ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE MANAGEMENT IN THE FORT WORTH DISTRICT OF TEXAS

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

in cooperation with:

TEXAS A&M AGRILIFE EXTENSION SERVICE
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TABLE OF CONTENTS

ACRONYMS

ABC	American Bird Conservancy
AGL	Above Ground Level
AMDUCA	Animal Medicinal Drug Use Clarification Act
ANG	Air National Guard
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Codes of Federal Regulations
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLIR	Forward Looking Infrared
FY	Fiscal Year
GAO	United States General Accounting Office
GAV	General Aviation
IC	Intracardiac
IV	Intravenous
LPC	Livestock Protection Collar
MOU	Memorandum of Understanding
NASS	National Agriculture Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historical Preservation Act
PEP	Post-exposure Prophylaxis
SOP	Standard Operating Procedure
TASS	Texas Agriculture Statistics Service
TDA	Texas Department of Agriculture
TDSHS	Texas Department of State Health Services
T&E	Threatened and Endangered
TPWD	Texas Parks and Wildlife Department
TWDMA	Texas Wildlife Damage Management Association
TWSP	Texas Wildlife Services Program
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VTCA	Vernon's Texas Codes Annotated
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

Wildlife is an important public resource greatly valued by people. Wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard wildlife as providing economic, recreational, and aesthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to many people. However, the behavior of animals may result in damage to agricultural resources, natural resources, property, and threaten human safety. Animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter, reproduce) where they can find a niche. If their activities result in lost value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e*., has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person. The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management could occur from specific threats to resources.

Native predatory wildlife performs a vital role in a healthy ecosystem; however, predatory animals can also cause damage or pose a threat to resources, including threats to people. To address damages associated with predatory animals, Chapter 825 in Title 10 of the Texas Health and Safety Code states, "*the state* [of Texas] *shall cooperate through The Texas A&M University System with the appropriate federal…agencies in controlling coyotes, mountain lions, bobcats…and other predatory animals…to protect livestock, food and feed supplies, crops, and ranges*." The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program is the federal agency responsible for providing federal leadership with managing conflicts with animals. Pursuant to the Texas Health and Safety Code, the Texas A&M University System, through the Texas A&M AgriLife Extension Service and the WS program have signed a Memorandum of Understanding (MOU)[2] to conduct a cooperative program to alleviate damage caused by predators. In addition, the Texas Wildlife Damage Management Association (TWDMA), which consists of local cooperative groups, including county governments, private associations, and/or individuals, also signed the MOU. This document will refer to the cooperative program created by the MOU as the Texas Wildlife Services Program (TWSP).

To provide efficient program support and assistance, the TWSP has divided Texas into districts for the purposes of implementing a program to manage predatory animals. The Fort Worth District includes 61 counties in northeast Texas (see Figure 1). The District covers approximately 27.4 million acres (about 20.8% of the State), consisting primarily of the Pineywoods, Post Oak Savannah, Blackland Prairies, and Cross Timbers and Prairies ecological region of Texas. The TWSP in the Fort Worth District continues

[1]The WS program is authorized to protect agriculture and other resources from damage caused by animals through the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c).

[2]The MOU also allows for the sharing of direct operating costs between the entities associated with providing assistance.

to receive requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with Virginia opossum (*Didelphis virginianus*), coyotes (*Canis latrans*), feral/free roaming dogs (*Canis familiaris*), mountain lions (*Felis concolor*), striped skunks (*Mephitis mephitis*), hooded skunks (*Mephitis macroura*), hog-nosed skunks (*Conepatus leuconotus*), western spotted skunks (*Spilogale gracilis*), eastern spotted skunks (*Spilogale putorius*), feral/free roaming cats (*Felis domesticus*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), bobcats (*Lynx rufus*), and raccoons (*Procyon lotor*). This document will collectively refer to those mammal species using the term "*predators*".

The purpose of this Environmental Assessment (EA) is to evaluate cumulatively the individual projects conducted by the TWSP in the Fort Worth District to manage damage and threats to agricultural resources, property, natural resources, and threats to people caused by predators. This EA will assist in determining if the proposed cumulative management of damage could have a significant impact on the human environment based on previous activities conducted by the TWSP and based on the anticipation of conducting additional efforts to manage damage caused by those species.

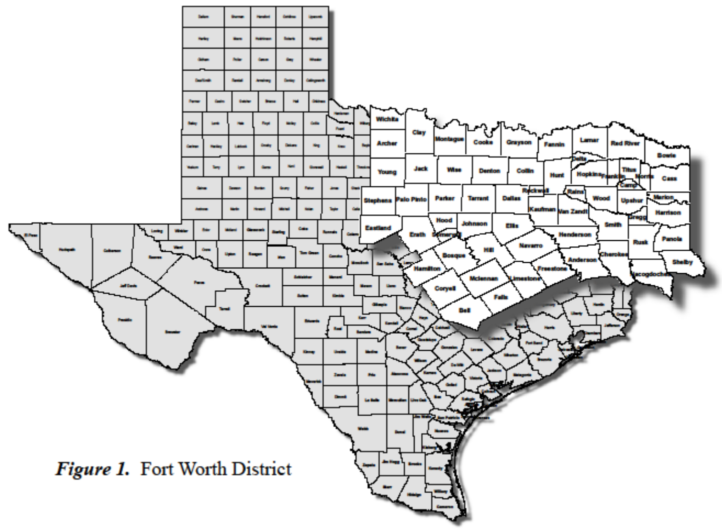

Figure 1. Fort Worth District

The goal of the TWSP in the Fort Worth District of Texas would be to conduct a coordinated program to alleviate damage caused by predators in accordance with plans, goals, and objectives developed to reduce damage pursuant to the MOU. The TWSP is preparing this EA pursuant to the National Environmental Policy Act (NEPA) to: 1) facilitate planning, 2) promote interagency coordination, 3) streamline program management, 4) clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities; and 5) evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action. The analyses contained in this EA are based on information derived from WS' Management Information System, published documents (see Appendix A), interagency consultations, and public involvement.

The EA evaluates the need for action to manage damage associated with predators in the District, the potential issues associated with predator damage management, and the environmental consequences of conducting different alternatives to meet the need for action while addressing the identified issues. The TWSP initially developed the issues and alternatives associated with predator damage management. The Texas Parks and Wildlife Department (TPWD) has regulatory authority to manage populations of most native wildlife species in the State. To assist with identifying additional issues and alternatives to managing damage associated with predators in the Fort Worth District, this EA will be made available to the public for review and comment prior to the issuance of a Decision[3].

[3]After the development of the EA by the TWSP and consulting agencies and after public involvement in identifying new issues and alternatives, WS will issue a Decision. Based on the analyses in the EA after public involvement, a decision will be made to either publish a Notice of Intent to prepare an Environmental Impact Statement or a Finding of No Significant Impact will be noticed to the public in accordance to NEPA and the Council of Environmental Quality regulations.

The TWSP previously developed an EA that addressed activities to manage damage associated with predators in the Fort Worth District of Texas (USDA 1997). Based on the analyses in that EA, a Decision and Finding of No Significant Impact were signed selecting the proposed action alternative. The proposed action alternative implemented a damage management program using a variety of methods in an integrated approach (USDA 1997). Changes in the need for action and the affected environment have prompted the TWSP to initiate this new analysis to address predator damage in the Fort Worth District. Additionally, this EA discusses the implementation of new Standard Operating Procedures (SOPs) that would be incorporated into all alternatives, as applicable. This EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on those changes.

In addition, this EA will: (1) assist in determining if the proposed management of damage associated with predators could have a significant impact on the environment for both people and other organisms, (2) analyze several alternatives to address the need for action and the identified issues, (3) coordinate efforts between members of the TWSP, (4) inform the public, and (5) document the analyses of the environmental consequences of the alternatives to comply with the NEPA. Since this EA will re-evaluate activities conducted under the previous EA to address the new need for action and the associated affected environment, the previous EA that addressed predator damage management in the Fort Worth District will be superseded by this analysis and the outcome of the Decision issued for this EA.

1.2 NEED FOR ACTION

Resolving damage caused by predators requires consideration of both sociological and biological carrying capacities. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or already met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety.

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (Berryman 1991, The Wildlife Society 1992). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. The need for action to manage damage and threats associated with predators in the Fort Worth District arises from requests for assistance[4] received by the TWSP (USDA 1997). There is a heavy urban presence in the district but most of the counties' primary economic and cultural interests are agricultural in nature,

[4]The TWSP would only conduct predator damage management after receiving a request for assistance. Before initiating damage management activities, the TWSP and the cooperating entity would sign a Memorandum of Understanding, Work Initiation Document, Annual Work Plan, or other comparable document that would list all the methods the property owner or manager would allow the TWSP to use on property they owned and/or managed.

with a large interest in sheep, goat, and cattle production. Table 1 shows the number of damage occurrences received by the TWSP from federal fiscal year[5] (FY) 2009 through FY 2011.

Between FY 2009 and FY 2011, the TWSP received 1,446 requests for assistance associated with damage caused by predators in the Fort Worth District, which represents nearly 482 damage occurrences per year. The TWSP in the Fort Worth District received reports of 422 damage occurrence associated with predators during FY 2009, 382 occurrences in FY 2010, and 642 damage occurrences during FY 2011. The majority of damage occurrences received by the TWSP in the Fort Worth District were associated with predator damage to agricultural resources. Nearly 75% of the requests for assistance were associated with predator damage to agriculture. Over 82% of the total requests for assistance were associated with coyote damage. Of the requests for assistance associated with coyote damage, nearly 84% were associated with agricultural resources, primarily predation on livestock. Coyotes, bobcats, striped skunks, and raccoons have been responsible for nearly 96% of the requests for assistance.

Table 1 – Damage occurrences recorded by the TWSP in the Fort Worth District, FY 2009 – FY 2011†

Species	**Resource Category**				**TOTAL**
	Agriculture	**Property**	**Human Safety**	**Natural Resources**	
Bobcat	29	27	16	2	**74**
Feral Cat	0	1	0	0	**1**
Coyote	996	90	67	37	**1,190**
Feral Dog	16	0	5	0	**21**
Gray Fox	2	7	0	0	**9**
Red Fox	7	2	0	0	**9**
Mountain Lion	14	2	0	1	**17**
Virginia Opossum	1	5	3	0	**9**
Raccoon	14	41	0	0	**56**
Striped Skunk	1	28	32	0	**61**
TOTAL	**1,080**	**203**	**123**	**40**	**1,446**

†This data only reflects unique occurrences of reported and verified damage

In addition to reported and confirmed damage occurrences shown in Table 1, the TWSP also receives requests for assistance to alleviate the threat of damage associated with predators. Table 2 shows the threat occurrences reported to the TWSP from FY 2009 through FY 2011 by resource category. An appropriate response effectively timed can reduce damage (Wagner and Conover 1999).

Similar to damage occurrences, most threat occurrences reported to the TWSP in the Fort Worth District are associated with threats predators pose to agriculture. Of the 423 threat occurrences reported to the TWSP from FY 2009 through FY 2011, nearly 44% were associated with agriculture and of those reported occurrences, nearly 82% were associated with coyotes. Nearly all threat occurrences reported to agricultural resources were associated with threats to livestock. The TWSP received 119 requests associated with threats to property, primarily associated with coyotes, bobcats, raccoons, and striped skunks. Of the human health and safety threats reported to the TWSP in the District from FY 2009 through FY 2011, most requests for assistance were associated with coyotes and striped skunks, with those threats primarily associated with disease transmission and threats of injury to people. The TWSP in the District also received requests for assistance associated with natural resources associated with coyotes, bobcats, and mountain lions.

[5]The federal fiscal year begins on October 1 and ends on September 30 the following year.

Table 2 – Threat occurrences recorded by the TWSP in the Fort Worth District, FY 2009 – FY 2011†

Species	Resource Category				TOTAL
	Agriculture	Property	Human Safety	Natural Resources	
Bobcat	3	17	10	1	**31**
Feral Cat	0	1	0	0	**1**
Coyote	150	58	62	9	**279**
Feral Dog	10	1	6	0	**17**
Gray Fox	0	3	0	0	**3**
Red Fox	1	1	0	0	**2**
Mountain Lion	7	5	4	1	**17**
Virginia Opossum	1	4	0	0	**5**
Raccoon	12	14	1	0	**27**
Striped Skunk	0	15	26	0	**41**
TOTAL	**184**	**119**	**109**	**11**	**423**

†This data only reflects unique occurrences of reported and verified damage

Requests for assistance are an indication of need, but the requests that have been received by the TWSP likely represents only a portion of the need in actuality. For example, Connolly (1992) determined that only a fraction of the total predation attributable to coyotes was reported to or confirmed by WS. Connolly (1992) also stated that based on scientific studies and livestock loss surveys generated by the National Agriculture Statistics Service (NASS), WS only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators. In most cases when addressing livestock predation, personnel of the TWSP would not attempt to locate every livestock reported by ranchers as being killed, but rather personnel would make attempts to verify sufficient losses to establish a need for managing damage and what the appropriate methods would be using the WS Decision Model. Therefore, in many cases, loss reports by the TWSP do not actually reflect the total number of livestock or other resource lost in the Fort Worth District, but provides an index of the annual losses. In addition, some people may be unaware of the TWSP and may try to resolve damage themselves or request the assistance of the TPWD, which may choose to handle certain depredation problems caused by furbearers or game animals without requesting assistance from the TWSP.

Need to Manage Predator Damage occurring to Agricultural Resources

During 2001, crop and livestock losses from wildlife in the United States totaled $944 million, with field crop losses totaling $619 million, livestock and poultry losses totaling $178 million, and losses of vegetables, fruits, and nuts totaling $146 million. Those losses include destruction of or damage to crops in the field and death or injury to livestock. In 2001, the NASS reported that raccoons were responsible for 6%, 3%, and 6% of the total damage to field crops; livestock and poultry; and vegetables, fruits, and nuts, respectively, in the United States (NASS 2002). As shown in Table 1 and Table 2, of the predator damage and threat occurrences reported to the TWSP from FY 2009 through FY 2011 in the Fort Worth District, most occurrences were related to agricultural resources. On average, the TWSP has received reports of or verified 421 damage or threat occurrences to agricultural resources per year in the Fort Worth District (see Table 1 and Table 2).

Livestock Predation and Disease Threats

Predators are responsible for preying upon a wide variety of livestock, including cattle, sheep, goats, swine, exotic pen-raised game, other hoofed-stock, and poultry. For example, cattle and calves are vulnerable to predation, especially during calving (Bodenchuk et al. 2002). Sheep, goats, and poultry are highly susceptible to predation throughout the year (Henne 1975, Nass 1977, Tigner and Larson 1977, Nass 1980, O'Gara et al. 1983, Bodenchuk et al. 2002). Livestock losses due to predation can cause economic hardships to farmers and ranchers, and without effective ways to reduce predation rates, economic losses from predation can increase (Nass 1977, Howard and Shaw 1978, Nass 1980, Howard and Booth 1981, O'Gara et al. 1983, Bodenchuk et al. 2002). Not all producers suffer losses to predators; however, for those producers that do suffer livestock losses caused by predators, those losses can be economically burdensome (Baker et al. 2008).

Of the predators that kill livestock, coyotes are likely responsible for the highest percentage (Knowlton et al. 1999, Shelton 2004, NASS 2005, NASS 2006, NASS 2010, NASS 2011). In a study of sheep predation on rangelands in Utah, coyotes accounted for 67% of depredated lambs, followed by cougar predation at 31%, and black bear predation at 2% (Palmer et al. 2010). Palmer et al. (2010) replicated a study from the 1970s to determine how predation rates on sheep may have changed over time. Overall, fewer lambs were lost to all causes than during the 1970s (5.8% compared with 9.5%, respectively); however, the proportion of losses to predators did not change substantially. Predators were responsible for 87% of the total lamb losses compared with 83% in the 1970s (Palmer et al. 2010). Coyotes accounted for 93% of all predator-killed lambs and ewes on nine sheep bands in shed lambing operations in southern Idaho and 25% of those sheep killed by coyotes were not fed upon (Nass 1977). DeLorenzo and Howard (1977) found that coyotes were the predominant predator on sheep during a study in Colorado and of those lambs killed by coyotes in the study, more than 43% were not fed upon. Similarly, coyotes were also the primary predator on sheep during a Wyoming study and essentially the only predator in winter (Tigner and Larson 1977).

Mountain lions can occasionally be responsible for large losses of sheep and lambs, sometimes called "*surplus killing*", when only selected tissues or parts are consumed or the carcasses are not fed on at all (Shaw 1987). For example, mountain lions commonly kill up to 30 sheep, but normally only feed on one or two sheep (McKinney 1996). Wade and Bowns (1982) found over 100 sheep killed by a mountain lion in one incident. Bodenchuk (2011) reported a mountain lion in Utah killed 102 head of livestock in one night. Mountain lions may also frighten an entire flock of sheep as they attack, resulting in a mass stampede, which sometimes results in many animals suffocating as they pile up on top of each other in a confined area, such as along the bottom of a drainage or in corrals.

A positive correlation between predator concentrations and livestock losses due to predation often exists (Shelton and Klindt 1974, Pearson and Caroline 1981, Nunley 1995). When predator concentrations increase, predation loss can be a major factor in cattle, sheep, and goat production. In 2010, the NASS (2011) reported cattle and calf losses from animal predation totaled 219,900 head in the United States according to livestock producers. Animal predation represented 5.5% of the total cattle and calf losses reported by livestock producers in 2010 totaling $98.5 million in economic losses. Livestock producers identified coyotes as the primary predator of livestock with 53.1% of cattle and calf losses attributed to coyotes. Producers also attributed livestock losses to bobcats, mountain lions, and dogs. Producers spent nearly $188.5 million dollars on non-lethal methods to reduce cattle and calf losses from predation by animals in 2010 (NASS 2011). The primary non-lethal method employed by livestock producers was the use of guard animals with a reported 36.9% of producers using guard animals. Producers also reported using exclusion fencing, frequent checking, and culling as additional employed methods for reducing predation (NASS 2011).

In 2009, farm and ranch commodities generated over $16.5 billion in annual sales in Texas (TASS 2010). Of this, livestock production, primarily cattle, sheep, swine, and poultry, accounted for about 64.2% of total agricultural commodity cash receipts. Near the beginning of 2010, Texas livestock inventories included 13,300,000 cattle and calves, 830,000 sheep and lambs, 760,000 swine, and 1,105,000 goats (TASS 2010). In addition, farmers and ranchers produce other livestock, including native deer, exotic species, equine, and poultry in Texas. Estimates indicate the presence of more than 2.9 million head of livestock in the Fort Worth District with an economic value of more than $1.1 billion (TASS 2010). Sheep and lamb inventory numbers have dropped in the United States over the last decade[6], but have increased recently in Texas. In 2011, farmers and ranchers maintained 880,000 head of sheep and lamps, which compared to 830,000 head in 2010, which was the lowest inventory recorded from 2002 to 2011 (NASS 2011).

The NASS (2005) reported that predators killed 16,000 adult sheep and 41,000 lambs in Texas during 2004, which were valued at $1,600,000 and $2,706,000, respectively. In 2009, the NASS (2010) reported that predators killed 23,000 adult sheep and 48,000 lambs in the State, which were valued at $2,254,000 and $3,120,000, respectively. In 2004, survey participants identified coyotes as responsible for 47% of the sheep losses associated with animal predators, while dogs accounted for 28%, bobcats killed 11%, and mountain lions and fox accounted for 2% of the losses, while coyotes, bobcats, dogs, fox, and mountain lions were responsible for 54%, 17%, 7%, 5%, and 2% of lamb losses, respectively (NASS 2005).

Cattle and calf predation losses due to predators in Texas totaled 4,100 and 35,000 head valued at over $18 million in 2005 (NASS 2006) and 6,000 and 40,000 head valued at over $19.4 million in 2010 (NASS 2011). Of the animal predators identified as causing losses to cattle in 2010, mountain lions/bobcats, coyotes, and dogs were responsible for about 28%, 22%, and 7% of the losses, respectively (NASS 2011). Of the calf loss, coyotes, mountain lions/bobcats, and dogs were responsible for 40%, 15%, and 9% of the losses, respectively (NASS 2011). Those losses represent direct costs to the producer (*e.g*., value of the animal and its wool or mohair). Livestock producers often incur indirect costs associated with livestock predation in addition to the direct loss from animals killed by predators, such as the implementation of methods to reduce predation rates (Jahnke et al. 1987). Economic losses associated with predation on livestock often occur despite efforts by livestock producers to reduce predation rates.

