFW 2009 pers. comm.). Hunters in Washington use lead ammunition to kill an estimated 40,241 big game animals and more than 343,992 small game animals each year (WDFW 2007 Hunter Harvest Report Online). Conservative estimates on the number of shots used to take each animal[23] would amount to over 54,000 pounds of lead distributed across Washington each year. These totals do not include the amount of lead deposited by recreational shooting on public and private lands or in shooting matches and are highly conservative, as the number of shots fired is expected to be higher. WS aerial gunning activities account for an average of 1,083 shots[24] annually containing a total of 101.5 pounds of lead. Therefore, WS' contribution to overall environmental lead in Washington from aerial gunning activities is less than 0.002% of the total amount of lead estimated to be spent from hunting/recreational activities each year.

The EPA "soil-lead hazard" is soil that contains total lead equal to or exceeding 400 ppm in a bare soil children's play area or average of 1,200 ppm of in the rest of a residential area (40 CFR 745.65(c))[25]. We

---

[23] 343,992 small game animals harvested at 2 shots of 1.25 ounces lead/shot totals 53,749 pounds of lead. 40,241 big game animals harvested using two 150 grain bullets per animal totals 860 pounds of lead.

[24] An average of 361 animals taken via aerially gunning each year, at 3 shots/animal totals 1,083 shots fired annually and about 101.5 pounds of lead.

[25] Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface is generally retained within the top 8 inches. A representative average weight of soil is in the range of 110 lbs. per cubic foot (Environmental Working Group [undated]). The number of cubic feet of soil in the top 8 inches of soil in one acre is about 29,000. Therefore, a reasonable estimate of the total weight of the top layer of soil per acre where spent lead shot should remain

are unaware of any established standards for lead deposition in soil in remote areas of the kind where Washington WS conducts predator damage management, but it is reasonable to assume the guidelines for residential areas would be more stringent than any standard that might be established for remote rural areas. The amount of lead in the soil impact zones of each shot can be calculated as follows: each shot distributes 1.5 ounces of lead into an approximate 30" circle, which is about 3.27 cubic feet of soil and amounts to about 260 ppm lead. It would be highly unlikely for a person or non-target species to encounter one of the affected impact spots, and even if someone did, there would be no health risk unless the person ingested some of the soil and the portion ingested contained lead eroded from the spent shot.

There is evidence that the lead threat is not as severe as previously thought. Hayes (1993) reviewed literature and analyzed the hazards of lead shot to raptors. Key findings of that review were:

- In studies that documented lead shot consumption in eagles, the shot was associated with waterfowl, upland game bird, or rabbit hunting, and was smaller than that used for most of WS' program activities.
- Frenzel and Anthony (1989) suggested that healthy eagles usually reduce the amount of time that lead shot stays in their digestive systems by casting the shot along with other indigestible material. It appears that healthy eagles can regurgitate lead shot in pellet castings which reduces the potential for lead to be absorbed into the blood stream (Pattee et al. 1981, Frenzel and Anthony 1989). Larger shot size should be more readily detected by eagles' and regurgitated, reducing lethal lead absorption.
- WS personnel examined nine coyotes shot with copper plated BB shot to determine the placement and number of shot retained by the carcasses; 84% were amassed just under the surface of the hide opposite the side of the coyote where the shot entered. Feeding eagles generally peel back the hide from carcasses to consume muscle tissue. Because most shot retained by coyotes was located just under the hide, it would generally be discarded with the hide. These factors, combined with the usual behavior of regurgitation of ingested lead shot indicate a low potential for toxic absorption of lead from eagles feeding on coyotes killed with BB or #4 buckshot.
- Breeding Bird Survey data indicate a general increasing trend in breeding populations of both golden and bald eagles in North America since 1966. Bald eagle populations appear to be increasing in the contiguous 48 states and have met or exceeded recovery goals in several states and were delisted by the USFWS from the ESA on August 8, 2007 (Federal Register 72:37346-37372). Golden eagle populations appear to be healthy, increasing 3.3% across North America (Sauer et al. 2008). Bald eagle population trends indicate a 12% increase Washington from 1980 through 2007 (Sauer et al. 2008). Thus, eagle populations do not appear to be adversely affected by toxicity problems.

