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SUMMARY REPORT
for
PREDATOR DAMAGE MANAGEMENT IN NEBRASKA FOR THE PROTECTION OF LIVESTOCK, WILDLIFE, PROPERTY, AND PUBLIC HEALTH AND SAFETY
FY 2004 - 2008

I. BACKGROUND / INTRODUCTION

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). USDA-APHIS-Wildlife Services (WS) uses an adaptive Integrated Wildlife Damage Management (IWDM) approach (WS Directive 2.105[1]), 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.

In 1999, the Nebraska WS program completed an Environmental Assessment (EA)[2] (USDA 1999a) which addressed the need to conduct predator damage management and the potential impacts of various alternatives for responding to predator damage in Nebraska. The EA analyzed potential impacts of the WS program as it involves conflict resolution with predatory species such as coyotes (*Canis latrans*), red fox *(Vulpes vulpes*), mountain lions (*Puma concolor*), raccoons (*Procyon lotor*), badgers (*Taxidea taxus*), bobcats (*Lynx rufus*), opossums (*Didelphis virginiana*), mink (*Mustela vison*), weasels (*Mustela* spp.) and striped skunks (*Mephitis mephitis*). For the development of this EA, the cooperating agencies (*i.e.,* U.S. Forest Service (USFS), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (USFWS), Nebraska Game and Parks Commission (NGPC), Nebraska Department of Agriculture (NDA) and the University of Nebraska Cooperative Extension (UNCE)) helped identify a variety of issues deeming relevant to the analyses. The NGPC has the responsibility to manage all wildlife in Nebraska, including federally listed T&E species and migratory birds, which is a joint responsibility with the USFWS. Within Nebraska, cattle, sheep and goats are permitted to graze on federal lands administered by the USFS and BLM and on state and private lands. As proposed in the EA, WS implemented a cooperative and coordinated program that protects livestock, wildlife, property, and public health and safety as requested and appropriate on all lands in Nebraska. The majority of requests for management are for predatory species whose populations are relatively high or are considered "anthropogenic abundant[3]" (Conover 2002) and have caused damage or present a risk.

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[1] 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 throughout this report, but have not been cited in the Literature Cited.

[2] Availability of USDA (1999a) was announced through publication of legal notices in the Omaha World Herald, Lincoln Journal Star, Crawford Clipper, Chadron Record, Scotts Bluff Star Herald, and North Platte Telegraph for 3 consecutive days. Additionally, copies of the EA and invitation to provide comments were mailed to approximately 300 individuals and organizations that had previously identified and expressed an interest in the WS program. A 40-day public comment period was provided for public input on the pre-decision EA: the public comment period ended on February 20, 1997.

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

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The Nebraska WS program conducted conflict reduction activities with various methods, as analyzed in the EA, on various land classes in Nebraska, as requested. The EA identified six Alternatives[4] which were analyzed in detail. Alternative 3, "Integrated Wildlife Damage Management for Multiple Resources and Land Classes" was selected as the Preferred Alternative and a Finding of No Significant Impact (FONSI) was issued and Decisions signed on October 5, 1999 (USDA 1999b). Copies of the EA and Decision/FONSI are available from the Nebraska WS State Office, USDA-APHIS-WS, P O Box 81866, Lincoln, NE 68501-1866.

II. AGENCY AUTHORITIES and COOPERATION

WS is the federal program 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]). Under the Act of March 2, 1931, as amended and U.S.C. §426c, APHIS may carry out wildlife damage management programs or enter into cooperative agreements with states, local jurisdictions, individuals and public and private agencies whereby they may fund and assist in carrying out such programs. Memoranda of Understanding (MOUs) signed between WS and the USFS, BLM, USFWS, NGPC and NDA clearly outline the responsibility, technical expertise and coordination between agencies. WS activities are conducted at the request of and in cooperation with other federal, state, and local agencies private organizations and individuals. Accordingly, WS' authorities support and authorize its mission of providing federal leadership and expertise to reduce problems caused by injurious and/or nuisance wildlife.

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 comparable documents are in place. When requested, WS cooperates with land and wildlife management agencies to effectively and efficiently reduce human/wildlife conflicts according to applicable federal, state and local laws, regulations, policies, orders, and procedures, including the Endangered Species Act of 1973 (ESA) as amended (16 USC 1531-1543) (WS Directive 2.210). None of WS' human/predator conflict reduction activities resulted in habitat modifications.

III. PURPOSE OF THIS REVIEW

The purpose of this Summary Review is to analyze and report: 1) the results of Nebraska WS' predator damage management activities conducted during FY 2004 through FY 2008 and evaluate the accuracy of the EA analyses, 2) review standard operating procedures to minimize or avoid potential adverse environmental effects, and 3) provide an opportunity for public review of program activities.

IV. SCOPE OF PREDATOR DAMAGE

The need for action remains as stated in the EA, that the adverse effect of predation on livestock and other resources in Nebraska can be serious for individual livestock producers, homeowners and businesses. Monetary losses from predator damage verified and reported to Nebraska WS from FY 2004 through 2008 was $255,161 and $364,752, respectively (Table 1). Requests from the public to address these problems ranged from depredations on livestock, game animals, wildlife, and pets; damage to field crops and landscaping; threats to human health and safety; and structural damage to buildings/property (Table 2). However, the majority of the damage in Nebraska was coyote predation on livestock (Management Information System (MIS) 2004, 2005, 2006, 2007, 2008).

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[4] Normally, according to the APHIS procedures for implementing the National Environmental Policy Act (NEPA), individual wildlife damage management actions are categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6,000, 6,003, (1995)). The EA was prepared to evaluate and determine if any potentially significant or cumulative impacts from the proposed and planned damage management program would occur.

Predator damage totaled $92.7 million in losses to ranchers/livestock nationwide with coyote predation on cattle totaling 51.1% of all animal depredation (NASS 2005). Livestock production in Nebraska is a sizeable industry, and predation on livestock can represent a large financial loss to individual livestock producers in the State. According to statewide data complied by the National Agricultural Statistics Service (NASS), a total of 500 adult sheep and 1,500 lambs, valued at $169,000 were reported killed by predators in Nebraska in 2004 (NASS 2005). Coyotes were responsible for the most damage, at 1,500 head of sheep and lambs. Predation by domestic dogs, eagles, and bobcats accounted for most of the other predator losses in Nebraska. Based on reported sheep inventories and lamb crop, these losses represented 1.2% predation loss on lambs and 0.5% loss on adult sheep in 2004 (NASS 2005). Those loss levels were sustained with an integrated predator damage management program in place. Research results suggest that predation losses in the absence of such a damage management program would average about 17% for lambs and 4.5% for adult sheep (USDA 1997).

Table 1. Nebraska WS Verified and Reported Damage ($) for FY04 - FY08.