The NASS (2005) reported that many Texas sheep and goat producers used non-lethal methods to reduce predator damage. Producers in Texas used fencing (32%), guard dogs (29%), night penning (24%), donkeys (24%), frequent checks (17%), lamb shed (16%), culling (11%), llamas (11%), bedding change (7%), herding (5%), carrion removal (5%), other nonlethal methods (4%), and frightening tactics (1%) to reduce predation. The NASS (2011) also reported that Texas cattle producers used guard animals (50%), culling (31%), frequent checks (30%), and exclusion fencing (24%) to reduce predation.

In a 2-year study of goat production in South Texas, Guthery and Beasom (1978) reported predators, primarily coyotes, killed 33 to 95% of the known kid crop on pastures with no predator management. Overall, predation rates on goats in studies of goat losses in the absence of management exceeded 50% (Bodenchuk et. al. 2002). During short-term fencing tests conducted in Texas, Shelton and Wade (1979) reported that predators killed all of the kids and lambs within the study area.

During requests for assistance received by the TWSP, cooperators often report or the TWSP verifies through site visits, damage associated with various species of predators in the Fort Worth District. Between FY 2009 and FY 2011, those persons requesting assistance reported to the TWSP or the TWSP verified over $860,300 in livestock losses associated predators (specifically coyotes, mountain lions, feral dogs, bobcats, red fox, gray fox, raccoons, and striped skunks) in the Fort Worth District (see Table 3). Between FY 2009 and FY 2011, personnel of the TWSP responded to requests for assistance in the District where reported and verified losses from predators for all classes of livestock, including exotic pen raised game and other hoofed stock, averaged 2,785 animals worth $286,771 annually. Average annual

[6]Sheep inventories in the United States, including Texas, have shown long-term downward trends as the demand for lamp meat and wool has declined.

livestock losses from FY 2009 to FY 2011 included 1,999 adult cattle and calves, 226 goats, 215 adult sheep and lambs, 183 poultry, 158 exotic pen-raised livestock, and 4 other hoofed livestock. Of the nearly $860,312 in combined losses from FY 2009 to FY 2011, coyotes and feral dogs accounted for 94% and 3% of the losses, respectively. Mountain lions, bobcats, gray fox, red fox, raccoons, and striped skunks also caused losses to livestock in the District between FY 2009 and FY 2011. Many of the other predators in Fort Worth covered by this EA can also kill or injure livestock, but the TWSP did not confirm any losses associated with those predators between FY 2009 and FY 2011.

Table 3 – Livestock killed or injured by predators in the Fort Worth District, FY 2009 – FY 2011†

Species	Livestock Resource											
	Cattle[1]		Sheep[1]		Goat[1]		Exotic[2]		Poultry		Other[3]	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
Coyote	5,941	$211,793	632	$52,430	665	$50,642	455	$484,550	318	$7,980	-	-
Mtn. Lion	15	$11,500	-	-	-	-	-	-	-	-	12	$7,650
Feral Dog	39	$23,100	-	-	9	$900	-	-	-	-	-	-
Bobcat	3	$1,000	-	-	-	-	19	$6,000	207	$1,802	-	-
Gray Fox	-	-	5	$100	-	-	-	-	-	-	-	-
Red Fox	-	-	7	$370	4	$100	-	-	14	$310	-	-
Raccoon	-	-	1	$60	-	-	-	-	-	-	-	-
Striped Skunk	-	-	-	-	-	-	-	-	10	$25	-	-
TOTAL	**5,998**	**$247,393**	**645**	**$52,960**	**678**	**$51,642**	**474**	**$490,550**	**549**	**$10,117**	**12**	**$7,650**

†Data reflects losses reported to the TWSP in the Fort Worth District and reflects the actual number of livestock killed or injured by predators

1Includes adults and young

2Includes exotic pen-raised animals, such as deer, antelope, and non-native species raised for commercial purposes

3Other hoofed livestock, such as swine, llamas, alpaca, and horses

The value of damage caused by predators that is documented by the TWSP is often related to the number of requests for assistance received for a particular species. However, differences can be noted between species, primarily because larger species often cause much more damage with a higher value in one incident than species that are smaller. Damage reported to or verified by the TWSP fluctuate annually, especially the value of the damage occurring. Fluctuations in the damage value often reflect decreased or increased field effort, value of the resource damaged, and population fluctuations. The monetary losses from livestock predation reflects losses that have occurred and that have been reported to or verified by the TWSP, but is not reflective of all livestock losses occurring in the Fort Worth District since not all livestock lost to predators are reported to the TWSP.

In addition to direct livestock losses to predators, such as predation and injury, livestock producers are often concerned about the transmission of diseases from wildlife to livestock, primarily the spread of rabies. For example, cattle could become infected with rabies after being bitten by infected animals, such as skunks and fox. If exposure to the rabies virus is not identified early and treated, rabies is nearly always fatal.

The domestic cat has been found to transmit *Toxoplasma gondii* to both domestic and wild animal species. Cats have been found to be important reservoirs and the only species known to allow for the completion of the life cycle for the protozoan parasite *T. gondii* (Dubey 1973, Teutsch et al. 1979). Both feral and domiciled cats may be infected by this protozoan, but this infection is more common in feral cats. Fitzgerald et al. (1984) documented that feral cats transmitted *T. gondii* to sheep in New Zealand, resulting in ewes aborting fetuses. Dubey et al. (1995) found cats to be 68.3% positive for seroprevalence of *T. gondii* on swine farms in Illinois and the major reservoir for this disease. Indirect losses due to disease transmission are typically minor, but the potential losses could be high if a major outbreak occurred.

Damage occurring to other Agricultural Resources

Besides livestock losses and injuries, predators in the Fort Worth District can also damage other agricultural commodities. Between FY 2009 and FY 2011, raccoons, coyotes, and feral dogs caused $1,425 in damages to crops in the District. Predators, such as coyotes, skunks, and raccoons, have damaged field crops such as alfalfa, corn, fruits, and nuts. Damage could also occur to beehives, haystacks, livestock feed, eggs, range/pasture, and irrigation systems. The burrowing and digging behavior of some predators, such as fox and coyotes, can cause damage to pastures and fields used for hay. The burrowing and digging leaves the ground uneven, which can damage mowing and planting equipment. Although damage to other agricultural resources has occurred and could occur, damage or the threat of damage to those resources occurs infrequently in the Fort Worth District.

Need to Manage Damage Occurring to Property

Predators can cause damage to a variety of property types in the Fort Worth District each year. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Predator damage to property occurs primarily through direct damage to structures. Accumulations of fecal droppings can cause damage to buildings and other structures where raccoons or feral cats frequent. Aircraft striking mammals can also cause substantial damage requiring costly repairs and aircraft downtime. Raccoons and skunks can cause damage to property by digging under porches, buildings, homes, and many other places. Skunks and raccoons can cause damage to lawns and landscaping while diffing for grubs and insects. Coyotes can attack companion animals.

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

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Thorpe 1997, Keirn et al. 2010). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995).

Between 1990 and 2012, there were 2,946 reported aircraft strikes involving terrestrial mammals in the United States (Dolbeer et al. 2013). The number of mammal strikes actually occurring is likely to be much greater, since Dolbeer (2009) estimated 39% of civil wildlife strikes are actually reported. Civil and military aircraft have collided with a reported 36 species of terrestrial mammals from 1990 through 2010, including raccoons, fox, cats, coyotes, opossums, dogs, and striped skunks (Dolbeer et al. 2013). Of the terrestrial mammals reported struck by aircraft, 35% were carnivores (primarily coyotes), causing over $4 million in damages (Dolbeer et al. 2013). Aircraft striking coyotes have resulted in 12,249 hours of aircraft downtime and nearly $3.6 million in damages to aircraft in the United States since 1990 (Dolbeer et al. 2013). Aircraft strikes involving dogs have caused over $382,000 in damage in the United States since 1990 (Dolbeer et al. 2013).

In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft, causing additional damage to the aircraft and increasing the threat to human safety. Nearly 63%

of the reported mammal strikes from 1990 through 2012 occurred at night, with 64% occurring during the landing roll or the takeoff run (Dolbeer et al. 2013).

Since 1990, aircraft have struck seven raccoons, three fox, one cat, 52 coyotes, 18 opossums, eight dogs, and 24 skunks in Texas according to reports filed with the Federal Aviation Administration (FAA) (FAA 2014). Airports in the Fort Worth District could request assistance with managing threats to human safety and damage to property associated with predators present inside the area of operations of airports. The infrequency of predator strikes does not lessen the need to prevent threats to human safety and the prevention of damage to property. Preventing damage and reducing threats to human safety is the goal of those cooperators requesting assistance at airports in the Fort Worth District given that a potential strike could lead to the loss of human life and considerable damage to property.

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

The TWSP could respond to requests from airports, landowners, and other property owners to alleviate property damage from predators in the Fort Worth District. The TWSP could respond to requests for assistance associated with the threat of coyotes being struck by aircraft at airports, raccoons and skunks burrowing into or under homes, skunks and raccoons gaining access into a home through a pet door to eat pet food, and skunks causing damage to landscaping, gardens, and golf courses from feeding activities. On average, the TWSP has received reports of or verified over 107 damage or threat occurrences to property per year in the Fort Worth District (see Table 1 and Table 2). Between FY 2009 and FY 2011, the TWSP in the Fort Worth District has received requests for assistance to manage damage or threats to property associated with bobcats, feral cats, coyotes, feral dogs, gray fox, red fox, mountain lions, opossum, raccoons, and striped skunks. In total, predators have caused $33,335 in verified or reported damages to property in the Fort Worth District from FY 2009 through FY 2011. Between FY 2009 and FY 2011, coyotes caused $17,500 in damages to property, while raccoons caused $13,485, striped skunks caused $1,300, gray fox caused $900, and opossum caused $150 in damages to property based on requests for assistance received by the TWSP.

The TWSP in the District has received reports of or verified loss or injuries to pets and zoo animals caused by bobcats, coyotes, gray fox, and red fox totaling $44,753 in damages between FY 2009 and FY 2011. Of those damages and losses, coyotes were identified as the cause of $42,748 in damages to pets and zoo animals between FY 2009 and FY 2011. Predators can kill or injure pets and zoo animals, especially in urban and suburban areas. Predators in suburban and urban areas often have adapted to human altered habitats and have acclimated to the presence of people. Coyotes can be territorial and aggressive, especially during the breeding season and especially toward other canids, such as dogs. When coyotes adapt to and acclimate to the presence of people, they can act aggressive and attack pet dogs, even when people walk those dogs on a leash. Deer are a primary food source for mountain lions. Deer often thrive in urban and suburban areas due to availability of food and water. The presence of high deer densities in urban and suburban areas can attract mountain lions to those areas. Pets and zoo animals often are easy prey items for mountains lions because they are confined inside an enclosure or are generally less wary than other prey.

Need to Manage Damage Occurring to Natural Resources

Natural resources may be described as those assets belonging to the public and often managed and held in trust by government agencies as representatives of the people. Such resources may be plants or animals, including T&E species, historic properties, or habitats in general. Examples of natural resources are historic structures and places; parks and recreation areas; natural areas, including unique habitats or topographic features; threatened and endangered plants or animals; and any plant or animal populations which have been identified by the public as a natural resource. From FY 2009 to FY 2011, the TWSP received reports of or verified 40 damage occurrences associated with predator damage to natural resources (see Table 1). Similarly, the TWSP received reports of or verified 11 threat occurrences associated with natural resources in the Fort Worth District (see Table 2).

Predation is one of many mortality factors that influence wildlife populations. Predators often play critical roles in the composition and function of wildlife populations in ecosystems (Witmer et al. 1996). Normally, predation by native predators would be considered part of the function of a healthy ecosystem. Many of the predators addressed in this EA are native to the Fort Worth District; however, many changes have occurred in the ecosystem of the District that has disrupted natural predator-prey relationships. Many of the changes that have occurred can be attributed to human influence, including habitat fragmentation, landscape alteration, and environmental contamination. In addition, human habitation alone can often alter the biological carrying capacity of a local environment. Some species such as raccoons and skunks live in high densities because of human activity. Those human-induced changes can negatively affect the viability of some native wildlife populations.

Declines in bird populations associated with habitat loss and fragmentation may be compounded by predation (Cote and Sutherland 1997). The effects of predation on birds can be detrimental to local populations; especially, when predator densities are high or when predators gain access to areas not historically occupied (Stoudt 1982, Bailey 1993). In general, ground nesting birds suffer the highest predation rates (DeVos and Smith 1995).

Under certain conditions, predators, especially coyotes and mountain lions, can adversely affect mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*), and pronghorn antelope (*Antilocapra americana*) populations, and predation may not be limited to sick or inferior animals (Pimlott 1970, Shaw 1977, Bartush 1978, USFWS 1978, Trainer et al. 1983, Hamlin et al. 1984, Neff et al. 1985). Connolly (1978) reviewed 68 studies of predation on wild ungulate populations and concluded that in 31 cases, predation was a limiting factor.

Mackie et al. (1976) documented high winter loss of mule deer to coyote predation in north-central Montana and stated that coyotes were the cause of most overwinter deer mortalities. Teer et al. (1991) documented that coyote diets contain nearly 90% deer during May and June and concluded from work done at the Welder Wildlife Refuge, Texas that coyotes remove a large portion of the fawns each year during the first few weeks of a fawn's life. Remains of 4 to 8 week old fawns were also common in coyote scats (feces) in studies from Steele (1969), Cook et al. (1971), Holle (1977), Litvaitis (1978), and Litvaitis and Shaw (1980). Mule deer fawn survival increased and was more consistent inside a predator-free enclosure in Arizona (Smith and LeCount 1976, LeCount 1977). Hamlin et al. (1984) observed that a minimum of 90% summer mortality of fawns was a result of coyote predation. Trainer et al. (1981) reported that heavy mortality of mule deer fawns during early summer and late autumn and winter was limiting the ability of the population to remain stable or increase. Other authors observed that coyotes were responsible for most of fawn mortality during the first few weeks of life (Knowlton 1964, White 1967).

Guthery and Beasom (1977) demonstrated that after coyote damage management, deer fawn production was more than 70% greater after the first year and 43% greater after the second year in their southern Texas study area. Another Texas study (Beasom 1974*a*, Beasom 1974*b*) found that predators were responsible for 74% and 61% of the fawn mortality for two consecutive years. Stout (1982) increased deer production on three areas in Oklahoma by 262%, 92%, and 167% the first summer following coyote damage management, an average increase of 154% for the three areas. Garner (1976), Garner et al. (1976), and Bartush (1978) found annual losses of deer fawns in Oklahoma to be about 88% with coyotes responsible for 88% to 97% of the mortality. Knowlton and Stoddart (1992) reviewed deer productivity data from the Welder Wildlife Refuge in Texas following coyote reduction. Deer densities tripled compared with those outside the enclosure, but without harvest management, ultimately returned to original densities due primarily to malnutrition and parasitism.

Jones (1949) believed that coyote predation was the main limiting factor of pronghorn antelope in Texas. A six-year radio telemetry study of pronghorn antelope in western Utah showed that 83% of all fawn mortality was attributed to predators (Beale and Smith 1973). In Arizona, Arrington and Edwards (1951) showed that intensive coyote damage management was followed by an increase in pronghorn antelope to the point where antelope were once again huntable, whereas on areas without coyote damage management this increase was not noted. A similar observation of improved pronghorn antelope fawn survival and population increase following damage management has been reported by Riter (1941), Udy (1953), and Smith et al. (1986). Major losses of pronghorn antelope fawns to predators have been reported from additional radio telemetry studies (Beale 1978, Barrett 1978, Bodie 1978, Von Gunten 1978, Hailey 1979, Tucker and Garner 1980).

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

Bighorn sheep are susceptible to predation, especially where their populations have reached precariously low numbers (Mooring et al. 2004). Mountain lions are the primary predator of bighorns, but coyotes and bobcats will also kill sheep. Mooring et al. (2004) found that in New Mexico, rams had the highest predation rates and thought it was mostly from mountain lions. Rams often use habitat conducive to predation by lions, have poor post-rut body condition, and have impaired vision because their curls block more of their rear vision (Harrison and Hebert 1989, Schaefer et al. 2000, Mooring et al. 2004). However, other studies found that lambs (Ross et al. 1997) and females (Krausman et al. 1989) were killed more by mountain lions in proportion to their population, while other studies found that predation rates reflected the proportion of sex and age class in the population (Hayes et al. 2000) or a particular lion's predation habits (Ross et al. 1997).

The above cases show that coyote predation can influence white-tailed deer (*Odocoileus virginianus*), mule deer, pronghorn antelope, and bighorn sheep populations. Ballard et al. (2001) reviewed published predator-deer relationship studies, including many of those above, since the mid-1970s and found that predators (coyote, mountain lion, and wolf) could cause high mortality, but managing predation may or may not result in higher populations and increased harvest levels for hunters. Ballard et al. (2001) found that managing predation benefitted big game mostly when herds were well below forage carrying capacity, predation was identified to be a limiting factor, efforts sufficiently reduced the predator population, efforts were timed correctly (prior to fawning and denning), and management was focused on a small scale (<259 mi^2). Conversely, managing predation was not effective when the above conditions were not met. In addition, Ballard et al. (2001) suggested that the experimental design of research being conducted on predator management to benefit deer needed to be improved because it was unclear in several studies if predator management had a sufficient effect protecting deer herds. The most convincing evidence of deer population increases as a result of predator management were from studies conducted in small enclosures (< 15 mi^2) because predator populations were much easier to regulate in smaller areas.

Clearly, under some circumstances, managing predation can be an important tool in maintaining specific wildlife management objectives. Managing game species in Texas is the responsibility of the TPWD and any decision to manage predation to benefit local game populations would be the responsibility of the TPWD. However, the TWSP could provide assistance if requested by the TPWD. A major goal of the TWSP would be to provide protection and conduct actions in areas where data suggests that managing predators would likely be effective and successful as suggested by Ballard et al. (2001).

Scientists estimate that nationwide cats kill hundreds of millions of birds and more than a billion small mammals, such as rabbits, squirrels, and chipmunks, each year. The American Bird Conservancy (ABC) states that "*cats often kill common* [bird] *species such as cardinals, blue jays, and house wrens, as well as rare and endangered species such as piping plovers, Florida scrub-jays, and California least terns*" (ABC 2011). Some feral and free-ranging cats kill more than 100 animals each year. For example, at a wildlife experiment station, a roaming, well-fed cat killed more than 1,600 animals over 18 months, primarily small mammals (ABC 2011). Researchers at the University of Wisconsin coupled their four-year cat predation study with the data from other studies, and estimated that rural feral and free-ranging cats kill at least 7.8 million and perhaps as many as 217 million birds a year in Wisconsin (Coleman et al. 1997). In some parts of Wisconsin, feral and free ranging cat densities reached 114 cats per square mile, outnumbering all similar-sized native predators (Coleman et al. 1997). Churcher and Lawton (1989) observed 77 well fed free-ranging cats in a British village for one year. Churcher and Lawton (1989) estimated that 30% to 50% of a cat's catch were birds and that the cats had adversely affected house sparrow populations within the village. Based on information acquired in the study, Churcher and Lawton (1989) estimated that more than 20 million birds are killed by cats in Britain each year with more than 70 million animals overall being lethally removed by cats annually.

The diet of feral and free-ranging cats varies depending on availability, abundance, and geographic location. In a survey of New Zealand scientific literature, Fitzgerald (1990) concluded that prey selection of feral and free-ranging cats is dependent on availability. Fitzgerald (1990) found that cats on the mainland fed most heavily on mammals; whereas, cats on islands fed almost exclusively on birds (particularly seabirds). Feral and free-ranging cats are known to prey on birds as large as mallard ducks (Figley and VanDruff 1982) and young brown pelicans (Anderson et al. 1989) along with mammals as large as hares and rabbits. Many cat populations rely heavily on humans either for handouts and/or for garbage. Pearson (1971) found that cats were serious predators of California voles and that the greatest pressure on voles occurred when vole numbers were lowest. Liberg (1984) found that cats in southern Sweden fed predominantly on native mammals. Prey use was based more on availability than abundance. Langham (1990) found that mammals made up 74% of diets of New Zealand farmland feral cats, while 24% were birds. Cats fed most heavily on the most abundant species and groups. A study on a southern Illinois farmstead concluded that well-fed cats preferred microtine rodents; however, they also consumed birds (George 1974). Microtine rodents are particularly susceptible to over harvest by cats and other predators (Pearson 1964). Coman and Brunner (1972) found that small mammals were the primary food item for feral cats in Victoria, Australia. Prey selection was directly related to proximity of cats to human habitation. Pearson (1964) found rodents composed a large portion of a cat's diet. Some people view the predation of rodents by cats as beneficial, but native small mammals are important to maintaining biologically diverse ecosystems. Field mice and shrews are also important prey for birds such as great horned owls and red-tailed hawks.