A remaining question is whether lead shot deposited by WS might cause contamination of water, either ground water or surface water via runoff. Stansley et al. (1992) indicated that even when lead shot is highly accumulated in areas with permanent water bodies, the lead does not necessarily cause elevated lead contamination of water further downstream. They also reported that muscle samples from two species of fish collected in the water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992). Craig et al. (1999) reported that the dissolution (*i.e.*, capability of dissolving in water) of lead declines when lead oxides on the surface areas of the spent bullets and fragments. This means "transport" of lead from bullets or shot distributed across the landscape is reduced once the bullets and shot form lead oxide deposits on their surfaces. These studies suggest that, given the very low concentrations of shot that occur from WS' activities lead contamination of water from such sources would be minimal to nonexistent.

Cumulative Impacts of Lead from all WS Activities

---

would be 3.2 million lbs. (110 X 29,000) or 1.5 million kg. Solid lead exposed to the environment tends to form an oxidizing layer that slows down its ability to be dissolved in water (Craig et al. 1999), which means the lead from spent shot in the soil would tend to remain in place and not distribute throughout the soil. This would further lessen the chance that wildlife or humans contacting an impact spot would become exposed to a lead hazard.

Predator damage management is not the only activity where Washington WS uses lead ammunition and, to account for any cumulative impacts, the following analysis is provided. There are small amounts of lead used in other projects across the state. Again, lead is selected for its effectiveness and its efficiency. Other sources of lead used by Washington WS include air rifle pellets, handgun, and rifle rounds. Based on amount of lead ammunition purchased and animals taken, Washington WS puts an less than 300 pounds of lead shot and bullets into the environment annually. This is an infinitesimally small amount of lead compared to hunter harvest and other lead uses, and lead ammunition use is legal under state, federal, and local laws.

We conclude that the amounts of lead deposited by Washington WS, even when considered cumulatively with the amounts deposited by hunters, fishermen and other lead uses are presumably far below any level that would pose any risk to public health or of significant contamination of water supplies. No evidence has been brought forth to indicate that any animals killed by WS have resulted in any indirect lead poisoning of people or animals. Further, WS has adopted and implemented all reasonable and prudent alternatives and measures and their terms and conditions to protect T&E species that were identified by USFWS in USDI (1992). Therefore, we conclude that the amounts of lead deposited by Washington WS during predator damage management, even when considered cumulatively with the amounts deposited by hunters, fishermen, other lead uses, and other WS shooting activities, are far below any level that would pose any risk to public health, non-target species or of significant contamination of water supplies.

WS STANDARD OPERATING PROCEEDURES (SOP) INCORPORATED INTO THE CURRENT PREDATOR DAMAGE MANAGEMENT PROGRAM

A SOP is any aspect of an action that serves to prevent, reduce, or compensate for negative impacts that otherwise might result from that action. The current program, nationwide and in Washington, uses many such SOPs. Many WS SOPs are discussed in depth in USDA (1997b, Chapter 5). Most SOPs are instituted to abate specific issues while some are more general and relate to the overall program. SOPs include those recommended or required by regulatory agencies such as EPA and these are listed where appropriate. Additionally, specific measures to protect resources such as T&E species that are managed by WS' cooperating agencies (USFWS and WDFW) are included in the lists below.

General SOPs Used by WS in Predator Damage Management

- WS predator damage management activities in Washington are consistent with USDA (1997b) SOPs.
- WS complies with all federal and applicable state or local laws and regulations that pertain to working on federally managed lands.
- WS would coordinate with Tribal officials for work on Tribal lands to identify and resolve any issues of concern with predator damage management.
- The use of predator damage management methods would conform to applicable rules and regulations administered by the State.
- WS personnel adhere to all label requirements for pesticides. EPA approved labels providing information on preventing exposure to people, pets, and T&E species along with environmental considerations would be followed. These restrictions preclude or reduce exposure to non-target species, the public, and pets.
- The WS Decision Model (Slate et al. 1992), which is designed to identify effective wildlife damage management strategies and their impacts, is consistently used.