Species	Reported	Verified	Reported & Verified
Badger	3,620	13,945	17,565
Bobcat	980	725	1,705
Coyote	280,355	149,261	429,616
Fox	5,632	1,580	7,212
Mtn. Lion	43,600	6,000	49,600
Mink	180	0	180
Opossum	450	920	1,370
Raccoon	14,145	55,215	69,360
Skunk	15,790	27,515	43,305

In response to requests for assistance from livestock producers and the public during FY2004-2008, WS personnel verified an annual average of $17,777 in livestock losses from predators[5] (Table2). Also, another $33,255 in average losses per year was verified during this same time period (MIS 2004, 2005, 2006, 2007, 2008) (Table 2).

Table 2. Nebraska WS Verified Damage by Resource (FY04-FY08).

Subcategory	Damage ($)
Game Animals	57,075
Livestock	88,886
Pets	2,140
Wildlife	10,525
Field Crops	22,220
Fruit & Nut	7,425
Livestock Feed, silage	7,960
Range/Pasture	890
Landscape/Turf/Garden	22,630
Food Items (Non-human)	935
Property (general)	4,600
Building (Resident & Non)	12,775
Dikes/Roads/Fence/Air Run	5,050
Human Health & Safety	12,050

Nationwide, farmers and ranchers spent $199 million on non-lethal predation reduction methods to prevent predation to their livestock, with fencing being most popular, followed by night penning and lamb sheds (NASS 2006). Nebraska sheep producers were above the national average in the percentage of ranchers using non-lethal methods such as shed lambing, night penning, guard dogs and frightening devices (Table 3) (NASS 2005). These proactive, non-lethal methods that ranchers use increase the validity for taking further, possibly lethal, action to alleviate damage from predators when predation continues to occur.

Public safety is another important responsibility for WS. Although attacks are rare, coyotes and other predators 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, Beier 1991, CDFG 2006, CDOW 2006). NGPC is the lead agency responsible for human and wildlife conflicts involving human health and safety, however WS may assist NGPC, upon request, by responding to safety and nuisance incidents.

Other public safety issues occur at airports when predators frequent airfields. Federal Aviation Administration (FAA) regulations require public airports (*i.e.*, Certificated) to provide for safe aircraft operations with regard to wildlife hazards, and through a 2005 MOU, FAA authorizes WS to assist airports to reduce those hazards. Wildlife strikes cost the commercial air transport industry in the United

[5] These losses represent only a fraction of the actual losses that likely occurred and serve more as an indicator of what kind of predator damage existed rather that an indication of damage magnitude (Connolly 1992).

States an estimated $490 million annually in structural damages alone (Linnell et al. 1996) and have killed more than 200 people.

Table 3. Comparative Use of Non-lethal Techniques in Sheep Production and the National Average (NASS 2005).

State	Fencing	Guard Dog	Llama	Donkey	Shed Lamb	Herding	Night Penning	Fright Tactics
Nebraska	35.9	44.0	10.9	7.7	45.1	5.5	56.7	2.5
US avg (%)	52.5	31.8	14.0	9.1	30.8	5.7	32.9	2.2
Difference	-16.6	12.2	-3.1	-1.4	14.3	-0.2	23.8	0.3

V. ALTERNATIVES ANAIYZED IN DETAIL

Six alternatives were analyzed in detail in relation to the primary issues identified below. Three additional alternatives were considered but not analyzed in detail. A thorough discussion of the anticipated effects of the various alternatives as they related to the issues is provided in USDA (1999a). The following summary provides a brief description of each alternative and its anticipated effects.

Alternative 1. Continuation of the Current Program (No Action Alternative) - The No Action Alternative was analyzed and used as a baseline for comparing the effects of the other alternatives as required by 40 CFR 1502.14(d). This alternative consists of the current program of technical assistance and operational IWDM by Nebraska WS on the Nebraska National Forest and associated Units, BLM, tribal, state county municipal and private lands under *Cooperative Agreement and Agreement for Control* with Nebraska WS. Alternative 1 would not allow WS to meet three of the seven objectives for the program. The current program direction is primarily for the protection of livestock.

Alternative 2. No Federal Nebraska WS Program - This alternative would terminate the federal predator damage management program in Nebraska. Alternative 2 was not selected because WS is authorized and directed by law to reduce damage caused by wildlife and reaffirmed by the US District Court of Utah (1993). This alternative would not allow WS to meet its statutory responsibility for providing assistance or reduce wildlife damage. Alternative 2 would not allow WS to meet six or the seven objectives for the program; only the non-target species objectives would be met. Alternative 2 violates the MOU between WS and the USFS and BLM whereby the USFS and BLM mutually recognize that predation reduction is necessary to achieve land and resource management objectives.

Alternative 3. Integrated Wildlife Damage Management for Multiple Resources and Land Classes: (Proposed Alternative) - This alternative would allow for predator damage management based on the needs of multiple resources (livestock, wildlife, property, and public health and safety) and would be implemented following consultations with the NGPC, NDA, federal agencies or tribes, as appropriate. This alternative would allow for a federal WS program to protect multiple resources on all lands classes at the request of the land management agency or individual if a *Cooperative Agreement, Agreement for Control* and/or a work plan with Nebraska WS, as appropriate, are in place. Alternative 3 was selected because it best allows WS to meet the objectives described in the EA and in most consistent with the USFS and BLM management plans. Alternative 3 conforms to the MOUs between WS, the USFS and BLM that mutually recognize that the reduction of wildlife damage on USFS and BLM land is important and may involve predator damage management to achieve land and resource management objectives. Alternative 3 would allow WS to meet seven of the seven objectives for the program. Analysis of Alternative 3 indicated a low level of impact for the target species, non-target species and T&E species.

Alternative 4. Nonlethal Damage Management Required Prior to Lethal Control - This alternative would require that nonlethal damage management be implemented before the initiation of lethal predator damage management by Nebraska WS. This alternative was not selected because no standard exists to

determine diligence in applying nonlethal methods nor are there any standard 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 and this was reaffirmed in the US District Court of Utah (1993). Consideration of wildlife protection is not included in the nonlethal methods currently available nor could WS base control strategies on the needs of designed wildlife. Alternative 4 would only allow WS to meet five of the seven objectives described in the EA. Alternative 4 would not allow WS to: 1) respond to all requests, 2) reduce predation to sheep, lambs and calves to objective levels or below, 3) assist the NGPC or USFWS in meeting wildlife management objectives, and 4) immediately address public health and safety requests.

Alternative 5. Corrective Damage Management Only - This alternative would require that verified livestock depredation occur before the initiation of lethal damage management. No preventive lethal damage management would be allowed and management could only be implemented after the onset of losses. Alternative 5 was not selected because it: 1) is often difficult to remove offending predators quickly enough to prevent further losses once predation has begun, 2) does not allow WS to meet the objectives described in the EA, and 3) does not allow WS to meet its statutory directives. WS is authorized and directed by law to minimize damage caused by wildlife and this was reaffirmed in the US District Court of Utah (1993). The alternative would delay management of problem wildlife while verification of loose occurred and management actions could be implemented. Alternative 5 would not allow WS to meet five of the seven objectives. Alternative 5 would not allow WS to: 1) respond to all requests, 2) reduce predation to sheep, lambs and calves to objectives level or below, 3) assist the NGPC or USFWS in meeting wildlife management objectives, and 4) immediately address public health and safety requests.