Reptiles are thought to provide an important food source to cats when birds and mammals are less abundant, and in some situations, cats have been observed to prey on threatened species of reptiles. Domesticated cats have been identified as significant nest and/or hatchling predators of sea turtles. A study on the Aldabra Atoll, Seychelles found feral cats had an adverse effect on green turtle hatchlings. Seabrook (1989) found a positive correlation in cat activity and green turtle nesting at Aldabra Atoll. Cats are known to have contributed to the near extirpation of the West Indian rock iguana (*Cyclura carinata*) on Pine Cay in the Caicos Islands (Iverson 1978).

Cats can adversely affect local wildlife populations, especially in habitat "*islands*", such as suburban and urban parks, wildlife refuges, and other areas surrounded by human development (Wilcove 1985). The loss of bird species from habitat islands is well documented and nest predation is an important cause of the decline of neotropical migrants (Wilcove 1985). A two-year study was conducted in two parks with grassland habitat. One park had no cats but more than 25 cats were being fed daily in the other park. There were almost twice as many birds seen in the park with no cats as in the park with cats. California thrasher and California quail, both ground-nesting birds, were seen during surveys in the no-cat area; whereas, they were never seen in the cat area. In addition, more than 85% of the native seer mice and harvest mice trapped were in the no-cat area; whereas, 79% of the house mice, an exotic pest species, were trapped in the cat area. The researchers concluded, "*Cats at artificially high densities, sustained by supplemental feeding, reduce abundance of native rodent and bird populations, change the rodent species composition, and may facilitate the expansion of the house mouse into new areas*" (Hawkins et al. 1999).

Childs (1986) and Childs (1991) found that urban cats use of rats is size limiting. Few rats of reproductive size or age were preyed on by domesticated cats. In rural areas, rats were more vulnerable to cat predation for longer periods. The duration of susceptibility of rats to predation is attributed to abundance of garbage and artificial food sources in the urban environment. Artificial feeding of cats also reduces predation to non-native rodents because of size differences in urban rats. In rural setting, cats can control rat populations for longer durations but ultimate suppression of population growth is achieved via chemicals (poisons). Jackson (1951) found feral and free-ranging cats in Baltimore, Maryland urban areas were insignificant predators of Norway rats. The largest percentage of ingested food was comprised of garbage. It was estimated that a cat in the study area would consume roughly 28 rats per year.

Impacts from cat predation are not always direct, but indirect in the form of competition for food resources. George (1974) speculated that domestic cats were not a direct limiting factor on bird populations. However, George (1974) did find evidence indicating cats indirectly could affect some birds-of-prey by competing for a limited resource (primarily microtine rodents).

The TWSP may be requested to assist with preventing predation on other wildlife species. If a management agency finds that a particular species would be impacted by predation, the TWSP could assist in determining if damage management efforts could help protect the species and implement necessary, if any, actions to prevent predation. In many cases, requests for assistance to manage damage to natural resources involve T&E species.

Need to Reduce Threats Occurring to Human Safety

Zoonoses (*i.e.*, wildlife diseases transmissible to people) are a major concern of cooperators when requesting assistance with managing threats from predator. Disease transmission could occur from direct interactions between people and animals or from interactions with pets and livestock that have direct contact with wild predators. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of disease to humans. These include viral, bacterial, mycotic (fungal), protozoal, and rickettsial diseases.

Individuals or property owners that request assistance with disease threats frequently are concerned about potential disease risks but are unaware of the types of diseases that can be transmitted by those animals. In those types of situations, assistance is requested because of a perceived risk to human health or safety associated with wild animals living in close association with people, from animals acting out of character by roving in human-inhabited areas during daylight, or from animals showing no fear when people are present. In many circumstances when human health concerns are the primary reason for requesting assistance there may have been no actual cases of transmission of disease to humans by predators. Thus, the risk of disease transmission would be the primary reason for requesting assistance from the TWSP.

The most common disease concern expressed by individuals requesting assistance is the threat of rabies transmission to people, pets, and companion animals. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal that poses an indirect and direct threat to humans. Indirect threats to humans occur from exposure from pets or livestock that have been infected from bites of a rabid animal. Direct threats can occur from handling infected wildlife or from aggressive animal behavior caused by rabies. The disease can be effectively prevented in humans when exposure is identified early and treated. In addition, domestic animals and pets can be vaccinated for rabies. However, the abundant and widely distributed reservoir among wild mammals complicates rabies control. The vast majority of rabies cases reported to the Centers for Disease Control and Prevention (CDC) each year occur in raccoons, skunks (primarily *Mephitis mephitis*), and bats (Order Chiroptera) (CDC 2011).

Over the last 100 years, the vector of rabies in the United States has changed dramatically. About 90% or greater of all animal cases reported annually to CDC now occur in wildlife (Krebs et al. 2000, CDC 2011). Before 1960, the majority of cases were reported in domestic animals. The principal rabies hosts today are wild carnivores and bats. The number of rabies-related human deaths in the United States has declined from more than 100 annually in the early 1900s to an average of one or two people per year in the 1990s. Modern day prophylaxis, which is the series of vaccine injections given to people who have been potentially or actually exposed, has proven nearly 100% successful in preventing mortality when administered promptly (CDC 2011). In the United States, human fatalities associated with rabies occur in people who fail to seek timely medical assistance, usually because they were unaware of their exposure to rabies. Although human rabies deaths are rare, the estimated public health costs associated with disease detection, prevention, and control have risen, exceeding $300 million annually. Those costs include the vaccination of companion animals, maintenance of rabies laboratories, medical costs such as those incurred for exposure case investigations, rabies post-exposure prophylaxis (PEP), and animal control programs (CDC 2011).

Accurate estimates of the aforementioned expenditures are not available. Although the number of PEPs given in the United States each year is unknown, it has been estimated to be as high as 40,000. When rabies becomes epizootic (*i.e.*, affecting a large number of animals over a large area) or enzootic (*i.e.*, present in an area over time but with a low case frequency) in a region, the number of PEPs in that area often increases. Although the cost varies, a course of rabies immunoglobulin and five doses of vaccine given over a 4-week period typically exceeds $1,000 (CDC 2011) and has been reported to be as high as $3,000 or more (Meltzer 1996). As epizootics spread in wildlife populations, the risk of "*mass*" human exposures requiring treatment of large numbers of people that contact individual rabid domestic animals infected by wild rabid animals increases. One case in Massachusetts involving contact with, or drinking milk from, a single rabid cow required PEPs for 71 persons (CDC 1999). The total cost of this single incident exceeded $160,000 based on a median cost of $2,376 per PEP in Massachusetts. Likely, the most expensive single mass exposure case on record in the United States occurred in 1994 when a kitten from a pet store in Concord, New Hampshire tested positive for rabies after a brief illness. Because of potential exposure to the kitten or to other potentially rabid animals in the store, at least 665 persons received post-exposure rabies vaccinations at a total cost of more than $1.1 million (Noah et al. 1995). The American Veterinary Medical Association (AVMA) estimated the total cost for this specific incident, including investigation, laboratory testing, and rabies immunoglobulin and vaccines was more than $1.5 million (AVMA 2004).

Rabies presents a human health threat through potential direct exposure to rabid animals, or indirectly through the exposure of pets that have an encounter with rabid animals. Additionally, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post exposure treatments can increase when rabies is present in an area. Human and financial resources allocated to rabies-related human and animal health needs also increase, often at the expense of other important activities and services.

The health and safety of people and domestic animals have been threatened in Texas since 1988 with the eruption of two rabies epizootics involving coyotes and gray foxes (Clark and Wilson 1995, Sidwa et al. 2005). In addition, endemic skunk rabies continues to cycle through a large geographic portion of the State (Oertli et al. 2009). During the two rabies epizootics involving coyotes and gray foxes, two human deaths were documented and more than 18,700 rabies post-exposure treatments were administered. Hundreds of confirmed cases of rabies in domestic animals have also been documented by the Texas Department of State Health Services during that same period (Texas Department of State Health Services 2013). Texas gray fox rabies variant has documented occurrence in 53 counties, domestic dog/coyote rabies variant in 21 counties, and South Central skunk rabies variant in 240 counties. The significance of the magnitude of the problem is reflected in the fact that a Public Health Emergency was declared in 1994 and a statewide rabies quarantine was enacted (E. Oertli, Texas Department of State Health Services pers. comm. 2012).

In an effort to halt the westward spread of the raccoon variant of the rabies virus and to limit the spread of the canine variant from Texas, WS began participating in the distribution of Oral Rabies Vaccine (ORV) baits (fishmeal polymer containing Raboral V-RG® vaccine [Merial, Athens, Georgia, USA]). Currently, the WS program participates in the distribution of ORV baits and the surveillance of wildlife rabies vectors in 26 states, including Texas.

Skunks are an important wildlife host for the rabies virus in North America and are second only to raccoons in being the most commonly reported rabid wildlife species in the United States (Majumdar et al. 2005). The skunk variant of rabies may be found in the Midwest and California; however, skunks found throughout North America may be infected with different variants of rabies such as the raccoon variant. The distribution of rabies in skunks extends from Georgia to Maine east of the Appalachians, Texas to the Canadian border, and throughout the northern two thirds of California (Majumdar et al. 2005). The fox is one of the four major maintenance hosts for rabies in North America. In the 1950s, rabies in red fox spread throughout Canada, parts of New England, and Alaska. The range has since decreased, but fox rabies persists in Alaska and parts of Texas. Clinical signs of rabies in fox are often manifested as the "*furious*" form of rabies (Majumdar et al. 2005).

Increasing populations of raccoons have been implicated in the outbreak of distemper in certain areas (Majumdar et al. 2005). Distemper has not been identified as transmissible to humans. However, cooperators who feel threatened by the possibility of disease transmission often request assistance after observing sick raccoons on their property. Symptoms of distemper often lead to abnormal behavior in raccoons that are similar to symptoms associated with rabies. Raccoons with distemper often lose their fear of humans and can act aggressively which increases the risk that people, livestock, or companion animals may be bitten. Distemper is also known to occur in coyotes, red fox, and gray fox with symptoms that are similar to those exhibited by animals infected with the rabies virus.

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health given the close association of those animals with humans and companion animals. The topic of feral animals and their impacts on native wildlife and human health elicits a strong response in numerous professional and societal groups with an interest in the topic. Feral cats and dogs are considered by most professional wildlife groups to be a non-native species that can have detrimental effect to the native ecosystems especially in the presence of a human altered landscape. However, a segment of society views feral animals to be an extension of companion animals that should be cared for and for which affection bonds are often developed especially when societal groups feed and care for individual feral animals. Of special concern are those cats and dogs considered companion animals that are not confined indoors at all times but are allowed to range outside the home for extended periods. If interactions occur between companion animals and feral animals of the same species, companion animals could become exposed to a wide-range of zoonoses that could be brought back into the home where direct contact between the companion animal and people increases the likelihood of disease transmission. Feral animals that are considered companion animals are also likely to affect multiple people if disease transmission occurs since those animals are likely to come in direct contact with several members of families and friends before diagnosis of a disease occurs.

Several known diseases that are infectious to people, including rabies, have been found in feral cats and dogs. A common zoonosis found in cats is ringworm. Ringworm (*Tinea* spp.) is a contagious fungal disease contracted through direct interactions with an infected person, animal, or soil. Other common zoonoses of cats are pasteurella, salmonella, cat scratch disease, and numerous parasitic diseases, including roundworms, tapeworms, and toxoplasmosis.

Most of the zoonoses known to infect cats and dogs that are infectious to people are not life threatening if diagnosed and treated early. However, certain societal segments are at higher risks if exposed to zoonoses. Women who are pregnant, people receiving chemotherapy for immunologic diseases and organ transplants, and those with weakened immune systems are at increased risk of clinical disease if exposed to toxoplasmosis (AVMA 2004). In 1994, five Florida children were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2004). The daycare center at the University of Hawaii in Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi*) and flea (*Ctenocephalides felis*) infestations afflicting 84 children and faculty. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000, despite a trap, neuter, and release effort (AVMA 2004).

This discussion on zoonoses is intended to briefly address the more common known zoonoses found in the United States for those species specifically addressed in this EA but is not intended to be an exhaustive discussion of all potential zoonoses. The transmission of diseases from wildlife to humans is neither well documented nor well understood for most infectious zoonoses. Determining a vector for a human infected with a disease known to occur in wildlife populations is often complicated by the presence of the known agent across a broad range of naturally occurring sources. For example, a person with salmonella poisoning may have contracted salmonella bacterium from direct contact with an infected pet but may have also contracted the bacterium from eating undercooked meat or from other sources.

Disease transmission directly from wildlife to humans is uncommon. However, the infrequency of such transmission does not diminish the concerns of those individuals requesting assistance that are fearful of exposure to a diseased animal since disease transmissions have been documented to occur. The TWSP actively attempts to educate the public about the risks associated with disease transmission from wildlife to humans through technical assistance and by providing technical leaflets on the risks of exposure.

In addition to disease transmission threats, requests are also received for assistance from perceived threats of physical harm from wildlife, especially from predatory wildlife. Human encroachment into wildlife habitat increases the likelihood of human-wildlife interactions. Those species that people are likely to encounter are those most likely to adapt to and thrive in human altered habitat. Several predatory and omnivorous wildlife species thrive in urban habitat due to the availability of food, water, and shelter. Many people enjoy wildlife to the point of purchasing food specifically for feeding wildlife despite laws prohibiting the act in many areas. The constant presence of human created refuse, readily available water supplies, and abundant rodent populations found in some areas often increases the survival rates and carrying capacity of wildlife species that are adaptable to those habitats. Often the only limiting factor of wildlife species in and around areas inhabited by people is the prevalence of diseases, which can be confounded by the overabundance of wildlife congregated into a small area that can be created by the unlimited amount of food, water, and shelter found within those habitats.

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of humans and human activity, a loss of apprehension occurs that can lead to threatening behavior toward humans. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although wildlife attacking people occurs rarely, the number of attacks appears to be on the increase. Timm et al. (2004) reported that coyotes attacking people have increased in California and the recent, highly publicized coyote attacks, including a fatal attack on a 19-year old woman in Nova Scotia (Canadian Broadcast Company 2009), have only heightened people's awareness of the threat of such encounters. Although attacks on people associated with those species addressed in this EA occurs rarely, requests for assistance to lessen the threat of possible attack do occur from people in the Fort Worth District. Often, wildlife exhibiting threatening behavior or a loss of apprehensiveness to the presence of humans is a direct result and indication of an animal inflicted with a disease. So, requests for assistance are caused by both a desire to reduce the threat of disease transmission and from fear of aggressive behavior either from an animal that is less apprehensive of people or induced as a symptom of disease.

The TWSP has received requests for assistance in the Fort Worth District to reduce human health and safety concerns. Human health and safety concerns may include attacks from coyotes that result in injuries or death, disease threats from rabies and plague outbreaks where predators act as reservoirs, odor and noise nuisances from skunks, opossums, and raccoons in attics and under houses, and aircraft strike hazards from coyotes and fox crossing runways at airports or airbases. Typically, the biggest concern of the public is the threat of attack on people by large predators (*e.g*., coyotes, mountain lions) despite the rarity of those types of events. Mountain lion attacks on people in the western United States and Canada have increased in the last two decades, primarily due to increasing mountain lion populations and human use of mountain lion habitats (Beier 1991, Beier 1992). Baker and Timm (1998), after several human-coyote interactions in an area, concluded that the use of foothold traps to capture and euthanize a few coyotes would be the best method to limit interactions and have the most lasting effects. After a coyote in Glendale, California, killed a child, city and county officials trapped 55 coyotes in an 80-day period from within one-half mile of the home, an unusually high number for such a small area (Howell 1982). No fatalities associated with predators have been documented in the Fort Worth District. Although predator attacks on people are rare, the TWSP in the District could receive requests for assistance if such attacks occur.

The TWSP in the Fort Worth District may assist residents, especially in urban and suburban areas, that express concerns about coyote attacks on their pets and their apparent loss of fear toward people. Between FY 2009 and FY 2011, the TWSP received reports of or verified damage or threat occurrences occurring to human safety associated with bobcats, feral cats, coyotes, feral dogs, gray fox, red fox, mountain lions, Virginia opossum, raccoons, and skunks (see Table 1 and Table 2). Between FY 2009 and FY 2011, people requesting assistance reported to the TWSP or the TWSP verified 232 damage or threat occurrences involving human safety. Coyotes and striped skunks represented nearly 81% of those damage or threat occurrences. Predator attacks on people occur very rarely, but could result in requests for assistance under the current program.

Disease Surveillance and Monitoring

Public awareness and health risks associated with zoonoses (*i.e.*, diseases of animals that can be transmitted to humans) have increased in recent years. Several zoonotic diseases associated with predators are addressed in this EA. Those zoonotic diseases remain a concern and continue to pose threats to human safety where people encounter predators. The TWSP has received requests to assist with reducing damage and threats associated with several predator species in Texas and could conduct or assist with disease monitoring or surveillance activities for any of the predator species addressed in this EA. Most disease sampling would occur ancillary to other wildlife damage management activities (*i.e.*, disease sampling occurs after wildlife have been captured or lethally removed for other purposes). For example, the TWSP may sample predators harvested during the annual hunting season or during other damage management programs or may collect ticks from raccoons that were lethally removed to alleviate damage occurring to property.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA documents the need for predator damage management, the issues associated with meeting that need, and alternative approaches to address those issues and to meet the need for action. WS mission is to provide federal leadership with managing damage and threats of damage associated with wildlife (see WS Directive 1.201). The TWSP would only provide assistance when the appropriate property manager or property owner requested assistance[7]. The TWSP could receive a request for assistance from a property owner or manager to conduct activities on property they own or manage, which could include federal, state, tribal, municipal, and private land within the Fort Worth District.

Appendix B of this EA discusses the methods available for use or recommendation under each of the alternative approaches evaluated[8]. The alternatives and Appendix B also discuss how the TWSP and other entities could recommend or employ methods to manage damage and threats associated with predators in the District. Therefore, the actions evaluated in this EA are the use or recommendation of those methods available under the alternatives and the employment or recommendation of those methods

[7]Prior to providing any direct operational assistance, a MOU, Work Initiation Document, Work plan, or another similar document would be signed between the TWSP and the appropriate property owner or manager that identifies the wildlife species to be addressed and the methods the cooperator has agreed to be implemented on property they own or manage.

[8]Appendix B contains a complete list of chemical and non-chemical methods available for use under the identified alternatives. However, listing methods neither implies that all methods would be used by the TWSP to resolve requests for assistance nor does the listing of methods imply that all methods would be used to resolve every request for assistance.

by the TWSP to manage or prevent damage and threats associated with predators from occurring when requested by the appropriate resource owner or manager. Activities that could involve the lethal removal of target predator species by the TWSP under the alternatives would only occur when agreed upon by the requester.

Federal, State, County, City, and Private Lands

Under four of the alternatives, the TWSP could continue to provide damage management activities on federal, state, county, municipal, and private land in Fort Worth District when the TWSP receives a request for such services by the appropriate resource owner or manager. In those cases where a federal agency requests assistance from the TWSP with managing damage caused by predators on property they own or manage, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA could cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, the scope of this EA analyzes actions that could occur on federal lands, when requested.

Native American Lands and Tribes

The TWSP program in Fort Worth District would only conduct damage management activities on Native American lands when requested by a Native American Tribe. The TWSP would only conduct activities after the TWSP and the Tribe requesting assistance signed a MOU or Work Initiation Document. Therefore, the Tribe would determine what activities would be allowed and when assistance was required. Because Tribal officials would be responsible for requesting assistance from the TWSP and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would likely occur. Those methods available to alleviate damage associated with predators on federal, state, county, municipal, and private properties under the alternatives analyzed in this EA would be available for use to alleviate damage on Tribal properties when the Tribe requesting assistance approved the use of those methods. Therefore, the activities and methods addressed under the alternatives would include those activities that the TWSP could employ on Native American lands, when requested and when agreed upon by the Tribe and the TWSP.

Period for which this EA is Valid

If the preparation of an Environmental Impact Statement (EIS) is not warranted based the analyses associated with this EA, WS would conduct reviews of activities conducted under the selected alternative to ensure those activities occurred within the parameters evaluated in the EA. This EA would remain valid until the TWSP determined that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Under the alternative analyzing no involvement by the TWSP, no review or additional analyses would occur based on the lack of involvement by the TWSP. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by the TWSP in the Fort Worth District under the selected alternative, when requested.