Effects on Target Predator Species

- Predator damage management is directed towards localized populations or individual offending animals, depending on the species and magnitude of the problem, and not an attempt to eradicate any native wildlife population.
- WS Specialists use specific trap types, lures, and placements that are most conducive for capturing the target animal.
- WS predator damage management is monitored. WS predator damage management is designed to maintain the level of harvest below that which would impact the viability of populations of native species. WS provides data on take of target animals to other agencies (*e.g.,* WDFW, USFWS) as requested.
- Decisions to relocate any species are coordinated with the WDFW. WDFW would be notified in a timely manner of all take for species such as black bear and mountain lion.

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

- WS personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with minimal impact to non-target species.
- WS operational personnel work closely with the WS National Wildlife Research Center to improve the selectivity of management actions and tools.
- Traps and snares are not set within 30 feet of exposed carcasses (*i.e.*, "draw stations") to prevent the capture of scavenging birds. The only exception to this policy is for the capture of mountain lion and black bear because the weight of these animals adequately allows foot capture-device tension adjustments to exclude the capture of smaller non-target animals.

- Foot snare trigger and foothold trap pan-tension devices are used by WS, as appropriate, throughout Washington to reduce the capture of non-target wildlife that weigh less than the target species.
- Non-target animals captured in foothold traps or foot snares are released at the capture site unless it is determined by WS Specialists that the animal is not capable of self maintenance.
- Predator damage management activities are directed at taking action against individual problem animals or local populations to resolve damage problems associated with them.

Measures to Reduce the Potential Take of T&E Species

WS personnel are trained in identifying sign of T&E species and when working in areas occupied by T&E species, they apply appropriate predator damage management methods. WS has also adopted and implemented reasonable and prudent measures and terms and conditions outlined in USDI (1992) to protect T&E species.

Fisher

- If WS conducted activities in fisher habitat, foothold traps and foot or leg snares set would be equipped with pan-tension devices sufficient to reduce the likelihood of capturing fisher.

Canada Lynx

- Foothold traps and foot or leg snares set for bears, cougars, or wolves would be equipped with pan-tension devices sufficient to reduce the likelihood of capturing lynx or other animals up to 35 pounds.
- WS would report details of any trapped, lethally taken, lynx or lynx-related observations to the nearest USFWS office and WDFW, and must make efforts to contact the USFWS when a lynx is captured alive to determine if the lynx should be radio-collared or released.
- WS will coordinate management activities with the USFWS and WDFW when conducting activities in occupied lynx habitat.

Gray Wolf

- Guidelines specifically for Washington in USDA (1997a) to protect the gray wolf have been developed.
- WS may assist the USFWS or WDFW in capturing wolves for management purposes. In the event that a wolf is suspected to have killed livestock in Washington, WS will investigate the predation and obtain pertinent evidence through coordination with the USFWS and WDFW (WDFW 2008).

Grizzly Bear

- WS will coordinate management activities with the USFWS and WDFW when conducting activities in occupied grizzly bear habitat.

SUMMARY AND CONCLUSION

The current program has the lowest overall negative environmental consequences combined with the highest positive effects. The environmental impacts from implementing predator damage management correspond with those raised and discussed in detail in USDA (1997b). Impacts associated with activities under consideration in this supplement are not "significant." The addition of past, present, and reasonably foreseeable future actions do not result in cumulative significant environmental impacts. Monitoring the impacts of Washington WS predator damage management activities on target and non-target species will continue. All predator damage management activities that may take place would comply with relevant laws, regulations, policies, orders, and procedures, including the ESA, NEPA and Migratory Bird Treaty Act.

Literature Cited and References

Andersen, D. E., O. J. Rongstad, and W. R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. Condor 91: 296-299.

ANG (Air National Guard). 1997a. Final Environmental Impact Statement for the Colorado Airspace Initiative. Air National Guard, National Guard Bureau; 3500 Fletchet Avenue, Andrews AFB, MD 20762-5157. Vol. I, Vol. II.