Alternative 6. Technical Assistance Only - Under this alternative, Nebraska WS would not conduct operational predator damage management in Nebraska. The entire program would consist of only technical assistance and all operational wildlife damage management in Nebraska would be eliminated. Alternative 6 was not selected because it was inconsistent with USFS and BLM policy, and it is likely the USFS and BLM could not meet their management guidelines. Alternative 6 would not allow WS to meet six of the seven objectives. Alternative 6 would not allow WS to: 1) respond to all requests, 2) reduce predation of sheep, lamb, and calves to objectives levels or below, 3) monitor the implementation of producer used non-lethal methods, 4) assist the NPGC or USFWS in meeting wildlife management objectives, 5) design a wildlife damage management program with NGPC and USFWS input, and 6) immediately address public health and safety requests.

VI. MAJOR ISSUES ANALYZED IN DETAIL

USDA (1999a) identified and analyzed a variety of issues deemed relevant to the analysis. The Multi-agency Team, consisting of representatives from the lead (WS) and cooperating agencies (BLM, USFS, USFWS, NGPC, NDA, and the UNCE) consolidated and determined the issues to be:

- Cumulative impacts on the viability of predators.
- Effectiveness and selectivity of damage management methods.
- Risks posed by damage management methods to the public and domestic pets.
- Concern about WS' impacts on T&E species.

Cumulative impacts on the viability of predators.

Between FY04 and FY08, an average of 3,061 target (Table 4) and 17 non-target animals were taken annually using methods analyzed in the EA. During this time, WS conducted management action on 8 of the 10 species (*i.e.,* coyote, red fox, badger, bobcat, raccoon, striped skunk, mink, and opossum) analyzed in the EA.

Coyote predation continues to be the biggest predator problem to livestock producers in Nebraska and more coyotes were taken than any other species (Table 4). Based on the coyote population impact analysis in USDA (1999a) and an estimated fall coyote population of about 75,900 animals (T. Hall, WS, unpubl. data), the known total mortality falls within the parameters of a low magnitude of impact. The mean number of coyotes killed annually by WS by all methods in Nebraska during 2004 through 2008 was 1,939 (Table 4). Other estimated mortality (sport hunter and trapper take) of coyotes averaged 30,958 annually (Table 5) (Wilson 2007). Harvest information suggests that the coyote population in Nebraska is viable and healthy (NGPC Fur Harvest Surveys, Wilson 2007) and WS' take of coyotes has remained relatively constant from 2004 through 2008. Pitt et al. (2001) used an "individual-based" computer model to mimic natural coyote populations and assess impacts to populations in relation to varying degrees of exploitation. The model did not observe population decrease until more than 60% of the population was removed annually. Even if the number of coyotes removed by Nebraska WS doubled, that level of mortality would still fall below the level where coyote abundance would decline (Connolly and Longhurst 1975, Connolly 1995, Pitt et al. 2001). Further, NGPC determined that WS' take of coyotes did not adversely affect species viability or cause long-term declines in species abundance (S. Wilson, NGPC, 2009, pers. comm.).

Table 4. WS Lethal Take of Target Species (MIS 2004 through 2008).

Species	FY04	FY05	FY06	FY07	FY08
Coyote	1754	2356	2080	1858	1648
Red Fox	110	56	70	101	91
Badger	43	43	25	28	31
Bobcat	3	4	1	0	1
Raccoon	791	526	534	491	558
Striped Skunk	440	293	170	215	195
Mink	0	1	1	1	0
Opossum	260	189	116	126	95
Weasel	0	0	0	0	0
Mountain Lion	0	0	0	0	0

Table 5. Estimated Sport Hunter and Trapper Harvest from NGPC (Wilson 2007).

Species	2006/2007		Total	2005-2006 Total	5 Yr Average (2001-2005)
	Hunter	Trapper			
Coyote	16,766	16,422	33,188	25,370	30,958
Red Fox	1,056	3,993	5,048	3,286	3,942
Badger	1,323	2,991	4,314	3,687	3,355
Bobcat	342	1,212	1,604	1,472	1,331
Raccoon	49,161	110,891	160,052	122,777	150,473
Mountain Lion	0	0	0	0	0
Striped Skunk	3,725	12,918	16,644	17,487	18,020
Mink	*	*	*	*	*
Opossum	6,937	27,784	34,721	27,069	26,414
Weasel	*	*	*	*	*

* Data are not available from NGPC

Nebraska WS also removed other predators to reduce damage and resolve complaints (Table 4). Based on the population impact analysis in USDA (1999a), the number of other predatory species removed by WS from FY 2004 through FY2008, when compared to other take, is insignificant with respect to species viability and abundance, and reported sport harvest information suggests that the predator populations in Nebraska are viable and healthy (Wilson 2007, NGPC Fur Harvest Surveys).

Effectiveness and selectivity of damage management methods

WS is largely cooperator funded, therefore, the measure of "effectiveness" 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 issues, humaneness and land management goals often reduce effectiveness, but are nonetheless important parts of the WS program. In a recent cost effectiveness study of the California WS program, Schwiff 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 a total of $9.5 to $14.0 million annually with livestock death loss rates being three times higher without predator management (Taylor 2007).

The selectivity of each method is based, in part, on the application of the method, the skill of WS' personnel, and the direction provided by WS' directives and policies. WS personnel are trained in the use of each method and are certified as Non-commercial Pesticide Applicators by the NDA. Effectiveness of the various methods may vary depending on circumstances at the time of application with effectiveness and/or applicability depending on factors such as weather conditions, the time of year, biological and economic considerations, legal and administrative restrictions, or other issues. Because various factors may preclude the use of certain methods, it is important to maintain the widest possible selection of damage management methods for use to selectively and effectively resolve predator damage management problems. Non-target take was very low with an average of 17 non-target animals killed per year from FY 04 through FY08. This represents 0.6% of WS total take for the summary reporting period and is a biologically insignificant number based on species abundance (S. Wilson, NGPC, 2009, pers. comm.) and as analyzed in the EA. This also demonstrates the professional ability of WS personnel to use management techniques to select for target species.

Several methods employed under the current program are typically 100% selective for target species. These methods include aerial gunning, shooting from the ground, and denning. Cage trapping may capture a few non-target animals, but these animals are typically released. While the methods discussed above are nearly 100% selective in capturing/killing only the target species, other methods such as leg-hold traps, snares and M-44s can be somewhat less selective.

WS uses leg-hold traps with pan-tension devices[6] to make traps more selective, and checks traps according to NGPC regulations. During FY 04 through 08, an average of 2,093 target and only 17 non-target animals were trapped, snared or killed with M-44s annually in Nebraska (Table 6). WS personnel often try to reduce the need for setting traps or snares by first trying to remove target animals by shooting. If shooting is not successful or feasible, other management methods are used to resolve the problem.