Site Specificity

As mentioned previously, the TWSP would only conduct damage management activities when requested by the appropriate resource owner or manager. This EA analyzes the potential impacts of predator damage management based on previous activities conducted on private and public lands in the Fort Worth District where the TWSP and the appropriate entities entered into a MOU, Work Initiation Document, Annual Work Plans, or other comparable document. This EA also addresses the potential impacts of predator damage management in areas where the TWSP and a cooperating entity sign additional agreements in the future. Because the need for action would be to reduce damage and because the program's goals and directives would be to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and analyzes the impacts of those efforts as part of the alternatives.

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

Chapter 2 of this EA identifies and discusses issues relating to predator damage management in the Fort Worth District. The standard WS Decision Model (Slate et al. 1992; see WS Directive 2.201) would be the site-specific procedure for individual actions that the TWSP could conduct in the District (see Chapter 3 for a description of the Decision Model and its application). Decisions made using the model would be in accordance with SOPs described in this EA, as well as relevant laws and regulations.

The district is the site-specific unit for which decisions are made within the TWSP. The analyses in this EA would apply to any action that may occur in any locale and at any time within the Fort Worth District of the TWSP. In this way, the TWSP believes it meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for the TWSP to comply with the NEPA and still be able to accomplish its mission.

Summary of Public Involvement

The TWSP initially developed the issues associated with conducting predator damage management. The TWSP defined the issues and identified the preliminary alternatives through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS implementing regulations for the NEPA, the TWSP will make this document available to the public for review and comment. The TWSP will make the document available to the public through legal notices published in local print media, through direct mailings to parties that have requested notification, or that the TWSP has identified as having a potential interest in the reduction of threats and damage associated with predators in the State. In addition, WS will post this EA on the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml for review and comment.

The TWSP will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, the TWSP will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. The TWSP would fully consider new issues, concerns, or alternatives the public identifies during the public involvement period to determine whether the TWSP should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

Environmental Assessment: Predator Damage Management in the Fort Worth Animal Damage Control District Texas – The TWSP has previously developed an EA that analyzed the need for action to manage damage associated with coyotes, feral dogs, red fox, gray fox, feral swine (*Sus scrofa*), bobcats, and raccoons in the Fort Worth District (USDA 1997). The EA identified the issues associated with managing damage caused by several mammal species addressed in this EA and analyzed alternative approaches to meet the specific need identified in the EA while addressing the identified issues.

Changes in the need for action and the affected environment have prompted the TWSP to initiate this new analysis to address damage management activities in the District. This EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of mammals and to evaluate potential cumulative effects associated with those activities. Since the TWSP is developing this EA to re-evaluate activities described in the previous EA to address the new need for action and the associated affected environment, the outcome of the Decision issued based on the analyses in this EA will supersede the analyses and Decision from the previous EA that addressed predators[9].

Environmental Assessment: Oral Vaccination to Control Specific Rabies Virus Variants in Raccoons, Gray Fox, and Coyotes in the United States - WS issued an EA that analyzed the environmental effects of WS' involvement in the funding of and participation in Oral Rabies Vaccination programs (USDA 2009). The EA evaluates the implementation of Oral Rabies Vaccination programs to eliminate or stop the spread of raccoon rabies in a number of eastern states and gray fox and coyote rabies in Texas (USDA 2009). WS determined the action would not have a significant effect on the quality of the human environment.

1.5 AUTHORITY OF FEDERAL AND STATE AGENCIES

Below are brief discussions of the authorities of WS and other agencies, as those authorities relate to conducting wildlife damage management.

WS' Legislative Authority

The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 426c). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with wildlife. WS' directives define program objectives and guide WS' activities when managing wildlife damage.

[9]The outcome of the Decision based on the analyses in this EA would only supersede those portions of the previous EA that related to coyotes, feral dogs, red fox, gray fox, bobcats, and raccoons, excluding the need for action addressed in the previous EA for those species (USDA 1997). That portion of the previous EA (USDA 1997) that evaluates the need for action and the issues associated with managing damage caused by feral swine remain valid and appropriate to activities conducted by the TWSP.

United States Environmental Protection Agency (EPA)

The EPA is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which regulates the registration and use of pesticides.

Texas A&M AgriLife Extension Service

The Smith-Lever Act of 1914 (7 USC 341 et seq.) authorizes and provides for the conduct of cooperative extension work in agriculture and related subjects by the land-grant colleges and universities in several states where the USDA is cooperating with that state. The Texas Legislature accepted the provisions of this Act in 1915 with the passing of House Concurrent Resolution No. 2 and designated The Texas A&M University System as the institution to receive and administer funds made available under the Smith-Lever Act. AgriLife Extension Service is an agency within The Texas A&M University System. The Texas Legislature has authorized the State of Texas to cooperate through The Texas A&M University System with the appropriate federal officers and agencies to control predatory animals and rodent pests (Texas Health and Safety Code, Title 10, Ch. 825).

The TWSP would work cooperatively with local livestock associations and county governments to provide assistance for their constituents. The TWSP would provide assistance with managing damage or threats associated with predators statewide in areas where funding was available. Activities could occur on both private and public lands.

Texas Wildlife Damage Management Association

The TWDMA consists of local cooperative groups, including county governments, private associations, and/or individuals that contribute and provide funding to the TWSP to address predators.

Texas Parks and Wildlife Department

The TPWD is responsible for the management of native wildlife, including some predatory species (VTCA, Title 5, Subsection 61). The TPWD regulatory authority does not extend to coyotes, bobcats, mountain lion, feral dogs, or feral cats. However, the TPWD authority does include the management of some furbearers, including skunks, raccoons, opossum, red fox, and gray fox. While the TWSP collaborates with the TPWD in the management of depredating wildlife, the TWSP has independent authority to conduct predatory animal management (Attorney General Opinion JM-683). Collaboration with the TPWD includes sharing data regarding predator damage management, cooperating with the protection of native wildlife from predation, and the collection of scientific data and samples as appropriate for management decisions. Although the TWSP has authority to conduct damage management associated with predators, the TWSP maintains a policy of conducting activities consistent with any management directions or plans that the TPWD has established on behalf of the State as applicable to the authorities of the TWSP.

Texas Department of Agriculture (TDA)

The TDA is responsible for regulating pesticide use in the State. Pesticides that would be available to manage predators would be registered and approved for use through the TDA. Personnel of the TWSP that use restricted-use pesticides must become a certified pesticide applicator by the TDA or be supervised by a certified applicator.

Texas Department of State Health Services (TDSHS)

The TDSHS consists of five state agencies with priorities of improving the health of Texans, creating opportunities for self-sufficiency and independence, and to protect vulnerable people in the State from abuse, neglect, and exploitation. As part of those functions, the TDSHS is responsible for the monitoring, testing, and management of rabies within the State. As part of the Oral Rabies Vaccination programs (USDA 2009), the TWSP could participate with the TDSHS during rabies surveillance and rabies suppression in emergencies involving wildlife species. The TWSP has participated with the TDSHS in actively distributing oral rabies vaccine baits along the Texas/Mexico border to address the threat of canine or gray fox strains from entering the State from Mexico (USDA 2009). Additionally, the TWSP and the TDSHS are evaluating the suppression of rabies in skunks through the Oral Rabies Vaccination programs (USDA 2009).

1.6 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes would authorize, regulate, or otherwise affect the activities of the TWSP under the alternatives. The TWSP would comply with applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Below are brief discussions of those laws and regulations that would relate to damage management activities that the TWSP could conduct in the District.

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities that federal agencies must accomplish as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. In part, the CEQ, through regulations in 40 CFR, Parts 1500-1508, regulate federal activities that could affect the physical and biological environment. In accordance with regulations of the CEQ and the USDA, the APHIS has published guidelines concerning the implementation of the NEPA (see 44 CFR 50381-50384).

Pursuant to the NEPA and the CEQ regulations, this EA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that WS infuses the policies and goals of the NEPA into agency actions. The TWSP prepared this EA by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives, including the potential direct, indirect, and cumulative effects of the alternatives.

Endangered Species Act (ESA)

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). The TWSP conducts Section 7 consultations with the United States Fish and Wildlife Service (USFWS) to use the expertise of the USFWS to ensure that "*any action authorized... funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency will use the best scientific and commercial data available*" (Sec.7 (a)(2)). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA and its implementing regulations (Public Law 110-426, 7 USC 136 et. seq.) require the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. The EPA and the Texas Department of Agriculture regulate chemical methods that could be available to manage damage associated with predators.

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106. None of the methods described in this EA that would be available cause major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor would involve the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be available under the alternatives would not generally be the types of methods that would have the potential to affect historic properties. If the TWSP planned an individual activity with the potential to affect historic resources under an alternative selected because of a decision on this EA, the TWSP would conduct the site-specific consultation, as required by Section 106 of the NHPA, as necessary.

The use of noise-making methods, such as firearms, at or in close proximity to historic or cultural sites for the purposes of removing wildlife have the potential for audible effects on the use and enjoyment of historic property. However, the TWSP would only use such methods at a historic site at the request of the owner or manager of the site to resolve a damage problem, which means such use, would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. The TWSP would conduct site-specific consultation as required by the Section 106 of the NHPA as necessary in those types of situations.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970 and its implementing regulations (29 CFR 1910) on sanitation standards states that, "*Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practical, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their* *presence is detected*." This standard includes wildlife that may cause safety and health concerns at workplaces.

Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including some chemical methods used for wildlife capture and handling, under the Food and Drug Administration.

Controlled Substances Act of 1970 (21 USC 821 et seq.)

This law requires an individual or agency to have a special registration number from the United States Drug Enforcement Agency to possess controlled substances, including some chemical methods used for wildlife capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act (AMDUCA) and its implementing regulations (21 CFR 530) establish several requirements for the use of animal drugs, including those animal drugs used to capture and handle wildlife in damage management programs. Those requirements are: (1) a valid "*veterinarian-client-patient*" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where the TWSP could use those immobilizing and euthanasia drugs. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (*i.e.*, a period after a drug is administered that must lapse before an animal may be used for food) for specific drugs. Animals that people might consume within the withdrawal period must be identifiable (*e.g.*, use of ear tags) and labeled with appropriate warnings.

Airborne Hunting Act

The Airborne Hunting Act, passed in 1971 (Public Law 92-159), and amended in 1972 (Public Law 92-502) added to the Fish and Wildlife Act of 1956 as a new section (16 USC 742j-l) that prohibits shooting or attempting to shoot, harassing, capturing or killing any bird, fish, or other animal from aircraft except for certain specified reasons. Under exception [16 USC 742j-l, (b)(1)], state and federal agencies are allowed to protect or aid in the protection of land, water, wildlife, livestock, domesticated animals, human life, or crops using aircraft.

Environmental Justice in Minority and Low Income Populations - Executive Order 12898

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. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations. This EA will evaluate activities addressed in the alternatives for their potential impacts on the human environment and compliance with Executive Order 12898.

The TWSP would use only legal, effective, and environmentally safe damage management methods, tools, and approaches. The EPA through the FIFRA, the Texas Department of Agriculture, the United

States Drug Enforcement Agency, MOUs with land managing agencies, and WS' Directives would regulate chemical methods that could be available for use by the TWSP pursuant to the alternatives. The TWSP would properly dispose of any excess solid or hazardous waste. The TWSP does not anticipate the alternatives would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. In contrast, the alternatives may benefit minority or low-income populations by reducing threats to public health and safety and property damage.

Protection of Children from Environmental Health and Safety Risks - Executive Order 13045

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. The TWSP makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children. The TWSP has considered the impacts that this proposal might have on children. The proposed activities would occur by using only legally available and approved methods where it is highly unlikely that activities conducted pursuant to the alternative would adversely affect children. For these reasons, the TWSP concludes that it would not create an environmental health or safety risk to children from implementing the alternatives. Additionally, the need for action identified a need to reduce threats to human safety, including risks to children; therefore, cooperators could request assistance with reducing threats to the health and safety of children posed by predators.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species.

Regulation of Dogs by Texas Counties (VTCA Title 10, Chapter 822)

Under Title 10, Chapter 822 of the Vernon's Texas Codes Annotated (VTCA), dogs that attack livestock may be killed by "*any person witnessing or having knowledge of the attack*". Personnel of the TWSP could assist counties in addressing feral dog damage through coordination with the Sheriff's Office, constable, police, or other county official.

Texas Health and Safety Code - Predatory Animals and Animal Pests

Title 10, Chapter 825, Subchapter A, Section 825.001 of the Texas Health and Safety Code requires The Texas A&M University System to cooperate with WS in controlling coyotes, mountains lions, bobcats, feral swine, and other predatory animals to protect livestock, food and feed supplies, crops, and ranges. Section 825.002 directs the Texas A&M AgriLife Extension Service (formerly known as the Texas Agricultural Extension Service) to enter into a cooperative agreement with WS to perform management activities associated with predatory animals and pests. Section 825.004 allows the commissioners of a county or the governing body of a municipality to cooperate with appropriate federal and state authorities and provide funding for activities related to the management of predatory animals. Section 825.005 requires that all furs, skins, and specimens of value that are lethally removed by personnel paid from state appropriations must be sold unless presented free of charge to any state, county, or federal institution for scientific purposes. Section 825.007 specifically exempts personnel performing their duties under

Subchapter A of Title 10, Chapter 825 from licensing requirements under Title 5, Section 71.004 of the Parks and Wildlife Code. Section 825.031 of Subchapter C allows the commissioners of a county to pay bounties for killing predatory animals that are not listed on state or federal protected species lists.

Fur-bearing Animals Causing Depredation

Title 5, Subtitle C, Chapter 71, Section 71.004(a) of the Texas Parks and Wildlife Code allows a landowner or their agent to lethally remove fur-bearing animals causing depredation on the landowner's property without a need for a permit or license.

Nuisance Fur-bearing Animals

Regulation pursuant to Title 5, Chapter 71, allows landowners or their agents to lethal removal nuisance fur-bearing animals in any number by any means at any time on that person's land without the need for a hunting or trapping license. However, fur-bearing animals or their pelts taken for these purposes may not be retained or possessed by anyone at any time except licensed trappers during the lawful open season and possession period. Nuisance fur-bearing animals may be captured and relocated if the person has received authorization from the department and the owner of the property where the release will occur.

Wildlife and Plant Conservation – Endangered Species

Title 5, Subtitle B, Chapter 68, Section 68.003 of the Texas Parks and Wildlife Code defines an endangered species as a "*species of fish and wildlife indigenous to Texas…if listed on: (1) the United States List of Endangered Native Fish and Wildlife; or (2) the list of fish or wildlife threatened with statewide extinction as filed by the director of the* [TPWD]". Section 68.015(a) prohibits persons from capturing, trapping, taking, or killing, or attempt to capture, trap, take, or kill, endangered fish or wildlife.

Permits to Control Protected Wildlife in Texas

Title 5, Subtitle A, Chapter 43, Section 43.154 states, "[o]*n receipt of an application, the* [TPWD] *may issue a permit for the killing of wildlife without regard to the closed season, bag limit, or means and methods*". Section 43.151 through Section 43.157 outline additional procedures and limitations for issuing permits to control wildlife.

Using Helicopters to Take Certain Animals

Under Title 5, Subtitle A, Chapter 43, Section 43.1075 of the Texas Parks and Wildlife Code, "[a] *qualified landowner or landowner's agent, as determined by commission rule, may contract to participate as a hunter or observer in using a helicopter to take depredating feral hogs or coyotes under the authority of a permit issued under this subchapter*".

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, the WS program, as part of the TWSP, is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. The TPWD is responsible for managing most native wildlife in the State of Texas.

Based on the scope of this EA, the decisions to be made are: 1) should the TWSP conduct predator damage management to alleviate damage when requested in the Fort Worth District, 2) should the TWSP conduct disease surveillance and monitoring in predator populations when requested, 3) should the TWSP implement an integrated methods approach, including technical assistance and direct operational assistance, to meet the need for action in the Fort Worth District, 4) if not, should the TWSP attempt to implement one of the alternatives to an integrated methods strategy, and 5) would the proposed action or the other alternatives result in significant effects to the environment requiring the preparation of an EIS.

CHAPTER 2: ISSUES AND AFFECTED ENVIRONMENT

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that the TWSP did not consider in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues. Additional descriptions of the affected environment occur during the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

As was discussed in Chapter 1, the TWSP has divided Texas into districts for the purposes of managing the damage that predatory animals cause. The Fort Worth District includes 61 counties in northeast Texas (see Figure1). The District covers approximately 27.4 million acres (about 20.8% of the State), consisting primarily of the Pineywoods, Post Oak Savannah, Blackland Prairies, and Cross Timbers and Prairies ecological regions. On average, the TWSP conducted activities on properties comprising nearly 1.3 million acres per year between FY 2009 and FY 2011 in the Fort Worth District, which would represent less than 5% of the land area per year in the District. The TWSP generally only conducts activities on a small portion of the land acres allowed under a MOU, Work Initiation Document, or other comparable document. For example, a landowner may allow the TWSP to conduct activities on the 200 acres they own but personnel of the TWSP might only conducted activities on 10 acres of the property.

Those species addressed in this EA are capable of utilizing a variety of habitats in the Fort Worth District. Most species of predators addressed in this EA occur throughout the year across the State where suitable habitat exists for foraging and shelter. Damage or threats of damage caused by those species could occur throughout the Fort Worth District wherever those predators occur. However, damage management would only be conducted by the TWSP when requested by a landowner or manager and only on properties where a MOU, Work Initiation Document, Annual Work Plan, or other comparable documents were signed between the TWSP and a cooperating entity.

Upon receiving a request for assistance, the TWSP could conduct activities to reduce predator damage or threats on federal, state, tribal, municipal, and private properties in the Fort Worth District. Areas where damage or threats of damage could occur include, but would not be limited to agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, aquaculture facilities, fish hatcheries, grain mills, grain handling areas, railroad yards, waste handling facilities, industrial sites, natural resource areas, park lands, and historic sites; state and interstate highways and roads; railroads and their right-of-ways; property in or adjacent to subdivisions, businesses, and industrial parks; timberlands, croplands, and pastures; private and public property where burrowing predators cause damage to structures, dikes, ditches, ponds, and levees; public and private properties in rural/urban/suburban areas where predators cause damage to landscaping and natural resources, property, and are a threat to human safety through the spread of disease. The area would also include airports and military airbases where predators are a threat to human safety and to property; areas where predators negatively affect wildlife, including T&E species; and public property where predators were negatively affecting historic structures, cultural landscapes, and natural resources. Chapter 4 also contains additional information on the affected environment.

Environmental Status Quo

As defined by the NEPA implementing regulations, the "*human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a federal action agency analyzes their potential impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the federal action, but also the potential impacts that occur or could occur in the absence of the federal action by a non-federal entity. This concept is applicable to situations involving federal assistance to reduce damage associated with wildlife species.

Neither state nor federal laws protect some wildlife species, such as most non-native species. State authority or law manages most mammal species without any federal oversight or protection. In some situations, with the possible exception of restrictions on methods (*e.g*., firearms restrictions, pesticide regulations), unprotected wildlife species and certain resident wildlife species are managed with little or no restrictions, which allows anyone to lethal remove or take those species at any time when they are committing damage. For predator damage management in the Fort Worth District, the TWSP has the authority to manage predator damage in the District.

When a non-federal entity (*e.g.,* agricultural producers, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action to alleviate predator damage or threat, the action is not subject to compliance with the NEPA due to the lack of federal involvement in the action. Under such circumstances, the environmental baseline or status quo would be an environment that includes those resources as other non-federal entities manages or affects those resources in the absence of the federal action. Therefore, in those situations in which a non-federal entity has decides that a management action directed towards mammals should occur and even the particular methods that should be used, WS' involvement in the action would not affect the environmental status quo since the entity could take the action in the absence of involvement by the TWSP. Involvement by the TWSP would not change the environmental status quo if the requestor had conducted the action in the absence of involvement by the TWSP in the action.

A non-federal entity could lethally remove predators to alleviate damage without the need for a permit (see Title 5, Subtitle C, Chapter 71, Section 71.004(a) of the Texas Parks and Wildlife Code; Attorney General Opinion JM-683). In addition, other entities could remove predators to alleviate damage during the hunting and/or trapping season, and/or through the issuance of permits by the TPWD. In addition, most methods available for resolving damage associated with predators would also be available for use by other entities. Therefore, WS' decision-making ability would be restricted to one of three approaches. The TWSP could take the action using the specific methods as decided upon by the non-federal entity, provide technical assistance only, or take no action. If the TWSP takes no action, another entity could take the action anyway using the same methods without the need for a permit or during the hunting or trapping season. Under those circumstances, the TWSP would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of direct involvement by the TWSP.