ANG. 1997b. Final Biological Assessment for the Colorado Airspace Initiative with emphasis on the American Peregrine Falcon; Air National Guard Readiness Center, Environmental Planning Branch; 3500 Fetchet Avenue; Andrews AFB, MD 20762-5157. 83 pp.

Awbrey, F. T., and A. Bowles. 1990. The effects of aircraft noise and sonic booms on raptors: a preliminary model and a synthesis of the literature on disturbance.

Ballard, W. B., D. Lutz, T. W. Keegan, L. H. Carpenter, and J. C. deVos, Jr. 2001. Deer-predator relationships: a review of recent North American studies with emphasis on mule and black-tailed deer. Wildl. Soc. Bull. 29: 99-115.

Beasom, S. L. 1974. Intensive short-term predator removal as a game management tool. Trans. N. Amer. Wildl. Conf. 39: 230-240.

Belanger, L., and J. Bedard. 1989. Responses of staging greater snow geese to human disturbance. J. Wildl. Manage. 53: 713-719.

Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. J. Wildl. Manage. 54: 36-41.

CDC (Center for Disease Control). 1985. Noise – Sound Without Value. Online. http://www.cdc.gov/nasd/docs/d001501-d001600/d001550/d001550.html

Chitty, D. 1967. The natural selection of self-regulatory behaviour in animal populations. Proc. Ecol. Soc. Australia. 2: 51-78

Clark, F. W. 1972. Influence of jackrabbit density on coyote population change. J. Wildl. Manage. 36: 343-356.

Connolly, G. E., and W. M. Longhurst. 1975. The effects of control on coyote populations. Div. of Agric. Sci., Univ. of Calif. Davis. Bull. 1872. 37 pp.

Conomy, J. T., J. A. Collazo, J. A. Dubovsky, and W. J. Fleming. 1998. Dabbling duck behavior and aircraft activity in coastal North Carolina. J. Wildl. Manage. 62: 1127-1134.

Connolly, G. E., R. M. Timm, W. E. Howard, and W. M. Longhurst. 1976. Sheep killing behavior of captive coyotes. J. Wildl. Manage. 40: 400-407.

Conover, M. 2002. Resolving human-wildlife conflicts: The science of wildlife damage management. CRC Press Company, Lewis Publishers, New York, New York, USA.

Crabtree, R. L., and J. W. Sheldon. 1999. Coyotes and canid coexistence in Yellowstone. Pp. 127-163 *in:* T. W. Clark, A. P. Curlee, S. C. Minta, and P. M. Karieva, eds. Carnivores in Ecosystems, The Yellowstone Experience. Yale University Press, New Haven, Connecticut. USA.

Craig, J. R., J. D. Rimstidt, C. A. Bonnaffon, T. K. Collins, and P. F. ScanIon. 1999. Surface water transport of lead at a shooting range. Bull. Environ. Contam. Toxicol. 63: 312-319.

Decker, D. J., and G. R. Goff. 1987. Valuing wildlife: economic and social perspectives. Westview Press. Boulder, Colorado. 424pp.

DeLaney, D. K., T. G. Grubb, P. Beier, l. L. Pater, and M. H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. J. Wildl. Manage. 63: 60-76.

Duda, M. D., T. Beppler, S. Nissell, A. Criscione, B. Hepler, J. Herrick, M. Jones, A. Ritchie, C. Schilli, T. Wineford, and A. Lanier. 2008. Public Opinion on Hunting and Wildlife Management in Washington. Harrisonburg, WA.

Eccleston, C. H. 1995. NEPA: Determining when an analysis contains sufficient detail to provide adequate coverage for a proposed action. Federal Facilities Environmental Journal, Summer.

Ellis, D. H. 1981. Responses of raptorial birds to low-level jet aircraft and sonic booms. Results of the 1980-81 joint U.S. Air Force-U.S. Fish and Wildl. Serv. Study. Institute for Raptor Studies, Oracle, AZ. 59 pp.

EPA (United States Environmental Protection Agency). 2000. How to evaluate alternative cleanup technologies for underground storage tank sites: A guide for corrective action plan reviewers. @http://www.epa.gov/cgi-bin/claritgw.