As used by WS in Nebraska, M-44s were slightly more selective than snares or traps (Table 6). The selectivity of snares is largely a function of how and where they are set. Break-away snare locks are also used to provide for the release of larger animals that could be accidentally caught.

In Nebraska, non-capture methods (*i.e.*, aerial gunning, calling and shooting, shooting, denning, M-44s and dogs) accounted for 8,552 or 88.2%, of the coyotes taken from FY 04 through 08. Capture methods (*i.e.*, leg-hold traps and neck snares) accounted for 1,144 or 11.8%, of the coyotes taken during FY 04-08.

Table 6. Selectivity of Traps, Snares and M-44s as used by Nebraska WS Personnel during FY04-08.

	Traps[1]	Snares[2]	M-44s
Target			
Coyote	564	580	4,355
Red Fox	117	10	30
Striped Skunk	1,110	59	0
Badger	103	44	0
Bobcat	5	4	0
Raccoon	2,423	319	0
Opossum	720	21	0
5-Year Total	5,042	1,037	4,385
Nontarget			
Red Fox	1	2	0
Striped Skunk	8	1	2
Badger	3	0	0
Porcupine	2	0	0
Wood Rat	1	0	0
Raccoon	21	3	3
Opossum	7	0	3
Woodchuck	2	0	0
Fox Squirrel	2	0	0
Rabbit	1	0	0
Swift Fox	0	0	2
Prairie Dog	1	0	0
Feral Cat	15	2	0
Feral Dog	0	0	5
Total	64	8	15
% Selectivity	98.75	99.23	99.66

[1] These figures only refer to target animals caught in leg-hold, cage and body-grip traps. Non-target animals caught and released are not included in these totals.
[2] These figures refer primarily to animals caught in neck snares.

[6] Pan-tension devices increase the amount of weight required to set off the trap and effectively reduce the capture of smaller nontarget animals (Turkowski et al. 1984, Phillips and Gruver 1996). Pan-tension devices are always used by WS unless their use would preclude capture of the intended target species.

Risks posed by damage management methods to the public and domestic pets

Between FY04 and FY08, an average of 3,078 target and non-target animals were taken using methods analyzed in the EA and there were no known reports of injury to domestic pets or the public from predator damage management methods as used by WS personnel. Methods employed by WS in Nebraska were implemented in a safe and responsible manner. WS activities, however, benefitted public safety and the safety of pets and livestock by reducing wildlife-human-domestic animal conflicts.

WS Specialists received on-the-job training and are supervised by wildlife biologists who provide guidance on methods and safety procedures from agency policy and field experience. Specialists also received hands-on training at state and district meetings on firearm use, trapping techniques or other issues deemed important to improving safety.

Concern about WS' impacts on T&E 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 T&E species and other species of special concern. To help ensure no adverse effect to listed species, WS consulted with the USFWS (USFWS 1992, Letter to D. Williams, WS State Director, Lincoln from S. Anschutz, USFWS, Ecological Services, Grand Island, December 20, 1996). USFWS (1992) determined that under the reasonable and prudent measures outlined in USDA (1997), that take would not occur or would not jeopardize the continued existence of listed species potentially affected by predator damage management activities. USFWS (1992) also outlines the circumstances under which reinitiation of consultation would be necessary and reporting procedures for potentially affected listed species. Nebraska WS also consulted with the NGPC concerning WS predator damage management actions (Letter to D. Williams, WS State Director, Lincoln from D. Figgs, NGPC Nongame Biologist, Lincoln, January 14, 1997). NGPC stipulated that they would consult with the NDA to address concerns with regard to T/E species as well as other wildlife resources through its review of USDA (1999a). A review of the USDA (1999a) Endangered Species Act (ESA) Section 7 consultation during this review determined that the analysis of potential impacts is still applicable.

VI. PUBLIC INVOLVEMENT

Issues related to the proposed action were initially developed by an interdisciplinary team process involving the NGPC, USFS, BLM, USFWS, NDA and UNCE. A Multi-agency Team of WS, NGPC, USFS, BLM, USFWS, NDA, and UNCE personnel refined the issues, prepared objectives and identified alternatives, and Nebraska WS included an invitation for public comment of USDA (1999a). An invitation for public comment letter containing issues, objectives, preliminary alternatives, and a summary of the need for action was sent to 262 individuals or organizations. Notice of the proposed action and invitation for public involvement was also placed in six newspapers with circulation throughout Nebraska. Public comments were documented from 25 letters or written comments on review of USDA (1999a). All responses are maintained in the administrative file at the Nebraska WS State Office, P.O. Box 81866, Lincoln, Nebraska 68501-1866.

As part of this summary review process, the Summary Report is being made available to the public for a 30-day public comment period and noticed through the APHIS website and a Notice of Availability (NOA) published for 3 consecutive days in the Lincoln Journal Star, Lincoln, NE, and NOAs mailed to those that responded to USDA (1999a). The NOA stated that WS was accepting comments for a 30-day period and copies of the USDA (1999a), the FONSI and Decision, and the Summary Report may be obtained from the USDA-APHIS-WS website or WS State Office in Lincoln. The WS State Office mailing address and phone number were provided.

INFORMATION AVAILABLE SINCE COMPLETION OF THE 1999 EA

Some issues related to WS' predator damage management were brought to the attention of WS, particularly the effects of aerial gunning on non-target species (from aircraft overflights), and recreationists. These issues have been addressed in WS (2005), which found no adverse effect on the quality of the human environment. Below is analysis for the Nebraska WS predator damage management program.

Aerial Gunning Activities

Aerial gunning is conducted with fixed-wing aircraft in Nebraska and an important method to reduce predator/livestock damage and is used in response to depredation complaints/events. The amount of time spent aerial gunning varies depending on funding, the severity of losses and weather conditions, as 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. During FY 04 through FY08, Nebraska WS killed 465, 1161, 982, 361, and 348 coyotes, respectively, by aerial gunning in the State, and averaging 663 coyotes per year (Table 7). Nebraska WS' use of aerial gunning to remove coyotes contributed to 34% of the coyotes taken during this analysis period. During this review period, aerial gunning was primarily conducted on private lands[7] totaling less than 2% of the total acreage in Nebraska and an average of about 167 hours of aerial gunning per year (Table 7). During FY2004 through FY2008, WS aerial gunning activities did not result in any accidents, fuel spills or fires and there were no reports of threats to public health or safety.

Table 7. Hours Flown and Coyotes Killed in Nebraska from FY04 through FY08.

Fiscal Year	Fixed-wing	Coyotes Killed
04	153.5	465
05	293.9	1,161
06	238.9	982
07	69.5	361
08	79.1	348

Aerial Gunning Issues

WS conducts relatively little aerial gunning in Nebraska. However, to help explain the effects of low-level flight, additional information is being provided. Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on aircraft to monitor the status of many animal populations including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1980), and colonial waterbirds (Speich 1986). Low-level flights are also required when aircraft are used to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1994).