Therefore, based on the discussion above, it is clear that in those situations where a non-federal entity has obtained the appropriate permit or authority, and has already made the decision to remove or otherwise manage predators to stop damage with or without assistance from the TWSP, the participation by the TWSP in carrying out the action would not affect the environmental status quo.

2.2 ISSUES ASSOCIATED WITH PREDATOR DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential effects that might occur from a proposed action. Agencies must consider such issues during the NEPA decision-making process. Initially, the TWSP developed the issues related to managing damage associated with predators in consultation with the TPWD. In addition, the TWSP will invite the public to review and comment on the EA to identify additional issues.

Chapter 4 discusses the issues, as those issues relate to the possible implementation of the alternatives, including the proposed action. The TWSP evaluated, in detail, the following issues:

Issue 1 - Effects of Damage Management Activities on Target Predator Populations

Predators play a vital role in a healthy ecosystem; therefore, a common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. Lethal and non-lethal methods would be available to resolve wildlife damage or threats to human safety.

Non-lethal methods could disperse or otherwise make an area unattractive to target species, which would reduce the presence of those species at the site and potentially the immediate area around the site where an entity employed those methods. Employing lethal methods could remove a predator or those predators responsible for causing damage or posing threats to human safety. Therefore, the use of lethal methods could result in local population reductions in the area where damage or threats were occurring. The number of animals removed from the population of a target species using lethal methods would be dependent on the number of requests for assistance received, the number of individual predators involved with the associated damage or threat, and the efficacy of methods employed.

The analysis in Chapter 4 will measure the number of individuals lethally removed in relation to that species abundance to determine the magnitude of impact to the populations of those species from the use of lethal methods. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data are quantitative. Determinations based on population trends and harvest trend data, when available, are qualitative.

In addition, many of the predator species addressed in this EA can be harvested in the State during annual hunting and/or trapping seasons and can be addressed using available methods by other entities in the State when those species cause damage or pose threats of damage. Damage or threats caused by predators could also be reduced during state hunting and trapping seasons. Without hunting and trapping, the International Association of Fish and Wildlife Agencies (2004) estimated that wildlife damage would increase from $20 billion to $70 billion in the United States. Therefore, any damage management activities conducted by the TWSP under the alternatives addressed would be occurring along with other natural process and human-induced events such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

Under certain alternatives, the TWSP could employ methods available to resolve damage and reduce threats to human safety that target an individual of a predator species or a group of individuals after applying the WS' Decision Model (Slate et al. 1992) to identify possible techniques. Chapter 4 analyzes the effects on the populations of target predator populations from implementation of the alternatives addressed in detail, including the proposed action. Information on predator populations and trends could be often available from several sources including the fur harvest reports, damage complaints, ground surveys, aerial surveys, and published literature.

Issue 2 - Effects on Non-target Species Populations, Including T&E Species

The issue of non-target species effects, including effects on T&E species, arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. Appendix B describes the methods available for use under the alternatives.

There are also concerns about the potential for adverse effects to occur to non-target wildlife from the use of chemical methods. Chemical methods that would be available for use to manage damage or threats associated with those predator species addressed in this EA include immobilizing drugs, euthanasia chemicals, sodium cyanide, sodium fluoroacetate, fumigants, and repellents. Chemical methods available for use to manage damage and threats associated with predators in Texas are further discussed in Chapter 4 and Appendix B. In addition, concerns have also been raised regarding the potential effects of aircraft overflights on non-target wildlife.

The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. The ESA requires that federal agencies consult with the appropriate implementing agency prior to undertaking any action that may take listed endangered or threatened species or their critical habitat. Chapter 4 discusses the potential effects of the alternatives on this issue.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

An additional issue often raised is the potential risks to human safety associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. Employees of the TWSP could use and recommend those methods that were legally available under each of the alternatives. Still, some concerns exist regarding the safety of methods available despite their legality and selectivity. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public. In addition to the potential risks to the public associated with the methods available under each of the alternatives, risks to employees would also be an issue. Selection of methods, under the alternatives, would include consideration for public and employee safety.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use or recommendation of chemical methods would include immobilizing drugs, euthanasia chemicals, fumigants, sodium cyanide, sodium fluoroacetate, and repellents. The EPA through the FIFRA and the TDA would regulate pesticide use. The United States Drug Enforcement Agency and the United States Food and Drug Administration would regulate immobilizing drugs and euthanasia chemicals. In addition, the use of all chemical methods by the TWSP would be subject to Texas laws and WS' Directives.

Another concern would be the potential for immobilizing drugs used in animal capture and handling to cause adverse health effects in people that hunt and consume the species involved. Among the species that the TWSP could capture and handle under the proposed action, this issue would be a primary concern for wildlife species that people hunt and consume as food.

Most methods available to alleviate damage and threats associated with predators would be non-chemical methods. Non-chemical methods may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include improved animal husbandry practices, altering feeding schedules, moving pastures, or night penning.

Limited habitat modification would be practices that alter specific characteristics of a localized area, such as removing bushes to eliminate shelter locations. Animal behavior modification methods would include those methods designed to disperse predators from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, barriers, electronic guards, effigies, and flagging. Other mechanical methods could include cage traps, foothold traps, body-gripping traps, cable restraints, cannon nets, shooting, or the recommendation that a local population of predators be reduced using hunting and/or trapping.

The primary safety risk of most non-chemical methods occurs directly to the applicator or those persons assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, pyrotechnics, or body-gripping traps. Most of the non-chemical methods available to address predator damage in the Fort Worth District would be available for use under any of the alternatives and by any entity, when permitted. Chapter 4 further discusses the risks to human safety from the use of non-chemical methods as this issue relates to the alternatives. Appendix B provides a complete list of non-chemical methods available to alleviate damage associated with predators.

Another concern is the threat to human safety from not employing methods or not employing the most effective methods to reduce the threats that predators could pose. The need for action in Chapter 1 addresses the risks to human safety from diseases associated with certain predator populations. The low risk of disease transmission from predators does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concerns occur when inadequately addressing threats to human safety associated with aircraft striking predators at airports in the Fort Worth District. Predators have the potential to cause severe damage to aircraft, which can threaten the safety of passengers. Limiting or preventing the use of certain methods to address the potential for aircraft striking predators could lead to higher risks to passenger safety. Chapter 4 further evaluates those concerns in relationship to the alternatives.

Issue 4 - Effects of Damage Management Activities on Recreational Activities

Another issue commonly identified is a concern that damage management activities conducted by the TWSP could conflict with recreational activities, such as hunting, fishing, wildlife viewing, sightseeing, horseback riding, camping, hiking, wood gathering, skiing, snowmobiling, and boating. Those species that are addressed in this EA can also be hunted and/or trapped during regulated seasons in the Fort Worth District.

Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to alleviate damage could reduce predator densities through dispersal in areas where damage or the threat of damage was occurring. Similarly, lethal methods used to reduce damage associated with predators could lower densities in areas where damage was occurring resulting in a reduction in the availability of those species in the area where those methods were applied.

In addition, some individuals believe their recreational experiences on public lands would be impaired knowing that damage management activities could be occurring on those lands, such as being deprived of the aesthetic experience of viewing or hearing coyotes or other predators because of activities conducted by the TWSP. Most of the land area in the Fort Worth District, as well as most of Texas, is privately owned. However, the TWSP could be requested to provide assistance on federal, state, county, and municipal properties within the District. Activities under the alternatives would only occur when the appropriate property owner or manager requested assistance from the TWSP.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that people can interpret in a variety of ways. Schmidt (1989) indicated that vertebrate damage management for societal benefits could be compatible with animal welfare concerns, if "*…the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process.*"

The AVMA (1987) has previously described suffering as a "*…highly unpleasant emotional response usually associated with pain and distress*." However, suffering "*…can occur without pain…*" and "*…pain can occur without suffering…*". Because suffering carries with it the implication of a time frame, a case could be made for "*…little or no suffering where death comes immediately…*" (California Department of Fish and Game 1991). Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when a person does not take action to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

The AVMA has previously stated "*...euthanasia is the act of inducing humane death in an animal*" and "*... the technique should minimize any stress and anxiety experienced by the animal prior to unconsciousness*" (Beaver et al. 2001). Some people would prefer using AVMA accepted methods of euthanasia when killing all animals, including wild and invasive animals. The AVMA has stated, "[f]*or wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible*" (Beaver et al. 2001).

Pain and suffering, as it relates to methods available for use to manage predators has both a professional and lay point of arbitration. Wildlife managers and the public must recognize the complexity of defining suffering, since "*…neither medical nor veterinary curricula explicitly address suffering or its relief*" (California Department of Fish and Game 1991). Research suggests that some methods, such as restraint in foothold traps or changes in the blood chemistry of trapped animals, indicate "*stress*" (Kreeger et al. 1988). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011).

The decision-making process involves tradeoffs between the above aspects of pain and humaneness. Therefore, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering. Chapter 4 further discusses the issue of humaneness and animal welfare. Chapter 3 discusses SOPs intended to alleviate pain and suffering.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

The TWSP in the Fort Worth District identified additional issues during the scoping process of this EA. The TWSP considered those additional issues but a detailed analysis did not occur for the reasons provided. Discussion of those additional issues and the reasons for not analyzing those issues in detail occur below.

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

The appropriateness of preparing an EA instead of an EIS was a concern the TWSP identified during the scoping process. Wildlife damage management falls within the category of actions in which the exact timing or location of individual activities can be difficult to predict well enough ahead of time to describe accurately such locations or times in an EA or even an EIS. Although WS could predict some of the possible locations or types of situations and sites where some kinds of predator damage would occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem had become intolerable to the point that they request assistance from WS. In addition, the TWSP would not be able to prevent such damage in all areas where it might occur without resorting to destruction of predator populations over broad areas at a much more intensive level than would be desired by most people, including the TWSP and other agencies. Such broad scale population management would also be impractical or impossible to achieve within the policies and professional philosophies of the TWSP.

Lead agencies have the discretion to determine the geographic scope of their analyses under the NEPA (Kleppe v. Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to APHIS procedures implementing the NEPA, WS' individual damage management actions could be categorically excluded (7 CFR 372.5(c)). WS' intent in developing this EA has been to determine if the proposed action or the other alternatives could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS. This EA addresses impacts for managing damage and threats to human safety associated with predators in the Fort Worth District to analyze individual and cumulative impacts and to provide a thorough analysis.

In terms of considering cumulative effects, one EA analyzing impacts for the entire Fort Worth District would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If the TWSP made a determination through this EA that the proposed action or the other alternatives could have a significant impact on the quality of the human environment, then the TWSP would publish a notice of intent to prepare an EIS and this EA would be the foundation for developing the EIS. Based on previous requests for assistance, the TWSP in the Fort Worth District would continue to conduct damage management in a very small area of the District where damage was occurring or likely to occur.

A Site Specific Analysis Should be made for Every Location Where Predator Damage Management Would Occur

The underlying intent for preparing an EA is to determine if a proposed action might have a significant impact on the human environment. The EA development process is issue driven, meaning issues that were raised during the interdisciplinary process and through public involvement that were substantive, would be used to drive the analysis and determine the significance of the environmental impacts of the proposed action and the alternatives. Therefore, the level of site specificity must be appropriate to the issues listed.

The analysis in this EA was driven by the issues raised during the scoping process during the development of the EA. In addition to the analysis contained in this EA, personnel in the TWSP would use the WS Decision Model (Slate et al. 1992) described in Chapter 3 as a site-specific tool to develop the most appropriate strategy for alleviating damage or threats of damage at each location. The WS Decision Model is an analytical thought process used by personnel of the TWSP for evaluating and responding to requests for assistance.

As discussed previously, one EA analyzing impacts for the Fort Worth District would provide a more comprehensive and less redundant analysis that allows for a better cumulative impact analysis. If a determination were made through this EA that the alternatives developed to meet the need for action could result in a significant impact on the quality of the human environment, then an EIS would be prepared.

Impact on Biodiversity

The TWSP does not attempt to eradicate any species of native wildlife. The TWSP operates in accordance with federal and state laws and regulations enacted to ensure species viability. The TWSP would use available methods to target individual animals or groups of animals identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or reproduction replaces the animals removed. As stated previously, the TWSP would only provide assistance under the appropriate alternatives after receiving a request to manage damage or threats. Therefore, if the TWSP provided direct operational assistance under the alternatives, the TWSP would provide assistance on a small percentage of the land area in the Fort Worth District. In addition, the TWSP would only target those predators identified as causing damage or posing a threat. The TWSP would not attempt to suppress predator populations across broad geographical areas at such intensity levels for prolonged durations that significant ecological effects would occur. The goal of the TWSP would not be to manage predator populations but to manage damage or threats associated with specific individuals of a species.

Often of concern with the use of certain methods is that predators that the TWSP lethally removes would only be replaced by other predators after the TWSP completes activities (*e.g.*, predators that relocate into the area) or by predators the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). The ability of an animal population to sustain a certain level of removal and to return to pre-management levels demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

For example, studies suggest coyote territories would not remain vacant for very long after removing coyotes from an area. Gese (1998) noted that adjacent coyote packs adjusted territorial boundaries following social disruption in a neighboring pack, thus allowing for complete occupancy of the area despite removal of breeding coyotes. Blejwas et al. (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the territorial pair. Williams et al. (2003) noted that temporal genetic variation in coyote populations experiencing high turnover (due to removals) indicated that "*...localized removal effort does not negatively impact effective population size...*". Chapter 4 evaluates the environmental consequences of the alternatives on the populations of target and non-target species based on available quantitative and qualitative parameters.

The Potential for Predator Removal to Cause Increases in the Populations of Other Wildlife Species

An issue often raised and identified is the potential effects of removing predators on the populations of prey species, which is similar to the previous issue discussing effects on biodiversity. For example, people are concerned that removing coyotes would cause an increase in rodent and rabbit populations, which could result in detrimental effects on vegetation and other resources. In general, predators may prolong the low points in rodent population cycles and spread the duration of the population peaks. Predators generally do not control rodent populations (Clark 1972, Wagner and Stoddart 1972, Keith 1974). It is more likely that prey abundance regulates to some degree the populations of predators (Clark 1972, Wagner and Stoddart 1972).

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 for some time at relatively low densities, 2) prey populations may escape this low point when predator populations decrease in response to low prey populations, and 3) since rabbit and rodent 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 black-tailed jackrabbit (*Lepus californicus*) populations in northern Utah and southern Idaho. Both Wagner and Stoddart (1972) and Clark (1972) concluded that coyote populations seemed to respond to an abundance of jackrabbits. 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).

Rabbit and rodent populations normally fluctuate substantially in several-year cycles. Two hypotheses attempt to explain these cyclic fluctuations. Those two hypotheses maintain that (1) rodent and rabbit populations are self-regulated through behavior, changes in reproductive capacity due to stress, or genetic changes (Chitty 1967, Myers and Krebs 1971), or (2) populations are regulated by environmental factors, such as food and predation (Pitelka 1957, Fuller 1969). Wagner (1988) reviewed literature on predator impacts on prey populations and concluded that such impacts vary with the locale. In some ecosystems, prey species, such as snowshoe hares, increased to the point that vegetative food sources were depleted, despite predation. In others, coyotes may limit jackrabbit density and evidence indicated food shortages do not occur to limit jackrabbit abundance (Wagner 1988). Wagner and Stoddart (1972) reported that coyote predation was a major source of jackrabbit mortality in the Curlew Valley of Utah, which may have caused a decline in the local jackrabbit population in the Valley.

Henke (1995) reviewed literature concerning coyote-prey interactions and concluded that short-term coyote removal efforts (≤6 months per year) typically did not result in increases of small mammal prey species populations. However, Henke (1995) concluded that long-term intensive coyote removal (9 months or longer per year) could, in some circumstances, result in changes to the rodent and rabbit species composition in the area where removals occurred, which could lead to changes in plant species composition and forage abundance. Henke (1995) based the conclusion that long-term intensive coyote remove could result in change to prey populations on a previous study (Henke 1992) that was conducted in the rolling plains area of Texas that involved one year of pretreatment and two years of treatment.

However, most damage management activities would occur in localized areas of the District and would not be conducted throughout the year but would occur for short periods after damage had occurred (*i.e.*, reactive damage management). Activities conducted to reduce threats of damage (*i.e.*, proactive damage management) would likely occur for short periods (90 to 120 days) during the time of year when addressing predators would be the most beneficial to reducing threats of damage (*e.g.,* the period of time immediately preceding and during calving and lambing in the spring). On average, the TWSP conducted activities on properties comprising nearly 1.3 million acres per year between FY 2009 and FY 2011 in the Fort Worth District, which would represent less than 5% of the land area per year in the District. The TWSP generally only conducts activities on a small portion of the land acres allowed under a MOU, Work Initiation Document, or other comparable document. For example, a landowner may allow the TWSP to conduct activities on the 100 acres they own but personnel of the TWSP might only conducted activities on 10 acres of the property. In addition, the number of predators addressed annually by the

TWSP and other entities is likely a small percentage of the actual populations of those species in the District; therefore, the effects on biodiversity would of low magnitude. Evidence also exists to suggest other carnivores such as badgers, bobcats, and fox increase in number when coyote populations are reduced (Robinson 1961, Nunley 1977). Therefore, even if a localized number of predators were removed, the number of other predatory species could increase in those areas.

The TWSP would only target those predators identified as causing damage or posing a threat. The TWSP would not attempt to suppress predator populations across broad geographical areas at such intensity levels for prolonged durations that significant ecological effects would occur. The goal of the TWSP would not be to manage predator populations but to manage damage or threats associated with specific individuals of a species.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that the TWSP or other entities should establish a threshold of loss before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking predators can lead to property damage and can threaten passenger safety if a catastrophic failure of the aircraft occurs because of the strike. Therefore, addressing the threats of aircraft strikes prior to an actual strike occurring would be appropriate.

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie National Forest, et al., the United States District Court of Utah determined that a forest supervisor could establish a need for wildlife damage management if the supervisor could show that damage from wildlife was threatened (Civil No. 92-C-0052A January 20, 1993). Thus, there is judicial precedence indicating that it is not necessary to establish a criterion such as a percentage of loss of a particular resource to justify the need for damage management actions.

Predator Damage Management Should Not Occur at Taxpayer Expense

An issue identified is the concern that the TWSP should not provide assistance at the expense of the taxpayer or that activities should be fee-based. Funding for activities could occur from federal appropriations, through state funding, and through cooperative funding. Funding for activities of the TWSP would occur through Work Initiation Documents with individual property owners or managers. Federal, state, and local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Currently, livestock producers and private resource owners that request assistance from the TWSP must pay for about 50% of the costs associated with the assistance that would be provided by the TWSP. Additionally, damage management activities are an appropriate sphere of activity for government programs, since managing wildlife is a government responsibility.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives that the TWSP is considering. However, the methods determined to be most effective to reduce damage and threats to human safety caused by predators and that prove to be the most cost effective would likely receive the greatest application. As part of an integrated approach and as part of the WS Decision Model, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstance where predators were causing damage or posing a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. Therefore, the cost of methods can often influence which methods are available to resolve damage and can influence the effectiveness of methods. Discussion of cost effectiveness as it relates to the effectiveness of methods occurs in the following issue.

Effectiveness of Predator Damage Management Methods

Defining the effectiveness of any damage management activities often occurs in terms of losses or risks potentially reduced or prevented. Effectiveness can also be dependent upon how accurately practitioners diagnose the problem, the species responsible for the damage, and how people implement actions to correct or mitigate risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to non-target animals and the environment, while at the same time, using methods as humanely as possible. The most effective approach to resolving any wildlife damage problem would be to use an adaptive integrated approach, which may call for the use of several management methods simultaneously or sequentially (Courchamp et al. 2003).

The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on people, target and non-target species, and the environment[10]. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and, for WS' personnel, the guidance provided by WS' directives and policies.