FAA (Federal Aviation Administration). 2008. Noise Levels for US Certificated and Foreign Aircraft. Appendix 7. Online. http://www.faa.gov/about/office_org/headquarters_offices/AEP/noise_levels/

Fraser, J. D., L. D. Franzel, and J. G. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. J. Wildl. Manage. 49: 585-591.

Frenzel, R. W., and R. G. Anthony. 1989. Relationship of diets and environmental contaminants in wintering bald eagles. J. Wildl. Manage. 53: 792-802.

Fuller, W. A. 1969. Changes in numbers of three species of small rodent near Great Slave Lake N.W.T. Canada, 1964-1967 and their significance for general population theory. Ann. Zool. Fennici. 6: 113-144.

GAO (United States General Accounting Office). 2001. Wildlife Services Program: Information on activities to manage wildlife damage. Report to Congressional Committees. GOA-02-138. 71pp.

Gardner, A. L. 1982. Virginia opossum. Pages 3-36 *in:* J. A. Chapman, and G. A. Feldhamer, eds. Wild Mammals of North America: Biology, Management, and Economics. Johns Hopkins Univ. Press, Baltimore, MD.

Gese, E. M., and S. Grothe. 1995. Analysis of coyote predation on deer and elk during winter in Yellowstone National Park, Wyoming. Am. Midl. Nat. 133: 36-43.

Gese, E. M., R. L. Ruff, and R. L. Crabtree. 1996. Social and nutritional factors influencing the dispersal of resident coyotes. Animal Behav. 52: 1025-1043.

Gier, J. T. 1968. Coyotes of Kansas. Kansas Agricultural Experiment Station Bulletin 393, Kansas State University, Manhattan.

Gladwin D N, K. M. Manci, and R. Villella. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife. Bibliog. Abstracts, USFWS, National Ecol. Res, Cen., Fort Collins, CO.

Guthery, F. S., and S. L. Beasom. 1977. Responses of game and nongame wildlife to predator control in south Texas. J. Range Manage. 30: 404-409.

Hayes, D. J. 1993. Lead shot hazards to raptors from aerial hunting. USDA, APHIS, ADC. Billings, MT. Unpubl. Rpt. 14 pp.

Henke, S. E. 1992. Effect of coyote removal on the faunal community ecology of a short-grass prairie. Ph.D. Thesis, Texas Tech. Univ., Lubbock. 229 pp.

Hoffmann, C. O., and J. L. Gottschang. 1977. Numbers, distribution, and movements of a raccoon population in a suburban residential community. J. Mammal. 58: 623-636.

Holthuijzen, M. A., W. G. Eastland, A. R Ansell, M. N. Kochert, R. D. Williams, and A. Young. 1990. Effects of blasting on behavior and productivity of nesting prairie falcons. Wildl. Soc. Bull. 18: 270-281.

Hunsaker, D., II. 1977. Ecology of New World marsupials. Pages 95-156 *in:* D. Hunsaker, II, ed. The Biology of Marsupials. Academic Press, New York, NY.

Jurgelski, W., Jr., and M. E. Porter. 1974. The opossum (*Didelphis virginiana* Kerr) as a biomedical model. III. Breeding the opossum in captivity: methods. Lab. Anim. Sci. 24: 412-425.

Keith, L. B. 1974. Some features of population dynamics in mammals. Int. Cong. Game Biol. 11: 17-59.

Kennelly, J. J., and B. E. Johns. 1976. The estrous cycle of coyotes. J. Wildl. Manage. 40: 272-277.

Knowlton, F. F. 1964. Aspects of coyote predation in south Texas with special reference to white-tailed deer. Ph.D. Thesis, Purdue Univ. Lafayette. 147 pp.

Knowlton, F. F., E. M. Gese and M. M. Jaeger. 1999. Coyote depredation control: an interface between biology and management. J. Range Manage. 52: 398-412.

Krausman, P. R., and J. J. Hervert. 1983. Mountain sheep responses to aerial surveys. Wildl. Soc. Bull. 11: 372-375.