A number of studies have looked at responses of various wildlife species to aircraft overflights. The National Park Service (NPS) (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 overflights are chronic. However, WS aerial gunning operations rarely occur in the same area on a daily basis and little time is actually spent flying over those particular areas.

The effects on wildlife from military-type aircraft have been studied extensively (ANG 1997a, 1997b) and were found to have no expected adverse effects on wildlife. Nebraska WS uses small fixed-wing aircraft and, may on occasion, use small helicopters[8] for aerial gunning. The noise level of the J3 Supercub (Piper PA-18) is reported by FAA to be 65 dBA when measured directly beneath the airplane flying at 500 feet above ground level (AGL) (http://www.faa.gov/about/office_org/headquarters_offices/AEP/noise_levels/media/uscert_appendix_07.xls). Put in perspective, that noise level is similar to

[7] WS activities are only conducted on those areas where the landowner or lessee has signed an "Agreement for Control" and primarily on private lands or where activities have been discussed with appropriate State and federal land management agencies.

[8] Helicopters have not been used in the Nebraska WS program in the last 5 years.

"normal conversation at 5 feet" (http://www.awp.faa.gov/atenviro/CRITERIA.htm). 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 J3 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 conducts aerial gunning on less than 2% of the land area of the State indicates that about 98% of wildlife populations are not even exposed to WS aerial gunning overflights in the State. Further lessening the potential for any adverse impacts is that such flights occur only a few days per year. 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. The below research results indicate 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 or helicopter produced no "drastic" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance. They observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They 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 Waterfowl Management Areas without the authorization of the managing agency. Thus, there is little to no potential for any adverse effects on these types of birds.

Raptors. Potential affects of aircraft overflights to raptors was analyzed in ANG (1997a) which summarized the effects of 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*) suggested that eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggests that golden eagles (*Aquila chrysaetos*) are not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Finally, one other study found that eagles were particularly resistant to being flushed from their nests (Awbrey and Bowles 1990).

Therefore, there is considerable evidence that eagles would not be adversely affected by WS aerial gunning overflights.

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

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

Passerines. Reproductive losses have been reported in one study of small territorial passerines ("perching" birds that include sparrows, blackbirds) after exposure to low altitude overflights (Manci et al. 1988), but natural mortality rates of both adults and young are high and variable for most passerines. 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.

Mammals

Pronghorn (antelope) and Mule Deer. Krausman et al. (2004) found that Sonoran pronghorn (*Antilocapra americana sonoriensis),* a T&E species in Arizona, were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. Krausman et al. (1986) reported that only three of 70 observed responses of mule deer (*Odocoileus hemionus*) to small fixed-wing aircraft overflights at 150 to 500 feet 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 pronghorn and 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 pronghorn or mule deer populations. However, to the extent that localized coyote removal reduces predation on deer and antelope fawns and other wildlife species, benefits to such species would outweigh potential adverse impacts from removal of coyotes, 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 maintaining pronghorn and mule deer populations (Neff et al. 1985).

Big-horned Sheep. Krausman and Hervert (1983) reported that, of 32 observations of the response of big-horned 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 big-horned sheep to leave an area. WS does not conduct aerial gunning in typical big-horned sheep habitat. If wild sheep are observed, the pilot avoids pursuit or harassment, therefore WS aerial gunning will have minimal or no impact to big-horned sheep.

Conclusion of Aircraft Overflight Impacts to Birds and Mammals

The above studies indicate that most birds and mammals are relatively tolerant of aircraft overflights, even those that involve noise at high decibels such as from military aircraft. In general, the greatest potential for impacts would be expected when overflights are frequent such as hourly and over many days representing "chronic" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species become habituated to overflights which appear to naturally mitigate for adverse effects on their populations. Nebraska WS aerial gunning occurs in rangeland areas and not near commercial airports or military flight training facilities. Therefore, it is reasonable 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).

Consequences of Aerial Gunning Accidents

As stated above, Nebraska WS has not had any aircraft accidents, fuel spills or fires, however aerial gunning, like any other flying, may result in an accident. WS pilots and crews are trained and experienced to recognize the circumstances which lead to accidents and have thousands of hours of flight time. The national WS Aviation Program has increased its emphasis on safety, including funding for additional training, the establishment of a WS Aviation Training and Operation Center (ATOC) and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences are evaluated.

Fuel Spills and Environmental Hazard from Aviation Accidents

The National Transportation Safety Board (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, pers. comm. 2000). N. Wiemeyer (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 government planes from FY02 – FY07 (R. Feivor, ATOC, 2009 pers. comm.). Further, the quantities potentially involved in aircraft used by WS are relatively small (36 gallons is standard in the aircraft used by Nebraska WS) and less than many vehicles traveling Nebraska highways. In addition, during much of each flight the amount of fuel on board would be less than these maximum amounts and in some cases, not all of the fuel would spill if an accident occurred. During FY02 through FY08, Nebraska WS aerial gunning activities did not result in any fuel spills or fires and there were no reports of threats to human health or safety.

Oil and Other Fluid Spills: In the case of federal 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 (6-8 quarts) capable of being spilled in any accident are small and insignificant with respect to the potential for environmental damage. Aircraft used by WS are single engine models, so the greatest potential amount of oil that could be spilled in one accident would be 8 quarts or less.

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, U. S. Environmental Protection Agency guidelines provide for "natural attenuation" or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents are not cleaned up, the oil does not persist in the environment or persists in such small quantities that there is no problem. Also, WS' flights generally occur in remote areas away from human habitation and drinking water supplies. Thus, 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 aviation accidents is considered low. In addition, based on the history and experience of the program in aircraft accidents, 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. WS' use of aviation should be recognized for its divergence from any other aviation use found in general aviation (GA). In 1998, WS commissioned an independent review of its aerial gunning operations. An independent panel reviewed aerial gunning and made several recommendations regarding enhanced safety. As a result, these recommendations have been implemented by WS and WS has implemented an Aviation Safety Program[9] to support aerial activities and recognizes that an aggressive overall safety and training program is the best investment in accident prevention. The safety program includes regular training for pilots and crew members as well as enhanced pilot training and evaluation. WS employees are trained in hazard recognition and shooting is only conducted in a safe manner. While the goal of the aviation safety program is no accidents there remains some possibility that accidents may occur (L. Burraston, WS 2008 pers. comm.).

Because of the remote locations in which WS conducts aerial operations, the risk to the public from aviation operations or accidents are extremely minimal. WS' aircraft accidents have never harmed anyone other than the individuals actually occupying the aircraft. The impacts to those employees that were injured or killed in aircraft accidents are certainly significant. 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 the ATOC in flight environments encountered during aerial gunning activities. But there has been no impact to overall public health and safety in regards to any injuries or harm to any other persons, or to any recreational activities, let alone a *significant* impact.

Based on the above information and analysis, it is reasonable to conclude that Nebraska WS' aerial gunning should not cause any significant adverse impacts to wildlife populations, public or employee safety or the environment.