The goal would be to reduce damage, risks, and conflicts with wildlife as requested and not to reduce/eliminate populations. Localized population reduction could be short-term with new individuals immigrating into the area or born to animals remaining at the site (Courchamp et al. 2003). The ability of an animal population to sustain a certain level of removal and to return to pre-management levels eventually does not mean individual management actions were unsuccessful, but that periodic management may be necessary. The return of wildlife to pre-management levels also demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

The TWSP often receives comments that lethal methods would be ineffective because additional predators would likely return to the area. In addition, comments also claim that because predators return to an area after initial removal efforts were complete, the use of lethal methods gives the impression of creating a financial incentive to continue the use of only lethal methods. Those statements assume predators only return to an area where damage was occurring if the TWSP or other entities used lethal methods. However, the use of non-lethal methods would also often be temporary, which could result in predators returning to an area where damage was occurring once the TWSP or other entities no longer used those methods. The common factor when employing any method would be that predators would return if suitable conditions continued to exist at the location where damage was occurring and predator densities were sufficient to occupy all available habitats to the extent that damage occurs. Therefore, any reduction or prevention of damage from the use of methods addressed in Appendix B would be temporary if habitat conditions continue to exist that attract predators to an area where damage was occurring.

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

Therefore, any method that disperses or removes predators from areas would only be temporary if habitat containing preferred habitat characteristics continued to exist. Dispersing predators using non-lethal methods addressed in Appendix B often requires repeated application to discourage those animals from returning to locations, which increases costs, moves animals to other areas where they could cause damage, and would be temporary if habitat conditions that attracted those predators to damage areas remained unchanged. Some people could view dispersing and translocating predators as moving a problem from one area to another, which would require addressing damage caused by those predators at another location, which increases costs and could be perceived as creating a financial incentive to continue the use of those methods since predators would have to be addressed annually and at multiple locations. WS' recommendation of or use of techniques to modify existing habitat or making areas unattractive to predators is discussed in Appendix B. The objective of the TWSP would be to respond to requests for assistance with the most effective methods and to provide for the long-term solution to the problem using WS' Decision Model.

Managing damage caused by predators can be divided into short-term redistribution approaches and long-term population and habitat management approaches. Short-term approaches focus on redistribution and dispersal of predators to limit use of an area where damage or threats were occurring. Short-term redistribution approaches may include prohibiting feeding, the use of pyrotechnics, propane cannons, effigies, and other adverse noise, erecting access barriers such as fencing, and repellents. Population reduction by limiting survival or reproduction, removing animals, and habitat modification would be considered long-term solutions to managing damage caused by wildlife.

Redistribution methods would often be employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing predators can often be a short-term solution that moves those predators to other areas where damages or threats could occur. Some short-term methods may become less effective in resolving damage as a predator population increases, as predators become more acclimated to human activity, and as predators become habituated to harassment techniques. Non-lethal methods often require a constant presence at locations when predators were present and must be repeated every day or night until the desired results are achieved, which can increase the costs associated with those activities. Non-lethal methods may also require constant monitoring and maintenance to insure proper results. For example, fencing could be used to prevent access to a resource; however, constant monitoring of the fencing would be required and necessary repairs completed to ensure the use of fencing would be successful in preventing access to resources. Long-term solutions to resolving predator damage often require management of the population and identifying the habitat characteristics that attract predators to a particular location.

Research has shown that in areas without some level of damage management, losses of adult sheep and lambs to predators can be as high as 8.4% and 29.3% of the total number of sheep, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983). Additional research has indicated that sheep and lamb losses are generally lower where predator damage management was applied (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Howard and Booth 1981). The effectiveness of damage management activities can also be measured by public satisfaction. In a survey conducted by the Policy and Program Development program of APHIS, respondents indicated a high level of satisfaction with damage management activities conducted by the WS program nationwide (APHIS 1994).

Shwiff and Merrell (2004) reported a 5.4% increases in the numbers of calves brought to market when coyotes were removed by aerial operations. Bodenchuk et al. (2002) reported benefit-cost ratios of 3:1 to 27:1 for agricultural resource protection from predators. Wagner and Conover (1999) found that total lamb losses declined 25% on grazing allotments in which coyotes were removed by winter aerial operations five to six months ahead of summer sheep grazing. On allotments where no aerial operations occurred, total lamb losses only declined 6%. Confirmed losses to coyotes declined by 7% on allotments where aerial operation occurred, but increased 35% on allotments where no aerial operations occurred (Wagner and Conover 1999).

Based on an evaluation of the damage situation using the WS Decision Model, the most effective methods could be employed individually or in combination based on prior evaluations of methods or combinations of methods in other damage management situations. Once employed, methods could be further evaluated for effectiveness based on a continuous evaluation of activities by the TWSP. Therefore, the effectiveness of methods would be considered as part of the decision making-process under the use of the Decision Model described in Chapter 3 for each damage management request based on the continual evaluation of methods and results.

Predator Damage Should be managed by Private Businesses

Wildlife control agents and private entities could be contacted to reduce predator damage when deemed appropriate by the resource owner. In addition, the TWSP could refer persons requesting assistance to agents and/or private individuals under all of the alternatives fully evaluated in the EA.

WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. The TWSP would only provide assistance after receiving a request from the appropriate property owner or manager. When responding to requests for assistance, the TWSP would inform requesters that other service providers, including private entities, might be available to provide assistance.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove animals. As described in Appendix B, the lethal removal of predators with firearms by the TWSP to alleviate damage or threats could occur using a handgun, rifle, or shotgun. The TWSP could use firearms during aerial operations, ground-based shooting, harassment shooting, and/or shooting to euthanize animals captured in live traps. During aerial operations using firearms, the TWSP would use shotguns and lead or non-toxic shot. Ground-based shooting activities would use lead bullets. The primary concerns, regarding sport hunting and lead shot contamination, have been focused on aquatic areas where waterfowl hunting occurs, and the feeding habits of many species of waterfowl that result in them picking up and ingesting shot from the bottoms of ponds, lakes, and marshes. Shooting lead shot on dry land upland areas has generally not raised similar levels of concern, except where such activities are more intensively concentrated (*e.g.*, dove hunting at harvested crop fields, 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 concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996). The use of firearms to target predators by the TWSP would result in lead shot and bullets that are scattered in distribution over relatively wide areas, mostly in remote uninhabited locations, where contact with people or ingestion by birds picking up grit to aid in digestion of food are highly unlikely. Craig et al. (1999) found that, in general, sport hunting using rifles or shotguns, which would be similar in nature to activities conducted by the TWSP with regard to the distribution of lead shot or bullets, tends to spread lead over wide areas, and at low concentrations.

The lethal removal of predators by the TWSP using firearms in the Fort Worth District would occur primarily from the use of shotguns shooting lead or non-toxic shot and rifles using lead bullets. However, the use of handguns using lead bullets could be employed to remove some species or to euthanize target animals. To reduce risks to human safety and property damage from bullets passing through predators, the use of firearms could be applied in such a way (*e.g.*, caliber, bullet weight, distance) to ensure the bullet does not pass through predators. Predators that were removed using firearms would occur within areas where retrieval of carcasses for proper disposal is highly likely. With risks of lead exposure occurring primarily from ingestion of bullet fragments or shot, the retrieval and proper disposal of carcasses would greatly reduce the risk of scavengers ingesting or being exposed to lead that may be contained within the carcass.

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

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

The TWSP tracks ground-based shooting activities, harassment shooting, and animals killed in traps using firearms. If, for example, personnel of the TWSP fired three shots for every animal lethally removed during ground-based shooting, one shot was fired to euthanize animals in traps, and one shot was fired for every 10 to 100 birds hazed from FY 2009 to FY 2011, then an average of 2,700 shots were fired annually over the entire District. When the TWSP uses shot shells with lead in hazing or shooting, the typical amount of lead distributed by each shot would be 1.0 to 1.5 ounces. High-powered rifle bullets are about 0.3 ounces and about 0.1 ounces for small caliber firearms and pellets for air rifles. Personnel of the TWSP primarily use shotguns in the District during damage management activities, with about 80% of the shots fired occurring by shotgun. About 5% of the shots fired by the TWSP occurs using high-powered rifles and over 15% of the shots fired are to euthanize animals in traps with small caliber pistols (.22) or to shoot birds with air rifles (~0.1 ounces each at most). The majority of predators shot by the TWSP are retrieved and disposed of, which means those carcasses would not be available for scavenging by other wildlife. However, if the carcasses do not retain the shot or bullets or if misses occurred, the TWSP could deposit lead over the landscape.

On average, property owners or managers allowed the TWSP to conduct damage management activities on approximately 1.3 million acres per year in the Fort Worth District, which represents less than 5% of the land area of the District. However, in any given year, the TWSP only conducts activities on a small portion of those areas. For example, a cooperator may own 100 acres of rangeland and the TWSP could conduct activities within that 100-acre property; however, the TWSP may actually only conduct activities on less than 10 acres of the property. The TWSP estimates that actual damage management activities occur on 10% to 20% of the total land area that property owners or managers allow the TWSP to conduct damage management activities. Therefore, the TWSP actually conducts damage management activities on less than 1% of the land area in the District and the TWSP does not conduct shooting using lead projectiles on all of the land area. Thus, at most, the TWSP could scatter lead shot or bullets across less than 1% of the land area in the Fort Worth District per year. The number of shots fired would be relatively minimal and scattered over considerable portions of the landscape.

If all ammunition used by the TWSP was lead and shooting occurred on every acre of land that the TWSP conducts activities, the TWSP potentially deposits about 166 pounds of lead from shot shells[11] and 7 pounds from bullet fragments[12] over about 260,000 acres in the District. Therefore, if all ammunition was lead and shooting occurred on every acre of land, the TWSP would scatter approximately 0.01 ounces of lead per acre in those areas. The amount of lead deposited on the landscape in the Fort Worth District from the use of firearms by the TWSP would be minor given the land area of the District.

The hazard standard set by the EPA for lead concentrations in residential soils is 400 ppm (1 ppm is equivalent to 1 mg/kg or 0.0064 oz/lb) in children's play areas, and 1,200 ppm on average for the rest of a residential yard[13]. Established standards for lead contamination of soil in remote rural areas of the kind where the TWSP conducts most activities are not known to exist, but it would be likely the guidelines for residential areas would be more stringent than any such standard that might ever 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 layer of the soil is generally retained within the top 20 cm (about 8 inches). A representative average weight of soil is in the range of 110 pounds (49.9 kg) per cubic foot (Environmental Working Group 2001). The number of cubic feet in the top 8 inches of soil in one acre is about 29,000 cubic feet. Therefore, a reasonable estimate of the total weight of the top layer of soil per acre where lead fired from a firearm should remain would be 3.2 million pounds (110 X 29,000) or 1.5 million kilograms. If considered over the amount of land area involved in damage management activities in the District during a typical year, the amount of lead distributed by the TWSP would constitute an average of about 0.0002 mg/kg of soil (at 0.01 ounce/acre), which would be represent a small fraction of the concentration in the EPA hazard standards for residential area soils.

The TWSP estimated the amount of lead in each of the spots on the ground where the soil is impacted by lead shot, and then evaluated the risk of a person encountering one of those spots and becoming exposed to toxic levels of lead. The amount of lead in the soil impact zones of each shot taken was calculated as each shot potentially distributes 1.2 to 1.5 ounces, or 34.0 to 42.5 grams of lead into an approximate 30" circle. Using the same estimate of weight per cubic foot of soil and depth of soil in which the lead shot would remain as discussed previously, the amount of lead per unit weight of soil in the 30" circle would be about 200 to 260 mg/kg (ppm). Therefore, even if a person were to encounter one of the impact spots on the ground, the amount of lead in the soil would average less than the EPA hazard standard for children's play areas. The chances of someone stumbling across one of the impact spots could be

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[11] Based on 1.2 oz./shell for 90% of the shooting and 1.5 oz./shell for 10% of the shooting

[12] Based on 100 grain bullets used for high-powered rifles and 50 grain bullets used for small caliber and air rifles

[13] 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 parts per million (ppm = mg/g) in a play area or average of 1,200 ppm for bare soil in the rest of the yard based on soil samples (40 CFR 745.65(c)).

calculated if there were 2,700 30" impact spots (shots per year) distributed over 260,000 acres, or more than 11.3 billion square feet, of landscape – this means that the total area of impact spots for any one year are only one millionth of the area of the affected landscape. It would be highly unlikely for a person to stumble across one of the affected impact spots, but, even if someone did, there would be no health risk unless the person ingested some of the soil and the portion ingested contained some lead eroded from the spent shot. As discussed previously, solid lead exposed to the environment tends to form an oxidizing layer that slows down its ability to be dissolved in water (Craig et al. 1999), which means the lead from spent shot in the soil would tend to remain in place and not distribute throughout the soil. This would further lessen the chance that someone contacting an impact spot would become exposed to a lead.

A reasonable estimate of the amount of lead deposited by small game hunters would be in the range of about 3.1 million pounds distributed over the entire State[14]. Considering the area of the State is about 268,820 $mi.^2$ or about 172,044,800 acres, the average amount of shot distributed is about 8 g/acre per year. Assuming this lead shot deposition rate by private small game harvesters occurs on the same areas where the TWSP conducts damage management activities, the total cumulative amount of lead deposited on average in the areas where the TWSP conducts activities would be about 9 g/acre per year. The TWSP found that this cumulative amount of lead deposited would average about 0.03 mg/kg (equivalent to ppm) of soil. The amount of lead that the TWSP could distribute across the landscape would be below the EPA hazard standard of 400 ppm to 1200 ppm of soil established for residential soils. Soil uncontaminated by human activities generally contains lead levels that range from less than 10 to 30 ppm (or 10 to 30 mg/kg), but can vary widely (Agency for Toxic Substances and Disease Registry 2007). If the soils in the areas where the TWSP would conduct damage management activities contained the upper limit of this baseline level, it would take an additional 370 mg/kg of lead in the soil to reach the EPA hazard standard for children's playgrounds, and 1,170 mg/kg to reach the standard for other residential yard areas. It would take millions of years for enough lead to accumulate from shooting by the TWSP and sportsmen to reach the EPA hazard standard for children's playgrounds.

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

Concerns have also arisen regarding lead poisoning from bald eagles scavenging predators that have been killed using a firearm. Pattee et al. (1981) found that four of five captive bald eagles force-fed uncoated lead shot died and the fifth went blind. Frenzel and Anthony (1989) suggested, however, 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 usually 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). Hayes (1993) reviewed literature and analyzed the hazard of lead shot to raptors, in particular eagles. Key findings of that review were:

[14]Total number of small upland game animals that were most likely harvested by use of shotguns, averaged over the last several years, was about 8.2 million doves and 333,000 other small upland game (quail, pheasants) (TPWD 2013). It has been estimated 5 to 8 shots are fired per dove taken in the field (Lewis and Legler 1968). At an average of 3 shots fired per animal harvested for all species except doves for which it is estimated that 6 rounds are fired per dove on average for this analysis, the total number of shots fired to harvest the 8.5 million animals would be about 50.2 million. At 1 ounce of shot per shell fired, the amount of lead distributed into the environment would be about 3,138,000 lbs.

- Eagles were known to scavenge on coyote carcasses, particularly when other food sources were scarce or when food demands was increased.

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

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

To minimize exposure, the TWSP retrieves predator carcasses where practical and disposes of them in an area where eagles and other scavengers such as vultures would not be able to scavenge on them. In addition, no evidence has been brought forth to indicate that any animals killed during damage management activities conducted by the TWSP have resulted in any indirect lead poisoning of scavenging eagles or other animals.

Since those predators removed by the TWSP using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of involvement the TWSP, assistance provided by the TWSP with removing those predators would not be additive to the environmental status quo. The amount of lead deposited into the environment could be lowered by involvement from the TWSP in damage management activities due to efforts by the TWSP to ensure projectiles do no pass through but are contained within the predator carcass, which limits the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by employees of the TWSP in firearm use and accuracy would increase the likelihood that predators were lethally removed humanely in situations that ensure accuracy and that misses occur infrequently, which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. In addition, involvement by the TWSP would ensure predator carcasses lethally removed using firearms would be retrieved and disposed of properly to limit the availability of lead in the environment and ensures predator carcasses were removed from the environment to prevent the ingestion of lead in carcasses by scavengers whenever possible. Based on current information, the risks associated with lead projectiles that could be deposited into the environment from activities conducted by the TWSP due to misses, the projectile passing through the carcass, or from predator carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination of water. Based on the above analysis, we conclude that the amounts of lead deposited by the TWSP, even when considered cumulatively with the amounts deposited by hunters, would be far below any level that would pose any risk to public health. The TWSP has tried various nontoxic (non-lead) shot loads to reduce the concern of lead poisoning. The TWSP would continue to move toward using non-toxic shot/bullets as new non-toxic ammunition is developed.

Alternatives May Be "*Highly Controversial*" and the Effects May Be "*Highly Uncertain*"

The failure of any particular special interest group to agree with every act of a federal agency does not create a controversy, and the NEPA does not require the courts to resolve disagreements among various scientists as to the methodology used by an agency to carry out its mission (*Marsh vs. Oregon Natural Resource Council*, 490 USC 360, 378 (1989)). Section 4.1 of this EA analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. If the TWSP made a determination through this EA that the effects were highly uncertain, then the TWSP would publish a notice of intent to prepare an EIS and this EA would be the foundation for developing the EIS.

Effects of Activities on Unique Characteristics of Geographic Areas

A number of different types of federal and state lands occur within the analysis area, such as National Wildlife Refuges and Wildlife Management Areas. The TWSP recognizes that some persons interested in those areas may feel that any activities, if conducted in those areas, would adversely affect the aesthetic value and natural qualities of the area. If the TWSP were requested to conduct activities in those types of areas, the TWSP would abide by federal and state laws, regulations, and policies to minimize any effect on the public and would abide by any restrictions imposed by the land management agency on activities conducted by the TWSP.

Cumulative Effects on Wildlife Populations from Oil and Gas Development, Timber Harvesting, Land Development, and Grazing

A concern identified is the potential effects of damage management activities on wildlife species when considered with past, present, and future effects from other activities, such as oil and gas development, timber harvesting, other land development actions such as residential subdivision development, and grazing. The TWSP has no authority to affect decisions of other entities that engage in or approve such actions. Thus, they are not related or connected to activities that could be conducted by the TWSP. The effects of such actions by other agencies and entities are part of the existing *environmental status quo* and would neither increase nor decrease because of activities that could be conducted by the TWSP.

The following discussion is provided to give an example of what potential, if any, damage management activities conducted by the TWSP could contribute to cumulative effects on wildlife species in the Fort Worth District and the environment that have resulted from oil and gas development, timber harvest, land development, and grazing (the environmental baseline). Information related to those activities in the Fort Worth District is not currently available.

Adverse effects on some wildlife could result from land management and development activities. Housing developments in rural areas have been recognized as having the potential to adversely affect wildlife by diminishing habitat (Gill 1999). Oil and gas development can adversely affect certain wildlife species by reducing the amount of available habitat. Road building and establishment of well pads (sites where wells are drilled to pump oil or gas out of the ground) reduce habitat directly by removing vegetation that animals use for food and cover. Timber harvest can benefit some wildlife species while negatively affecting others (United States Forest Service 1998). For example, deer and elk generally benefit from the creation of openings in large expanses of mature forest. Roads established to support oil and gas development and timber harvest further indirectly reduce the amount of habitat effectively available to certain species because many of those species fear using areas where humans are traveling, which is considered a displacement effect caused by roads. The primary wildlife species identified as being affected in this way include mule deer and elk.

In an EIS covering oil and gas leasing and development in five Resource Areas in Colorado, the Bureau of Land Management stated that indirect impacts on some wildlife species would be from the loss of 17,900 acres of habitat over a 20-year period because of ground surface disturbance, which was considered minor compared to the 5.1 million acres of federal oil and gas mineral estate in the five Resource Areas evaluated (Bureau of Land Management 1991). Other impacts were qualitatively discussed but no quantitative measures of such effects were described in the EIS (Bureau of Land Management 1991). The Records of Decision issued by the Bureau of Land Management for oil and gas leasing and development in the five Resource Areas adopted a number of mitigation measures described in the EIS to protect wildlife habitat for the purposes of preventing substantial adverse effects on wildlife populations. The mitigation measures included habitat improvement efforts and stipulations or conditions on leases such as conditions of approval, no surface occupancy, and timing limitations, each designed specifically to protect important wildlife habitat. The Bureau of Land Management concluded that cumulative impacts on wildlife from implementing their proposed oil and gas development proposed action would be insignificant (Bureau of Land Management 1991).

The TWSP reviewed all species considered sensitive in Texas and determined that damage management would have no or minimal effect on any of the species listed. The TWSP also reviewed the alternatives for any potential for contributing to or causing significant adverse effects on any of those wildlife species identified in the affected environment components. The TWSP evaluated the potential impacts on wildlife resources associated with mining, oil and gas development, timber harvest, and grazing and analyzed whether those actions had effects on the same wildlife resources as those wildlife resources affected by damage management activities that could be conducted by the TWSP. Based on those evaluations, the TWSP would not cumulatively add to potential impacts from land management activities (including mining, oil and gas development, and livestock grazing).