Krausman, P. R., B. D. Leopold, and D. L. Scarbrough. 1986. Desert mule deer response to aircraft. Wildl. Soc. Bull. 14: 68-70.

Krausman, P. R., C. L. Blasch, K. K. G. Koenen, L. K. Harris, and J. Francine. 2004. Effects of military operations on behavior and hearing of endangered Sonoran pronghorn. Wildl. Monogr. 157. 41 pp.

Kushlan, J. A. 1979. Effects of helicopter censuses on wading bird colonies. J. Wildl. Manage. 43: 756-760.

Lamp. 1989. Monitoring the effects of military air operations at Naval Air Station Fallon on the Biota of Nevada. NV Dept. of Wildl. (as cited in ANG1997a).

Llewellyn, L. M., and F. H. Dale. 1964. Notes on the ecology of the opossum in Maryland. J. Mammal. 45: 113-122.

Manci, K., D. Gladwin, R. Villevilla, and M. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife. A literature synthesis, Fort Collins, CO: USFWS National Ecology Research Center. NERC-88/29.

MIS (Management Information System). 2008. Washington program data (Unpubl. Draft). United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Olympia, Washington, USA.

Myers, J., and C. J. Krebs. 1971. Genetic, behavioral, and reproductive attributes of dispersing field voles *Microtus pennsylvanicus* and *Microtus ochrogaster*. Ecol. Monogr. 41: 53-78.

NASS (National Agricultural Statistics Service). 2005. Sheep and Goat Predator Loss. Washington D.C. 18 pages. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1628

National Park Service. 1995. Report of effects of aerial overflights on the National Park System. USDI-NPS D-1062, July.

Neff, D. J., R. H. Smith, and N. G. Woolsey. 1985. Pronghorn antelope mortality study. Arizona Game and Fish Department, Res. Branch Final Rpt. Fed. Aid Wildl. Restor. Proj. W-78-R. 22 pp.

Pater, L. L. 1981. Gun blast far field peak overpressure contours (Technical Report NSWC TR 79-442): Naval Surface Weapons Center.

Pattee, O. H., S. N. Wiemeyer, B.M. Mulhern, L. Sileo, and J. W. Carpenter. 1981. Experimental lead-shot poisoning in bald eagles. J. Wildl. Manage. 45: 806-810.

Pepper, C. B., M. A. Nascarella, and R. J. Kendall. 2003. A review of the effects of aircraft noise on wildlife and humans, current control mechanisms, and the need for further study. Environ. Manage. 32: 418-432.

Pitelka, F. A. 1957. Some characteristics of microtine cycles in the Arctic. Arctic Biol.: 73-88.

Pitt, W. C., F. F. Knowlton, and P. W. Box. 2001. A new approach to understanding canid populations using an individual-based computer model: preliminary results. Endangered Species Update 18: 4.

Reynolds, H. C. 1952. Studies on the reproduction in the opossum (*Didelphis virginiana*). Univ. California Publ. Zool. 52: 223-284.

Rivest, P., and J. M. Bergeron. 1981. Density, food habits, and economic importance of raccoons (*Procyon lotor*) in Quebec agrosystems. Can. J. Zool. 59: 1755-1762.

Sanderson, G. C. 1987. Raccoon. Pages 486-499 *in:* M. Novak, J.A. Baker, M.E. Obbard, and B. Mallock, eds. Wild Furbearer Management and Conservation in North America. Ministry Nat. Resour., Toronto, Ontario, Canada.

Sauer, J. R., J. E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD.

Schueler, D.G. 1993. Contract Killers. Sierra Magazine. November/December 1993.

Seidernsticker, J. C., M. A. O'Connell, and A. J. T. Johnsingh. 1987. Virginia opossum. Pages 247-261 *in:* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch. Wild Furbearer Management and Conservation in North America. Ministry Nat. Resour., Toronto, Ontario, Canada.

Slate, D. A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Trans. North Amer. Wildl. Nat. Res. Conf 57: 51-62.

Sonenshine, D. E., and E. L. Winslow. 1972. Contrasts in distribution of raccoons in two Virginia localities. J. Wildl. Manage. 36: 838-847.