Effects on Wildlife from WS' Gunshot Noise

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[9] The Aviation Training and Operation Center (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.

The time spent shooting at coyotes from aircraft during aerial gunning is actually an exceedingly small proportion of the total flying time. WS aerial gunning data for Nebraska show an average of four (3.97) coyotes killed per hour of aerial gunning from FY04 through FY08. 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 about 30-45 seconds of every hour spent flying are involved in making passes and shooting (L. Burraston, WS, pers. comm. 2005) which means that only about 1-2% of the time spent aerial gunning is actually spent generating gunshot noises.

Further, as part of the existing human environment (*i.e.*, "environmental status quo"), about 118,000 persons participate in hunting with 1,611,000 days in the field in Nebraska in 2006 (USFWS 2008) and killed an estimated average of 1,184,630 big and small game animals during the review period (Table 7); Nebraska WS aerial gunning accounted for an average about 663 animals shot annually during the review period. At an average of 3 shots per animal killed during aerial gumming, the number of shots fired annually during the review period is less than 2,000 shots during aerial gunning. The number of shots fired by sport hunters each year would, at a highly conservative estimate of 1 shot fired per animal killed, would be 1,184,630. Therefore, WS' contribution to overall gunshot noise in areas of wildlife habitat is less than 0.17% of the number of shots fired at wild animals in the State and adds only an exceedingly small amount of gunshot noise annually as part of the existing human environment Nebraska.

Table 7. Sport Harvest of Game Species by Firearm by Year in Nebraska

Year	Antelope	Deer	Elk	Pheasant	Bobwhite	Doves	Turkey	Waterfowl
2004	~400	44,500	51	405,701	163,778	385,062	16,700	229,600
2005	~400	55,500	59	437,279	122,865	323,536	18,600	264,800
2006	~400	60,500	73	386,686	134,971	255,842	21,900	225,800
2007	~400	63,500	77	366,294	124,831	246,783	27,400	341,000
2008	405	72,500	105	Not available	Not available	Not available	Not available	Not available
Total	2005	296,500	365	1,595,960	546,445	1,211,223	84,600	1,067,200
Average	401	59,300	73	398,990	136,611	302,805	21,150	265,300

Data cited from: K. Hams, Big Game Program Manager, NGPC, pers. comm., 2009; J. Lusk, NGPC, Upland Game Program Manager, pers. comm. 2009; USFWS. 2006. Migratory bird hunting activity and harvest during the 2004 and 2005 hunting seasons: Preliminary estimates. U.S. Department of the Interior, Washington, D.C. U.S.A.; Richkus, K.D., K. A. Wilkins, R.V. Raftovich, S.S. Williams, and H.L. Spriggs. 2008. Migratory bird hunting activity and harvest during the 2006 and 2007 hunting seasons: Preliminary estimates. USFWS, Laurel, Maryland. USA.

Gunshot noise from WS aerial gunning activities probably has no discernable or at most only minor affect on wildlife populations because of the small frequency and duration of WS flights and the small proportion of geographic area involved in Nebraska (about 2% of the State) which means only small proportions of nontarget wildlife would ever hear any noise from WS gunshots. Also, shooting from aircraft is virtually always at an extreme downward angle towards the ground. Pater (1981 *cited in* Larkin 1996) reported that muzzle blast is louder in the direction toward which the weapon is pointed by up to 14 decibels. Thus, shooting downward toward the ground would lessen the noise in lateral directions from the aircraft. WS personnel on the ground observing aerial gunning training passes in which shots are taken report that the gunshot noise heard at a distance of 150 yards or more is like a "pop" noise rather than the sound of an explosion (L. Burraston, WS, pers. comm. 2005). This indicates shotgun noise from the airplane is not loud enough to cause much of a startling or disturbance effect at a distance.

The low frequency of occurrence of flights and small fraction of time actually spent firing the shotgun, along with the very small proportion of the geographic area over which shooting passes are made suggests only very small proportions of wildlife would be exposed to any close-proximity gun shot noise. Further, if gunshot noise caused serious adverse effects on wildlife populations, we believe that NGPC and other wildlife agencies would have addressed and mitigated such effects from the hundreds of thousands of private hunters that hunt and shoot at game and certain nongame animals.

Areas Exposed to WS Aerial Gunning. From FY04 though FY08, WS flew an average of about 167 hours annually over about 1,400 mi^2 of properties that were under WS agreements in Nebraska or less than 2% of the land area of the State. Thus, WS aerial gunning activity is minor in terms of geographic scope because 98% of the land area in the State is not exposed to any such activity. The average time spent flying over the properties averaged 7 minutes per mi^2 per year. Therefore, on the small proportion of the landscape exposed to aerial gunning only a tiny fraction of the time in an entire year is generally exposed to aerial gunning overflights.

Conclusions about Cumulative Impacts from WS Overflights

There is no obvious significant "threshold" of WS cumulative effects from aerial gunning overflights on wildlife. Our analysis and the analysis of ANG (1997a, 1997b) show that, despite considerable research, no scientific evidence exists to indicate any substantive adverse effects on wildlife populations from low level or other overflights. It is apparent that WS' aerial gunning activities within the same areas as other flights are an inconsequential addition. This is because available studies suggest adverse effects do not occur even when flights are far more frequent than WS aerial gunning activities in specific areas. That fact by itself goes a long way toward providing qualitative support that there are no significant adverse effects on the quality of the human environment.

Effects from Use of Lead Shot in Nebraska WS

The primary concern raised thus far about sport hunting and lead contamination have been focused on aquatic areas where waterfowl hunting occurs and the feeding habits of many species of waterfowl that result in the ingestion of shot from the bottoms of ponds, lakes, and marshes. Shooting of lead shot in upland areas has not raised similar levels of concern except where such activities are more intensively concentrated, such as those which can occur with dove hunting at harvested crop fields and with game bird hunting at "shooting preserves" (Kendall et al. 1996). In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the exposure mode of concern rather than just contact with lead shot or lead leaching from lead shot distributed in the environment (Kendall et al. 1996). Shots fired during WS activities are scattered in distribution over relatively wide areas where contact with humans or ingestion by birds is highly unlikely (Craig et al. 1999).

Further, the amount of lead deposited on the landscape from the firing of shotguns using shotshells with 1.5 ounces of shot is small compared to the amount of land area where activities can occur. Nebraska WS uses an estimated less than 2,000 shotgun shells annually in the State for its aerial gunning program. These shots are not highly concentrated in small areas, but rather are dispersed over considerable portions of the landscape. In terms of actual acres, Nebraska WS has approximately 900,000 acres (all acres under agreement or those under agreement for aerial) per year under agreement for aerial gunning and over which the 1,989 (using the average of 663 coyotes per year/3 shots) shots are distributed. This amounts to 1.5 ounces, or 42.5 grams, of lead released by each shotshell used in the WS aerial program. This means Nebraska WS aerial gunning deposited approximately 186 lbs. of lead over about 900,000 acres in Nebraska amounting to an average of only about 0.0033 ounces (0.094 grams) of lead per acre during the 5-year period. If the amount of lead used by WS doubled, it would probably be dispersed over a larger area and this rate of deposition is a small amount of lead which would not be likely to negatively affect the human environment.