Concerns that Killing Wildlife Represents "*Irreparable Harm*"

Public comments have raised the concern that the killing of any wildlife represents irreparable harm. Although an individual predator or multiple predators in a specific area may be killed by the TWSP under some of the alternatives to alleviate damage or threats of damage, the lethal removal of an individual predator or multiple predators in a localized area would represent irreparable harm to the continued existence of a species. Wildlife populations experience mortality from a variety of causes, including human harvest and damage management activities (see Section 4.2). The TWSP would conduct damage management activities associated with predators only at the request of a cooperator to reduce damage that was occurring or to prevent damage from occurring. The TWSP would monitor activities to ensure any potential impacts were identified and addressed. The TWSP would work closely with resource agencies to ensure damage management activities would not adversely affect predator populations and that activities conducted by the TWSP were considered as part of management goals established by those agencies. The legislated mission of the TPWD is to preserve, protect, and perpetuate all the wildlife of the State. Therefore, the TPWD would be expected to regulate management activities of protected wildlife species in the State to avoid irreparable harm. Historically, activities conducted by the TWSP to manage predators have not reached a magnitude that would cause adverse effects to predator populations. Therefore, mortality from the TWSP would not represent irreparable harm. The environmental consequences that each alternative could have on target predator populations are addressed in Chapter 4.

Effects of Livestock Grazing on Riparian Areas and Wildlife Habitat as a Connected Action to Damage Management Activities

Based on other scoping process, some members of the public have expressed that livestock grazing is a connected *action* to damage management activities. However, a connected action implies that grazing is an interdependent part of damage management activities that depends on such activities for its justification, that it is automatically triggered by damage management activities, or that grazing cannot and will not proceed unless damage management occurs (40 CFR 1508.25).

Livestock grazing in Texas occurs on private property at the discretion of the property owner without involvement from the TWSP or any activities conducted by the TWSP. Therefore, livestock grazing is not automatically triggered by damage management activities conducted by the TWSP, and it clearly can and does proceed in the absence of damage management assistance provided by the TWSP.

Some public commenters have asserted that damage management activities to protect livestock cannot or would not proceed unless livestock grazing was occurring. If no livestock production occurred, there would be no need to protect livestock from predation and there would be no reason for the TWSP to conduct damage management for livestock protection if there were no livestock. Conversely, there would be no damage management actions to protect livestock if there were no predators. Damage management activities associated with predators could and do occur by other entities in the Fort Worth District, whether the TWSP provides such assistance or not. Since federal agencies do not have the authority to regulate private land livestock grazing, such grazing and its effects are part of the existing human environment (*i.e.*, environmental status quo) and such private land livestock grazing is quite common and extensive.

As long as livestock producers experience economic losses from predators, activities to prevent or reduce further losses would continue to occur whether assistance was provided by the TWSP or not. In the absence of any involvement by the TWSP, livestock owners and managers or authorized state agencies would continue to conduct damage management activities on their own. Even if some livestock producers went out of business due to economically severe predation in the absence of any assistance that does not mean livestock grazing would not continue. Some of those producers would be expected to sell their properties to other producers that may have a better economic ability to withstand predation losses.

Livestock grazing and its impacts on the environment and damage management activities conducted by non-federal entities does not have to comply with the requirements and provisions of the NEPA and would represent the environmental status quo for the human environment. Damage management activities by private or non-federal entities would not be governed or restricted by the environmental laws that govern federal agencies, such as the NEPA and the preventive measures consultation requirements of Section 7 of the ESA. The only livestock grazing activities that are subject to the requirements of the NEPA would be those that were authorized by federal land management agencies to occur on federal lands, such as the Bureau of Land Management or United States Forest Service. Those federal agencies would prepare documents pursuant to the NEPA covering their authorization of livestock grazing on federal public lands and the potential environmental effects of livestock grazing.

Impacts of Predator Removal on the Public's Aesthetic Enjoyment of Predators

Wildlife is generally regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Some members of the public have expressed concerns that damage management could result in the loss of aesthetic benefits to the public, resource owners, or local residents. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

In the wild, few animals in the United States have life spans approaching that of people. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. Mortality in wildlife populations is a natural occurrence and people who form affectionate bonds with animals experience loss of those animals over time in most instances. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls and Labott 1994, Marks and Koepke 1994, Zasloff 1996, Archer 1999, Ross and Baron-Sorensen 1998, Meyers 2000). Similar observations were probably applicable to close bonds that could exist between people and wild animals. As observed by researchers in human behavior, normal human responses to loss of loved ones proceed through phases of shock or emotional numbness, sense of loss, grief, acceptance of the loss or what cannot be changed, healing, and acceptance and rebuilding which leads to resumption of normal lives (Lefrancois 1999). Those who lose companion animals, or animals for which they may have developed a bond and affection, are observed to proceed through the same phases as with the loss of human companions (Gerwolls and Labott 1994, Boyce 1998, Meyers 2000). However, they usually establish a bond with other individual animals after such losses. Although they may lose the sense of enjoyment and meaning from the association with those animals that die or are no longer accessible, they usually find a similar meaningfulness by establishing an association with new individual animals or through other relational activities (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Parkes 1979, Lefrancois 1999).

Some predators with which humans have established affectionate bonds may be removed from some project sites by the TWSP. However, other individuals of the same species would likely continue to be present in the affected area and people would tend to establish new bonds with those remaining animals. In addition, human behavior processes usually result in individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that might be removed from a specific location. Activities conducted by the TWSP would not be expected to have any cumulative effects on this element of the human environment.

Since those predators that could be removed by the TWSP under the appropriate alternatives could be removed by other entities, the involvement of the TWSP in removing those predators would not likely be additive to the number of predators that could be removed in the absence of involvement by the TWSP. In addition, activities that could occur under the alternatives by the TWSP would occur on a relatively limited portion of the total area in the Fort Worth District, and the portion of various predator species' populations removed activities would typically be low (see Section 4.1 and Section 4.2). In localized areas where the TWSP removes predators, dispersal of predators from adjacent areas typically contributes to repopulation of the area within a few weeks to a year, depending on the level of predator removal and predator population levels in nearby areas. Those target species addressed in this EA are relatively abundant, but may not be commonly observed because many of the species are secretive and nocturnal. The environmental consequences that each alternative could have on target predator populations are addressed in Chapter 4. The effects on target predator populations from damage management activities would be relatively low under any of the alternatives being considered in this EA, and opportunities to view, hear, or see evidence of predators would still be available over the majority of land in the Fort Worth District.

Effects of Damage Management Activities on the Regulated Harvest of Predators

Another issue commonly identified is a concern that damage management activities conducted by the TWSP would affect the ability of persons to harvest those species during the regulated hunting and trapping seasons either by reducing local populations through the lethal removal of predators or by reducing the number of predators present in an area through dispersal techniques. Hunting and trapping seasons exist for fur-bearing animals in the State. Skunks, raccoons, opossum, and fox are considered fur-bearing animals in the State (see Parks and Wildlife Code, Title 5, Subtitle C, Chapter 71, Section 71.001(1)). Coyotes and bobcats are not considered fur-bearing animals and may be harvested throughout the year.

Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to alleviate damage caused by those predator species could reduce predator densities through dispersal in areas where damage or the threat of damage was occurring. Similarly, lethal methods used to reduce damage associated with those predators could lower densities in areas where damage was occurring resulting in a reduction in the availability of those species during the regulated harvest season. The magnitude of lethal removal addressed in the proposed action would be low when compared to the mortality of those species from all known sources. When the removal of predators by the TWSP in the Fort Worth District was included as part of the known mortality of those species and compared to the estimated populations under the relevant alternatives analyzed in detail, the impact on those species' populations was below the level of removal required to lower population levels (see Section 4.1). Based on the low magnitude of removal that could occur by the TWSP, activities conducted pursuant to the relevant alternatives analyzed in detail would not reach a magnitude that would limit the ability of people to harvest target species in the District.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that were developed to meet the need for action discussed in Chapter 1 and to address the identified issues discussed in Chapter 2. Alternatives were developed for consideration based on the need for action and issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. SOPs for predator damage management in the Fort Worth District are also discussed in Chapter 3.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed to meet the need for action and address the identified issues associated with managing damage caused by predators in the Fort Worth District:

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action)

The no action alternative[15] would continue the current implementation of an adaptive integrated methods approach, when requested, to reduce damage and threats associated with predators in the Fort Worth District. A major goal of the program would be to resolve and prevent damage associated with predators and to reduce threats to human safety. To meet this goal, the TWSP would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding was available, operational damage management. Funding could occur through federal appropriations, from state funding, or from cooperative funding. The adaptive approach to managing damage associated with predators would integrate the use of the most practical and effective methods to resolve a request for assistance as determined by a site-specific evaluation to reduce damage or threats to human safety for each request. City/town managers, agricultural producers, property owners, and others requesting assistance would be provided information regarding the use of appropriate non-lethal and lethal methods.

[15] Alternative 1 was identified as the no action alternative and meets the definition of the no action alternative as defined by the CEQ (CEQ 1981). The CEQ has made two distinct interpretations of what constitutes a "*no action*" alternative. One interpretation involves the situation where an ongoing program would continue, even as a new plan is being developed. In those cases, "*no action*" has been interpreted by the CEQ to mean "*no change*" from the current management direction or level of intensity. The "*no action*" alternative is considered a continuation of the present course of action until the action is changed.

Under this alternative, the TWSP could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by predators, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage.

Property owners or managers requesting assistance from the TWSP would be provided with information regarding the use of effective and practical non-lethal and lethal techniques. Preference would be given to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Property owners or managers may choose to implement recommendations of the TWSP on their own (*i.e*., technical assistance), use contractual services of private businesses, use the services of private people, use the services of the TWSP (*i.e*., direct operational assistance), take the management action themselves, or take no further action.

The TWSP would work with those people experiencing predator damage as expeditiously as possible to address those predators responsible for causing damage. WS' Decision Model would be the implementing mechanism for a damage management program under the no action alternative that could be adapted to an individual damage situation that allows for the broadest range of methods to be used to address damage or the threat of damage in the most effective, most efficient, and most environmentally conscious way available. An adaptive integrated approach allows for the largest possible array of options to create a combination of techniques appropriate for the specific circumstances. An integrated approach that adapts to each request for assistance may incorporate cultural practices (*e.g*., animal husbandry), limited habitat modification (*e.g*., removing brush piles), altering animal behavior (*e.g*., propane cannons), local population reduction (*e.g*., removing a raccoon using a cage trap), or any combination of these, depending on the characteristics of the specific damage problems.

When the TWSP receives a request for direct operational assistance, the TWSP could conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage based on the informed judgment of trained personnel. The use of the Decision model by employees of the TWSP is further discussed below. Using the Decision Model and based on site visits or reported information, consideration would be given to several factors before selecting or recommending methods and techniques. Those factors could include 1) the species responsible for damage, 2) the magnitude, geographic extent, frequency, and duration of the problem, 3) the status of target and non-target species, including T&E species, 4) local environmental conditions, 5) the potential biological, physical, economic, and social impacts, 6) potential legal restrictions, 7) the cost of control options, and 8) prevention of future damage. Those factors would be incorporated into the Decision Model to determine the methods that would be appropriate to resolving a particular request for assistance. Both non-lethal and lethal methods would be available for use under this alternative.

Non-lethal methods that would be available for use by the TWSP under this alternative include, but are not limited to minor habitat modification, behavior modification, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, decoy dogs, tracking dogs, hand-capture, immobilizing drugs, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods that would be available to the TWSP under this alternative would include body-gripping traps, cable restraints, the recommendation of lethal removal during hunting and/or trapping seasons, fumigants, euthanasia chemicals, sodium cyanide, sodium fluoroacetate, and shooting, including the use of firearms from aircraft. In addition, target predator species live-captured using non-lethal methods (*e.g*., live-traps, immobilizing drugs) could be euthanized. The lethal control of target predators would comply with WS Directive 2.505.

Discussing methods does not imply that all methods would be used or recommended by the TWSP to resolve requests for assistance and does not imply that all methods would be used to resolve every request for assistance. The most appropriate response would often be a combination of non-lethal and lethal methods, or there could be instances where application of lethal methods alone would be the most appropriate strategy. For example, if an entity requesting assistance had already attempted to alleviate damage using non-lethal methods, the TWSP would not necessarily employ those same non-lethal methods, since those methods were proven ineffective at reducing damage or threats to an acceptable level to the requester. As part of an integrated approach, the TWSP may provide technical assistance and direct operational assistance to those people experiencing damage to agricultural resources, property, and threats to human safety associated with predators.

In addition, the National Wildlife Research Center (NWRC) functions as the research unit of WS by providing scientific information and the development of methods for wildlife damage management, which are effective and environmentally responsible. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques for managing wildlife damage. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving wildlife and methods.

Technical Assistance Recommendations

Under the proposed action, the TWSP would provide technical assistance to those persons requesting assistance with managing damage as part of an integrated approach. Technical assistance provided by the TWSP would occur as described in Alternative 4 of this EA.

Education is an important element of technical assistance because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations, the TWSP provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. The TWSP frequently cooperates with other entities in education and public information efforts. Additionally, technical papers have been and would continue to be presented at professional meetings and conferences so that other wildlife professionals and the public were periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Direct Operational Assistance

Operational damage management assistance would include damage management activities that were directly conducted by or supervised by personnel of the TWSP. Operational damage management assistance could be initiated when the problem could not be effectively resolved through technical assistance alone and there was a written MOU, Work Initiation Document, Annual Work Plans, or other comparable document signed between the TWSP and the entity requesting assistance. The initial investigation by personnel of the TWSP would define the nature, history, and extent of the problem, species responsible for the damage, and methods available to resolve the problem. The professional skills of personnel from the TWSP could be required to effectively resolve problems, especially if chemical methods were necessary or if the problems were complex. Depending on the assistance request received, activities conducted by the TWSP could be categorized as preventative or corrective.

Preventative activities would be associated with employing methods before damage occurs based on damage that has occurred historically at a location. For example, Wagner and Conover (1999) found that removing coyotes from lambing grounds in Utah three to six months prior to the arrival of adult sheep could reduce future predation rates of lambs. When requested, personnel of the TWSP could provide information and conduct demonstrations, or take action to prevent damage from recurring. Most non-lethal methods, whether applied by the TWSP or the resource owner, would be employed to prevent future damage from occurring. For example, fencing is often used to keep wildlife, such as predators, out of livestock pastures and to prevent future livestock predation from occurring. On lambing grounds with historically high predation rates of lambs, the TWSP may provide information about livestock guarding animals, fencing, or other husbandry techniques, or if requested and appropriate, the TWSP could conduct damage management activities before lambing begins to reduce future predation rates.

Corrective activities would be associated with stopping or reducing damage that was currently occurring. For example, if a mountain lion was verified as killing several calves, the TWSP, upon request, could conduct damage management activities to remove the mountain lion to prevent further predation. The United States General Accounting Office (GAO) concluded that, according to available research, localized lethal damage management was effective at reducing predator damage (GAO 1990). Corrective actions would often be employed to provide immediate resolution to damage occurring until long-term approaches could be implemented (*e.g*., building a fence) or have had time to reach the desired result (*e.g*., acquiring and raising guard animals).

Decision Making Procedures

Personnel of the TWSP would use a thought process for evaluating and responding to damage complaints that is depicted by the WS Decision Model (see WS Directive 2.201) and described by Slate et al. (1992). Personnel of the TWSP would assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, methods deemed practical for the situation would be incorporated into a damage management strategy. After this strategy was implemented, monitoring would be conducted and evaluation would continue to assess the effectiveness of the strategy. If the strategy were effective, the need for further management would be ended. In terms of the WS Decision Model, most efforts to resolve predator damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including the TWSP.

Community-based Decision Making

The TWSP could receive requests for assistance from community leaders and/or representatives. In those situations, the TWSP under this alternative would follow the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, the TWSP could provide technical assistance regarding the biology and ecology of predators and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include non-lethal and lethal methods. The TWSP and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources were available. Under this approach, resource owners and others directly affected by predator damage or conflicts would have direct input into the resolution of such problems. They may implement management recommendations provided by the TWSP or others, or may request direct operational assistance from the TWSP, local animal control agencies, private individuals, or private businesses.

Under a community based decision-making process, the TWSP would provide information, demonstration, and discussion on available methods to the appropriate representatives of the community for which services were requested to ensure a community-based decision was made. By involving decision-makers in the process, damage management actions could be presented to allow decisions on damage management to involve those individuals that the decision-maker(s) represents. As addressed in this EA, the TWSP could provide technical assistance to the appropriate decision-maker(s) to allow for information on damage management activities to be presented to those persons represented by the decision-maker(s), including demonstrations and presentation by the TWSP at public meetings to allow for involvement of the community. Requests for assistance to manage damage caused by predators often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives of the community, the decision-maker(s) would be able to provide the information to local interests either through technical assistance provided by the TWSP or through demonstrations and presentation by the TWSP on damage management activities. This process would allow decisions on damage management activities to be made based on local input. The community leaders could implement management recommendations provided by the TWSP or others, or may request management assistance from the TWSP, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Community Decision-Makers

The decision-maker for the local community would be elected officials or representatives of the communities. The elected officials or representatives would be popularly elected residents of the local community or appointees who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities can be more complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. The TWSP could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Direct assistance could be provided by the TWSP only if requested by the local community decision-maker, funding was provided, and if the requested direct control was compatible with recommendations made by the TWSP.

Private Property Decision-Makers

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has the discretion to involve others as to what occurs or does not occur on property they own or manage. Due to privacy concerns, the TWSP cannot disclose cooperator information to others. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree others were involved in the decision-making process would be a decision made by that individual. Direct operational assistance could be provided by the TWSP if requested, funding was provided, and the requested management was in accordance with recommendations made by the TWSP.

Public Property Decision-Makers

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. The TWSP could provide technical assistance to this person and recommendations to reduce damage. Direct operational assistance could be provided by the TWSP if requested, funding was provided, and the requested actions were within the recommendations made by the TWSP.

Activities conducted by the TWSP on federal, state, county, or municipal properties would follow all laws and regulations that have been determined to apply to damage management activities on those properties, such as the limited use of traps, snares, or toxicants. When a request was received from a federal, state, county, or municipal entity to conduct activities on properties they own or manage, the TWSP would provide information on proposed activities. Those entities would be responsible for reviewing proposed activities to assess their compatibility with established practices and procedures for compliance on their properties. For public land, the land management agency would be responsibility for clearly showing where a proposed activity would likely conflict with land use plans. In most cases, maps would be used to delineate areas where restrictions or limitations were needed to avoid conflicts with land uses. Those Work Plans and the WS Decision Model (Slate et al. 1992) would provide further site-specific planning mechanisms to evaluate and monitor activities for a given area.

***Planned Control Areas*:** If activities were requested on by the appropriate entity, planned control areas would be established where the TWSP would actively work or would have plans to work to limit predator damage. Planned activities would be those activities that would be anticipated to occur based on historical needs. However, actual activities may or may not be conducted in those areas because the need to manage damage would likely vary from year to year and site to site. Generally, the TWSP cannot predict where damage would occur at any given time; however, based on historic information, some locations where damage is likely to occur can be predicted. For example, damage management activities could be concentrated in areas where livestock were most abundant and during times when they were most vulnerable to predators, such as during calving and lambing. Requests for assistance in reducing property damage and threats to human health and safety would be by their nature, intermittent and, thus, far less predictable.

***Unplanned/Emergency Control Areas*:** On occasion, unplanned and emergency activities could be provided when requested in areas where activities were not scheduled to occur, except in areas designated as restricted. The restricted zones would be identified by appropriate management agency, cooperators, or the TWSP. Where unanticipated local damage or threats arise, the TWSP could take immediate action to alleviate damage or the threat of damage provided the proposed activities did not occur within a designated restricted activity zone. Emergency or unplanned activities would be handled on a case-by-case basis, as the need arises and would only occur if the appropriate entity allowed unplanned or emergency activities. The TWSP would notify the cooperating agency as soon as practicable after the emergency action commences or the work was performed.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

The proposed action alternative would continue the current program of implementing methods in an adaptive integrated approach to alleviate damage or threats of damage associated with predators (see Alternative 1). In addition, the TWSP could respond to requests for assistance from the TPWD, the USFWS, and/or other entities to enhance survival of native wildlife populations in areas where the TWSP has been requested to alleviate damage to other resources, when requested by the appropriate entity and when approved by the property owner. For example, the TWSP could be requested to prevent coyote predation on calves by a livestock producer. If the area also served as critical pronghorn habitat and pronghorn were below population objectives established by the TPWD due, in part, to coyote predation, the TWSP could also conduct damage management activities at the request of the TPWD on the property to enhance survival of antelope fawns by managing predators. Activities to manage predation could extend beyond the calving season if needed to prevent predation on pronghorn fawns. The TWSP would only conduct those activities when the property owner had agreed to allowing the TWSP to conduct those activities.