Stansley, W., L. Widjeskog, and D.E. Roscoe. 1992. Lead Contamination and Mobility in Surface Water at Trap and Skeet Ranges. Bull. Environ. Contam. Toxicol. 49: 640-647.

Stinson, D. W., D. W. Hayes, and M. A. Schroeder. 2004. Washington State Recovery Plan for the Greater Sage-grouse. Washing Department of Fish and Wildlife, Olympia, WA. 109 Pages.

Till, J. A. 1992. Behavioral effects of removal of coyote pups from dens. Proc. Vertebr. Pest Conf. 15: 396-399.

Till, J. A., and F. F. Knowlton. 1983. Efficacy of denning in alleviating coyote depredations upon domestic sheep. J. Wildl. Manage. 47: 1018-1025.

Twichell, A. R., and H. H. Dill. 1949. One hundred raccoons from one hundred and two acres. J. Mammal. 30: 130-133.

Urban, D. 1970. Raccoon populations, movement patterns, and predation on a managed waterfowl marsh. J. Wildl. Manage. 34: 372-382.

U.S. Coast Guard. 1999. NAS (Naval Air Station) - Point Mogu Endangered Species Act Programmatic Consultation Biological Assessment. @ http:/www.srnr.arizona.edu/mugu/nas/bioassess5.html.

USDA. 1997a. Predator Damage Management in Washington. USDA-APHIS-WS, 720 O'Leary Street, NW, Olympia, WA 98502

USDA. 1997b (revised). Animal damage control program, final environmental impact statement. USDA-APHIS-ADC [WS] Operational Support Staff, 4700 River Road, Unit 87, Room 2D-07.3, Riverdale, Maryland, USA.

USDA. 2005. Predator Damage Management in Colorado EA. WS State Office, 12345 West Alameda Parkway, Suite 204, Lakewood, CO 80228.

USDI (U.S. Department of the Interior). 1979. Mammalian predator damage management for livestock protection in the Western United States. Final Environmental Impact Statement. Washington, D.C. 789 pp.

USDI. 1992. Biological Opinion. Animal Damage Control Program U.S. Fish and Wildlife Service, Washington D.C.

USFS (U.S. Forest Service). 1992. Potential impacts of aircraft overflights of National Forest System Wildernesses. Report to Congress. USDA, FS.

USFWS. 2005. Endangered and Threatened Wildlife and Plants; 12-Month Finding for Petitions To List the Greater Sage-Grouse as Threatened or Endangered. Federal Register 70: 2244-2282.

Wagner, F.H. 1988. Predator control and the sheep industry. Iowa State Univ. Press. Ames. 230 pp.

Wagner, F. H., and L. C. Stoddart. 1972. Influence of coyote predation on black-tailed jackrabbit populations in Utah. J. Wildl. Manage. 36: 329-342.

Wagner, K. K. 1997. Preventive predation management: an evaluation using winter aerial coyote hunting in Utah and Idaho. Ph.D. Thesis. Utah St. Univ., Logan.

Wagner, K. K., and M. R. Conover. 1999. Effect of preventive coyote hunting on sheep losses to coyote predation. J. Wildl. Manage. 63: 606-612.

Weaver, J. L. 1979. Influence of elk carrion upon coyote populations in Jackson Hole, Wyoming. Pages 152-157 *in:* M. S. Boyce and L. D. Hayden, editors. Symposium on North American Elk: ecology, behavior, and management. University of Wyoming, Laramie.

WDFW. 2007. Online. http://wdfw.wa.gov/wlm/living/coyotes.htm.

WDFW. 2008. 2009-2015 Game Management Plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia.

White, C. M., and S. K. Sherrod. 1973. Advantages and disadvantages of the use of rotor-winged aircraft in raptor surveys. Raptor Research 7: 97-104.

White, C. M., and T. L. Thurow. 1985. Reproduction of ferruginous hawks exposed to controlled disturbance. Condor 87: 14-22.

Yeager, L. E., and R. G. Rennels. 1943. Fur yield and autumn foods of the raccoon in Illinois river bottom lands. J. Wildl. Manage. 7: 45-60.