The WS Program has tried various nontoxic (non-lead) shot loads to reduce the concern of lead poisoning; however there is some evidence that the lead threat is not as severe as previously thought and the use of some "non-toxic" shot (*i.e.*, steel shot) can cause serious human health hazards from shot that ricochets off solid objects. (*i.e.*, shot, bullets and pellets from air rifles). 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 (*i.e.,* based on examining the contents of regurgitated pellets), the shot was associated with waterfowl, upland game bird, or rabbit remains, and was smaller than BB or #4 buckshot used for most of WS' program activities.
- Frenzel and Anthony (1989) suggested that eagles usually reduce the amount of time that lead shot stays in their digestive systems by casting most of 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).
- WS personnel examined nine coyotes shot with copper plated BB shot to determine the numbers of shot retained by the carcasses; fifty-nine shot pellets were recovered, averaging 6.5 pellets per coyote. Of the 59 recovered pellets, 84% were amassed just under the surface of the hide opposite the side of the coyote where the shot entered, many exhibited minute cracks of the copper plating, and two shot pellets were split. The fired shot were weighed and compared with unfired shot and were found to have retained 96% of their original weight. 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.
- 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. Breeding Bird Survey data indicate a general increasing trend in breeding populations of both golden and bald eagles in North America since 1966 (Sauer et al. 2008) and bald eagle population trends indicate a 25-fold increase in Nebraska and increasing at a rate of 8.5% annually (http://audubon.org/news/pressroom/Bald_eagle/eagle_chart.pdf). Thus, eagle populations do not appear to be adversely affected by toxicity problems.

The hazard standard set by EPA for lead concentrations in residential soils is 400 parts per million (ppm), in childrens' play areas, and 1,200 ppm on average for the rest of a residential yard[10]. We are unaware of any established standards for lead contamination of soil in remote areas of the kind where Nebraska WS conducts aerial gunning, but it is reasonable to assume the guideline for residential areas would be more stringent than any standard that might be established for remote rural areas. 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 would be 3.2 million lbs. (110 X 29,000) or 1.5 million kg. If considered over the amount of land area where Nebraska WS aerial gunning occur during the 5-year analysis period, the amount of lead distributed from WS activities would constitute an average of about 0.0627 ppb in soil. This is an infinitesimally small fraction of the concentration in the EPA hazard standards for residential area soils shown above.

Viewed another way, what is the risk of a non-target species encountering one of those spots and becoming exposed to toxic levels of lead? The amount of lead in the soil impact zones of each shot can be calculated as follows: each shot distributes 1.5 ounces, or 42.5 grams of lead into an approximate 30" circle, which is about 5 ft^2. Under the assumption of weight per cubic foot of soil and depth of soil in which the lead shot would remain shown above, the amount of lead per unit weight of soil in the 5 $ft.^2$ circle would be about 250 ppm. Therefore, even if a person came in contact with one of the impact spots

[10] The EPA soil-lead hazard is bare soil on residential real property or on the property of a child occupied facility that contains total lead equal to or exceeding 400 ppm in a play area or average of 1,200 ppm of bare soil in the rest of the yard based on soil samples (40 CFR 745.65(c)).

on the ground, the amount of lead in the soil would average less than the EPA hazard standard for children's play areas. The chances of someone stumbling across one of the impact spots could be calculated as follows: there are about 2,000 impacts spots in more than a 7.8 trillion 5-square-foot impact spots distributed over 900,000 acres. Therefore, it would be highly unlikely for a person or non-target species to encounter one of the affected impact spots, but, even if someone did, there would be no health risk unless the person ingested some of the soil (which people, obviously do not normally do) and the portion ingested contained some lead eroded from the spent shot. Solid lead exposed to the environment tends to form an oxidizing layer that slows down its ability to be dissolved in water (Craig et al. 1999), which means the lead from spent shot in the soil would tend to remain in place and not distribute throughout the soil. This would further lessen the chance that someone contacting an impact spot would become exposed to a lead hazard.

A remaining question is whether lead shot deposited by WS might lead to contamination of water, either ground water or surface water via runoff. Stansley et al. (1992) found that lead did not appear to "transport" readily in surface water when soils are neutral or slightly alkaline in pH *(i.e.,* not acidic), but that it will transport more readily under slightly acidic conditions. In their study, they looked at lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Although they detected elevated lead levels in water in a stream and a marsh that were in a shot "fall zones", they did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot where it was believed the lead contamination was due to water runoff from the parking lot, and not from the shooting range areas. Their study 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 lead levels in water draining away from a shooting range with high accumulations of lead bullets were far below the EPAs "action level" (*i.e.,* requiring action to treat the water to remove lead) of 15 ppb ("parts per billion"). They 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 these crusty lead oxide deposits on their surfaces, which serves to naturally further reduce the potential for ground or surface water contamination. These studies suggest that, given the very low and highly scattered shot concentrations that occur from WS' activities, as well as most other forms of dry land small game hunting, lead contamination of water from such sources would be minimal to nonexistent.

Based on the above analysis, we conclude that the amounts of lead deposited by Nebraska WS, even when considered cumulatively with the amounts deposited by hunters, are far below any level that would pose any risk to public health or of significant contamination of water supplies. Furthermore, 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 Nebraska WS during predator damage management, even when considered cumulatively with the amounts deposited by hunters and fisherman, are far below any level that would pose any risk to public health, non-target species or of significant contamination of water supplies. WS also evaluated various non-toxic (non-lead) shot loads to reduce the concern of lead poisoning and found them less safe and effective than lead. Based on the above analysis, we conclude that the amounts of lead aerial gunning could deposit during predator damage management in Washington are far below any level that would pose any risk to public health or non-target species, or result in significant contamination of water supplies.

Compliance and Monitoring

The analyses provided in USDA (1999a) and the Summary Review indicate that there have not been any significant impacts, individually or cumulatively, affecting the quality of the human environment or to wildlife populations from implementing the proposed action, and the action does not constitute a major federal action. Management actions were conducted pursuant to applicable laws, regulations policies and orders to reduce damages or potential damages caused by predatory species in Nebraska, as requested. Nebraska WS' predator damage management activities have been conducted in a manner consistent with all applicable environmental regulations, including the Endangered Species Act and the National Environmental Policy Act, and the analysis in USDA (1999a). Further, APHIS, WS representatives will continue to meet with cooperating officials from the BLM, USFS, USFWS, NGPC, NDA and the UNCE, as applicable, regarding conduct of predator damage management activities.

I find the current program[11] to be environmentally acceptable, addressing the issues and needs while balancing the environmental concerns of State and federal management agencies landowners and advocacy groups. The rationale for this is based on several considerations, taking into account current and previous public comments, social/political and economic concerns, public health and safety and current science. However, the foremost considerations are that predator damage management by Nebraska WS is only conducted at the request of landowners/managers, management actions are consistent with applicable laws, regulations, policies and orders, and no adverse impacts were identified in the analysis. As a part of the current program, Nebraska WS will continue to provide effective and practical technical assistance and direct management techniques that could reduce damage.

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Date 2/25/09

[11] Substantial changes in the scope of work or changes in relevant guidance documents or environmental regulations may trigger the need for further analysis.

Literature Cited

Anderson, 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. Unpubl. Report. Noise and Sonic Boom Impact Technology Technical Operating Report No. 12. BBN Systems and Technologies Corporation. Wright-Patterson Air Force Base, Ohio. 158 Pp. (Contract No. F33615-86-C-0530)

Baker, R. O., and 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.

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.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA.

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. 1992. Coyote damage to livestock and other resources. Pages 161-169 *in* A. H. Boer, ed. Ecology and Management of the Eastern Coyote. Univ. New Brunswick, Fredericton, New Brunswick, Canada.

Connolly, G. E. 1995. The effects of control on coyotes populations: another look. Pages23-29 in D. Rollings, C. Richardson, T. Blankenship, K. Canon and S. Henke, editors. Coyotes in the southwest: a compendium of our knowledge. Texas Parks and Wildlife Department Austin, Texas, USA.

Connolly G. E., and W. M. Longhurst. 1975. The effects of control on coyotes population. University of California, Division of Agricultural Science, Davis, California, USA.

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.

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

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.

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.

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, M. R. and J. A. Mosher. 1987. Raptor survey techniques. Pages 37-65 *in*: B. A. Giron Pendleton, B.A. Millsap, K.W. Cline, and D.M. Bird (eds.) Raptor management techniques manual. Natl. Wildl. Fed., Washington, D.C.

Gilmer, D. S., L. M. Cowardin, R. L. Duval, L. M. Mechlin, C. W. Shaiffer, and V. B. Kuechle. 1981. Procedures for the use of aircraft in wildlife biotelemetry studies. USFWS Resource Publ. 140. 19pp.

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.

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

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.

Kendall, R. J., T. E. Lacher, Jr., C. Bunck, B. Daniel, C. Driver, C. E. Grue, F. Leighton, W. Stansley, P. G. Watanabe, and M. Whitworth. 1996. An ecological risk assessment of lead shot exposure in non-waterfowl avian species: upland game birds and raptors. Envir. Toxicol. and Chem. 15: 4-20.

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.

Laidlaw, M. A. S., H. W. Mielke, G. M. Filippelli, D. L. Johnson, and C. R. Gonzales. 2005. Seasonality and children's blood lead levels: developing a predictive model using climatic variables and blood lead data from Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA). Environmental Health Perspectives 113(6), June 2005. Obtained at: http://ehp.niehs.nih.gov/members/2005/7759/7759.html. *Last visited 12/02/2005.*

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 Air National Guard (ANG). 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.)

Lancia, R. A., C. S. Rosenberry, and M. C. Conner. 2000. Population parameters and their estimation. Pp. 64-83 *in*: S. Demarais and P. R. Kruasman (editors). Ecology and management of large mammals in North America. Prentice-Hall, Inc. Upper Saddle River, NJ.

Larkin, R. P. 1996. Effects of military noise on wildlife: a literature review. http://nhsbig.inhs.uiuc.edu/bioacoustics/noise_and_wildlife.pdf

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.

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.

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). 2004. Nebraska WS program statewide overview report for FY2004. USDA, APHIS, Wildlife Services, Nebraska WS State Office, P.O. BOX 81866, Lincoln, NE 68501.

MIS. 2005. Nebraska WS program statewide overview report for FY2005. USDA, APHIS, Wildlife Services, Nebraska WS State Office, P.O. BOX 81866, Lincoln, NE 68501.

MIS. 2006. Nebraska WS program statewide overview report for FY2006. USDA, APHIS, Wildlife Services, Nebraska WS State Office, P.O. BOX 81866, Lincoln, NE 68501.

MIS. 2007. Nebraska WS program statewide overview report for FY2007. USDA, APHIS, Wildlife Services, Nebraska WS State Office, P.O. BOX 81866, Lincoln, NE 68501.

MIS. 2008. Nebraska WS program statewide overview report for FY2008. USDA, APHIS, Wildlife Services, Nebraska WS State Office, P.O. BOX 81866, Lincoln, NE 68501.

NASS. 2005. Livestock. USDA – National Agricultural Statistics Service. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1628

NASS. 2006. Cattle Death Loss. Washington D.C. 15 pages.

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.

NGPC. 2005. Fur harvest survey 2004/2005 season. NGPC. 2200 N. 33rd St., Lincoln, NE 68503

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

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.

Phillips, R. L., and K. S. Gruver. 1996. Performance of the Paws-I-Trip™ pan tension device on 3 types of traps. Wildl. Soc. Bull. 24:119-122.

Pitt, W.C., R. Owens G. Connolly and G. Simmons. 2001. Anew 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.

Samuel, M.D. and M.R. Fuller. 1994. Wildlife radiotelemetry. Pp. 370-418 *in*: T.A. Bookhout (ed.) Research and management techniques for wildlife and habitats. Fifth Ed. The Wildlife Society. Bethesda, MD.

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.

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.

Speich, S. M. 1986. Colonial waterbirds. Pages 387-405 *in*: Cooperrider, A.Y., R.J. Boyd, and H.R. Stuart (editors) Inventory and monitoring of wildlife habitat. Bureau of Land Management. Denver, CO.

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.

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.

Turkowski, F. J., A. R. Armistead, and S. B. Linhart. 1984. Selectivity and effectiveness of pan tension devices for coyote foothold traps. J. Wildl Manage. 48:700-708.

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).

US. District Court of Utah. 1993. Civil No. 92-C-0052A, January, 1993.

USDA. 1997, revised. Animal damage control program, final environmental impact statement. USDA, APHIS, Animal Damage Control, Operational Support Staff, Riverdale, Maryland, USA.

USDA. 1999a. Predator damage management in Nebraska for the protection of livestock, wildlife, property and public health and safety EA. USDA, APHIS, WS, P.O. BOX 81866, Lincoln, Nebraska, USA.

USDA. 1999b. Finding of No Significant Impact and Decision for predator damage management in Nebraska for the protection of livestock, wildlife, property and public health and safety. USDA, APHIS, WS, P.O. BOX 81866, Lincoln, Nebraska, USA.

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

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

USFWS. 2008. National survey of fishing, hunting, and wildlife-associated recreation - Nebraska. U.S. Dept of Interior, USFWS; U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census; FHW/06-NE,Issued March 2008. (http://www.census.gov/prod/2008pubs/fhw06-ne.pdf)

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.

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.

Wilson, S. 2007. Fur Harvest Survey – 2006/2007. Nebraska Game and Parks Commission, 2200 N. 33rd St., Lincoln, NE 68503.

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