In another example, the TWSP could integrate the activities associated with threats to human safety into decisions regarding managing damage to other resources. Rabies management projects include active surveillance of potential wildlife vectors/reservoirs of the rabies virus. Gray fox, coyotes, bobcats, and striped skunks addressed during damage management efforts could be sampled to determine the presence and extent of rabies outbreaks. Similarly, if surveillance of those species is determined to be a key component for rabies management purposes, the TWSP could target those species using available methods for sampling during efforts targeting other predators even if those animals pose little risk to other resources (*e.g.*, skunks could be targeted during projects addressing coyote predation), when allowed by the cooperator requesting assistance.

When using the WS Decision Model under this alternative, the TWSP would consider the use of methods to alleviate damage or threats of damage on meeting population objectives of local wildlife when such management assistance is requested by the TPWD, the USFWS, and or other entities and when agreed upon by the property owner requesting assistance from the TWSP. In some instances, management methods and timing could be adjusted to prevent predation on native wildlife to enhance survival as well as top reduce damage to other resources.

Conversely, the TWSP would coordinate with land managing agencies and the TPWD to prevent predators from negatively affecting other resources. For example, the TWSP could be requested to disperse or removing mountains lions in areas to alleviate predation on livestock. Removing or dispersing mountain lions in an area to prevent predation on livestock could also result in an increase in wild burro populations by reducing natural regulation (*i.e.*, reducing mountain lion predation rates on burros). In those situations, the TWSP could manage predation associated with mountain lions in that area using cultural or limited habitat modification methods (*e.g.*, regulating the availability of water, if feasible). The need for action associated with managing predator damage to natural resources was addressed in Section 1.2 of this EA.

Methods available to resolve damage or threats of damage under this alternative would include the same methods available under Alternative 1. However, when managing damage or threats of damage to natural resources, some methods would be unavailable. Livestock Protection Collars would only be available to reduce coyote predation on sheep or goats and may not be used to alleviate damage or threats of damage to natural resources. In addition, M-44 devices cannot be used to alleviate damage or threats of damage occurring to natural resources, except to prevent coyote, red fox, grey fox, and feral dogs from predating on wildlife species listed pursuant to the ESA by the USFWS as threatened or endangered.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the federal WS program would not be involved with the TWSP. The TWSP would consist of the Texas A&M AgriLife Extension Service and the TWDMA. The WS program would not be involved with any aspect of managing damage caused by predators in the Fort Worth District. All requests for assistance received by the WS program to resolve damage caused by predators would be referred to the TWSP, other governmental agencies, and/or private entities. The TWSP, consisting of the Texas A&M AgriLife Extension Service and the TWDMA, could continue to provide assistance as described in Alternative 1 or Alternative 2.

Despite no involvement by the WS program in resolving damage and threats associated with predators in the Fort Worth District, those people experiencing damage caused by predators could continue to resolve damage through assistance provided by the TWSP. In addition, those people experience damage or threats of damage caused by predators could continue to employ those methods legally available to address predator damage on their own since predators could be addressed to alleviate damage or threats without a the need for a permit from the TPWD. All methods described in Appendix B could be available for use by the TWSP and those people experiencing damage or threats under this alternative except for the use of immobilizing drugs and euthanasia chemicals. Immobilizing drugs and euthanasia chemicals could only be used by the TWSP or appropriately licensed veterinarians.

Under this alternative, those people experiencing damage or threats of damage could contact the WS program; however, WS would immediately refer the requester to the TWSP and/or to other entities. The requester could contact other entities for information and assistance with managing damage, could take actions to alleviate damage without contacting any entity, or could take no further action.

Alternative 4 – The WS Program Provides Technical Assistance Only

Under this alternative, the federal WS program would continue to participate as part of the TWSP; however, when people contacted personnel with the WS program, WS' personnel would provide those people seeking assistance with technical assistance only. WS could also provide technical assistance to the Texas A&M AgriLife Extension Service and the TWDMA and refer people requesting assistance to the Texas A&M AgriLife Extension Service and the TWDMA. The Texas A&M AgriLife Extension Service and the TWDMA could continue to provide assistance as described in Alternative 1 or Alternative 2.

Similar to the other alternatives, the TWSP could receive requests for assistance from community representatives, private individuals/businesses, or from public entities. Technical assistance provided by the WS program would provide those people experiencing damage or threats caused by predators with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve or prevent damage would be the responsibility of the requester with no direct involvement by the WS program; however, the TWSP could provide direct operational assistance. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Technical assistance could be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, several management strategies would be described by WS to the requester for short and long-term solutions to managing damage. Those strategies would be based on the level of risk, need, and the practicality of their application. The WS program would use the Decision Model to recommend those methods and techniques available to the requester to manage damage and threats of damage. Those people receiving technical assistance from the WS program could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from the TWSP, could seek assistance from other entities, or take no further action.

Under a technical assistance only alternative, the WS program would recommend an integrated approach similar to Alternative 1 and Alternative 2 when receiving a request for assistance; however, the WS program would not provide direct operational assistance under this alternative. Preference would be given to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Recommendation of methods and techniques by WS to resolve damage would be based on information provided by the individual seeking assistance using the WS Decision Model. In some instances, wildlife-related information provided to the requestor by the WS program would result in tolerance/acceptance of the situation. In other instances, damage management options would be discussed and recommended. Only those methods legally available for use by the appropriate individual would be recommended or loaned by the WS program. Similar to the other alternatives, those methods described in Appendix B would be available to those people experiencing damage or threats associated with predators in the Fort Worth District, except for immobilizing drugs and euthanasia chemicals.

Immobilizing drugs and euthanasia chemicals would only be available to employees of the WS program, appropriately licensed veterinarians, or people under the supervision of a veterinarian. The TWSP in the Fort Worth District, including the WS program, regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing predator damage. Technical assistance would include collecting information about the species involved, the extent of the damage, and previous methods that the cooperator had attempted to resolve the problem. The WS program would then provide information on appropriate methods that the cooperator could consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups, such as homeowner associations or civic leagues.

This alternative would place the immediate burden of operational damage management work on the resource owner, Texas A&M AgriLife Extension Service, the TWDMA, other governmental agencies, and/or private businesses. Those persons experiencing damage or were concerned with threats posed by predators could seek assistance from the TWSP, other governmental agencies, private entities, or conduct damage management on their own. Those people experiencing damage or threats could take action using those methods legally available to resolve or prevent predator damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 5 – Use of Only Non-lethal Methods by the WS Program

Under this alternative, the federal WS program would be required to implement only non-lethal methods to resolve damage or threats of damage associated with predators. Only those methods discussed in Appendix B that are considered non-lethal would be employed or recommended by WS. No lethal removal of predators would occur by employees of the WS program. The use of lethal methods to manage damage could continue under this alternative by the TWSP, by landowners or resource managers, and by other entities. The non-lethal methods used or recommended by WS under this alternative would be identical to those identified in any of the alternatives.

In situations where non-lethal methods were impractical or ineffective to alleviate damage or threats of damage, WS could refer requests for information regarding lethal methods to the Texas A&M AgriLife Extension Service, the TWDMA, other governmental agencies, and/or private businesses.

Under this alternative, non-lethal methods would include fencing, deterrents/repellents, pyrotechnics, visual deterrents, exclusion, harassment, minor habitat alteration, cage traps, foothold traps, cable restraints, decoy dogs, tracking dogs, and translocation. If WS were to conduct operational assistance, predators live-captured would be translocated because lethal methods would be unavailable. Chemical repellents would also be available for use by WS under this alternative. Appendix B describes a number of non-lethal methods available for recommendation and use by WS under this alternative. WS would recommend an integrated approach to resolving requests for assistance under this alternative using those non-lethal methods available. WS would continue to provide technical assistance and direct operational assistance, when requested. Those activities described in Alternative 1 and Alternative 2, except for the recommendation and/or use of lethal methods, would continue to be available under this alternative. Property owners or managers could still resort to lethal methods or other methods not recommended by WS. In addition, those people experiencing damage or threats of damage could request assistance from the Texas A&M AgriLife Extension Service, the TWDMA, take actions themselves, use the services of other entities that were available to them, or take no action.

Under this alternative, TWSP would be required to implement only nonlethal methods to resolve predator damage problems. Only those methods discussed in Section 3.2 that are considered nonlethal would be employed or recommended by TWSP. No lethal removal of predatory animals would occur by TWSP. The use of lethal methods could continue under this alternative by producers, state agency personnel, landowners or resource managers of areas where predation is occurring. The nonlethal methods used or recommended by TWSP under this alternative would be identical to those identified in any of the alternatives.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives analyzed in detail, several additional alternatives were identified by the TWSP. However, those alternatives will not receive detailed analyses for the reasons provided. Many of the alternatives identified would only be applicable to the WS program, since the Texas A&M AgriLife Extension Service and the TWDMA are not part of the WS program and WS has no authority to govern their activities. Those alternatives considered but not analyzed in detail include:

Compensation for Predator Damage Losses

The compensation alternative would require the WS program to establish a system to reimburse persons impacted by predator damage and to seek funding for the program. Under such an alternative, the WS program would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. The TWSP, through the Texas A&M AgriLife Extension Service and the TWDMA, could continue to provide direct operational assistance when requested under this alternative. Evaluation of this alternative indicates that a compensation only alternative has many drawbacks. A compensation program implemented by WS would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) compensation most likely would be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) not be practical for reducing threats to human health and safety.

Establish a Bounty System for Predators

This alternative would require the WS program to establish a system that paid people for each predator killed. Payment of funds (bounties) for killing some mammals suspected of causing economic losses exist in Texas. Under Title 10, Chapter 825, Subchapter C, Section 825.031 of the Texas Health and Safety Code, "*the commissioners court of a county may pay bounties for killing predatory animals*…" and "…*may determine which animals are predatory animals in that county*" and the "…*amount of a bounty to be paid*…*for each animal*". Bounties are generally not effective in abating damage, especially over a wide area, such as a county or District, but may provide some benefits by removing surplus animals. A standard problem with bounties is that the circumstances surrounding the lethal removal of animals are typically arbitrary and completely unregulated. Abuse is often common with bounty systems and many animals could come from places outside the bounty area. The WS program does not have the authority to establish a bounty program.

A Short Term Eradication and Long Term Population Suppression of Predator Populations

An eradication alternative would direct all WS' program efforts toward total long-term elimination of predator populations wherever a cooperative program was initiated in the Fort Worth District. Some landowners would prefer that some species of predators be eradicated, especially those that have become abundant and caused damage without intervention from wildlife agencies (International Association of Fish and Wildlife Agencies 2004). Eradication of native species is not a desired population management goal of the TWSP, the TPWD, the TDA, and the USFWS. Eradication as a general strategy for managing predator damage was not considered in detail because state and federal agencies with interest in, or jurisdiction over, wildlife oppose eradication of any native wildlife species and eradication is not acceptable to most people.

Suppression would direct the efforts of WS toward managed reduction of certain problem populations or groups. In areas where damage could be attributed to localized populations of predators, the TWSP could decide to implement local population suppression using the WS' Decision Model. However, large-scale population suppression would not be realistic or practical to consider as the basis of the TWSP. Problems with the concept of suppression would be similar to those described above for eradication. Typically, WS' activities in the Fort Worth District would be conducted on a very small portion of the sites or areas inhabited or frequented by problem species.

Management Activities Would only be conducted after Damage Had Occurred

Managing damage proactively and reactively are the general approaches to alleviating damage cause by predators (Baker et al. 2008). Proactive damage management would be the application of methods to target predators prior to damage occurrences based on historical damage that has occurred (*i.e*., based on a threat of damage). As requested and appropriate, the WS program, the Texas A&M AgriLife Extension Service, and the TWDMA provide information, conduct demonstrations or take action to prevent damage from recurring. For example, in areas where substantial lamb depredation has occurred on lambing grounds, the TWSP could provide information about guard dogs, fences, or other husbandry techniques, or be requested to provide direct operational assistance to remove predators prior to lambing. Reactive damage management would be the application of methods targeting predators in response to an incurred loss with the intent of abating or reducing further losses (*i.e*., after damage has already occurred). Under this alternative, the WS program would only provide reactive assistance and only conduct activities after damage has occurred. No proactive assistance would be provided by the WS program; however, the Texas A&M AgriLife Extension Service and the TWDMA could continue to provide proactive assistance by conducing activities based on a threat of damage similar to Alternative 1 and Alternative 2. The TWSP would only conduct activities based on a request for assistance. In some cases, proactive damage management is prohibited or not agreed to (*e.g*., proactive management cannot occur on the Wilderness Study Areas managed by the Bureau of Land Management).

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie National Forest, et al., the United States District Court of Utah determined that a forest supervisor could establish a need for wildlife damage management if the supervisor could show that damage from wildlife was threatened (Civil No. 92-C-0052A January 20, 1993). The Court stated that, *"The agency need not show that a certain level of damage is occurring before it implements a [*WS*] Program… Hence, to establish need for* [WS], *the forest supervisors need only show that damage from predators is threatened."* Thus, there is judicial precedence indicating that it is not necessary to establish a criterion, such as a percentage of loss of a particular resource to justify the need for damage management actions.

Non-lethal Methods Implemented Before Lethal Methods

This alternative would require that non-lethal methods or techniques described in Appendix B be applied by the WS program to all requests for assistance to reduce damage and threats to safety from predators in the Fort Worth District. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety at each damage situation, lethal methods could then be employed to resolve the request. Non-lethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by other members of the TWSP or by those persons experiencing predator damage but would only prevent the use of those methods by the WS program until non-lethal methods had been employed. The WS program could recommend the use of lethal methods through technical assistance under this alternative; however, the operational use of lethal methods would only occur after non-lethal methods had been proven ineffective.

Few non-lethal methods available to alleviate damage or threats associated with predators, such as livestock management practices (*e.g*., night-penning, herding, carcass removal) and physical exclusion (*e.g.*, predator-proof fencing), are practical for implementation by WS' personnel. Those persons experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting the WS program. Most non-lethal methods are put into use by the resource owner (Knowlton et al. 1999). Many of those non-lethal methods (*e.g.*, fencing and guard dogs) require a large investment in time to implement and have a high initial cost (Mitchell et al. 2004). Even with the additional effort and costs, those methods are not always effective at reducing damage and potentially have side effects (*e.g.*, concentrating livestock can cause unwanted damage to particular pasture areas) (Knowlton et al. 1999).

Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of non-lethal methods could be evaluated. The no action alternative (Alternative 1), the proposed action alternative (Alternative 2), and the technical assistance only alternative (Alternative 3) would be similar to a non-lethal before lethal alternative because WS would use or recommend non-lethal methods before lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not contribute additional information to the analyses in the EA.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with predators. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Predator damage could be effectively reduced using non-lethal methods. For example, the use of guard dogs can be effective at reducing predation rates or installing proper fencing can exclude some predators from areas. In those situations where damage could be alleviated using non-lethal methods deemed effective, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

Live-capture and Translocate Predators Only

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Predators would be live-captured using primarily immobilizing drugs, cage traps, foothold traps, and restraining cables. All predators live-captured through direct operational assistance by the WS program would be translocated. Translocation sites would be identified and have to be approved by the property owner where the translocated predators would be placed prior to live-capture and translocation. Live-capture and translocation could be conducted as part of the alternatives analyzed in detail. WS could translocate predators or recommend translocation under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, other entities could translocate predators under Alternative 3. The Texas A&M AgriLife Extension Service and the TWDMA could continue to provide assistance similar to Alternative 1 and Alternative 2 under this alternative.

Generally, translocating predators that have caused damage to other areas following live-capture would not be effective or cost-effective. Translocation is generally ineffective because predators are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in damage problems at the new location. In addition, several animals would need to be captured and translocated to solve some damage problems; therefore, translocation could be unrealistic. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, threat of spreading diseases, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988). Based on those factors and the availability of additional methods that could be used to effectively resolve damage or threats of damage, this alternative was not evaluated in detail. In addition, the WS program could translocate or recommend translocation under any of the alternatives analyzed in detail, except for the no involvement by WS alternative (Alternative 3).

Reducing Damage by Managing Predator Populations through the Use of Reproductive Inhibitors

Under this alternative, the only method that would be available to resolve requests for assistance by WS would be the recommendation and the use of reproductive inhibitors to reduce or prevent reproduction in predators responsible for causing damage. Reproductive inhibitors are often considered for use where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). Use and effectiveness of reproductive control as a population management tool is limited by population dynamic characteristics (*e.g.*, longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity), habitat and environmental factors (*e.g.*, isolation of target population, cover types, and access to target individuals), socioeconomic, and other factors.

Reproductive control for predators could be accomplished through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through: 1) surgical sterilization (vasectomy, castration, and tubal ligation), 2) chemosterilization, and 3) through gene therapy. Bromley and Gese (2001*a*, 2001*b*) conducted studies to determine if surgically sterilized coyotes would maintain territories and pair bond behavior characteristics of unsterilized coyotes, and if predation rates by sterilized coyote pairs would decrease. The results indicated that behaviorally, sterile coyote pairs appeared to be no different from unsterilized pairs, except for predation rates on lambs. Unsterilized coyote packs were six times more likely to prey on sheep than were sterilized packs (Bromley and Gese 2001*b*). Bromley and Gese (2001*b*) believed this occurred because sterile packs did not have to provision pups and food demands were lower. Therefore, sterilization could be an effective method to reduce lamb predation if enough coyote breeding pairs could be captured and sterilized. Bromley and Gese (2001*a*, 2001*b*) captured as many coyotes as possible from all packs on their study area and controlled coyote exploitation (mortality) on their study area. During their studies, Bromley and Gese (2001*a*, 2001*b*) found survival rates for coyotes in the unexploited study area were similar to those survival rates reported for mostly unexploited wild coyote populations. Bromley and Gese (2001*b*) concluded a more effective and economical method of sterilizing resident coyotes was needed to make sterilization a practical management tool on a larger scale.

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

Sterilization methods were not analyzed in detail in the EA because: (1) surgical sterilization would require that each animal be captured and sterilization conducted by licensed veterinarians, which would be labor intensive and expensive; and (2) currently no federal or state approved chemosterilants are available for operational use to manage local predator populations.

Contraception could be accomplished through: 1) hormone implantation (synthetic steroids such as progestins), 2) immunocontraception (contraceptive vaccines), and 3) oral contraception (progestin administered daily).

Population modeling indicates that reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproduction control technologies as a wildlife management tool for some species.

Currently, chemical reproductive inhibitors are not available for use to manage most predator populations. Given the costs associated with live-capturing and performing sterilization procedures on predators and the lack of availability of chemical reproductive inhibitors for the management of most predator populations, this alternative was not evaluated in detail. If reproductive inhibitors become available to manage a predator population and if an inhibitor had been proven effective in reducing localized predator populations, the use of the inhibitor could be evaluated as a method available that could be used to managing damage.

WS should use Lithium Chloride as an Aversive Agent

This alternative would require WS to use lithium chloride to prevent predation on livestock. Lithium chloride has been tested as a taste aversion agent to condition coyotes to avoid livestock, especially sheep. Despite extensive research, the efficacy of this technique remains unproven (Conover et al. 1977, Sterner and Shumake 1978, Burns 1980, Burns and Connolly 1980, Burns 1983, Horn 1983, Johnson 1984, Burns and Connolly 1985). Results of studies evaluating lithium chloride as a taste aversion agent to prevent coyote predation have reported varying results. Some studies report success using lithium chloride (Gustavson et al. 1974, Ellins and Martin 1981, Gustavson et al. 1982, Forthman-Quick et al. 1985*a*, Forthman-Quick et al. 1985*b*), while other studies have shown lithium chloride to be ineffective, especially in field situations (Conover et al. 1977, Burns 1980, Bourne and Dorrance 1982, Burns 1983, Burns and Connolly 1985). The GAO (2001) reported "…*while the coyotes learned not to eat lambs, they still killed them*". In addition, lithium chloride is currently not registered for use with the EPA and the TDA. Therefore, at the time this EA was developed, lithium chloride could not be used to prevent predation. If a product containing lithium chloride becomes available to manage damage and if the product has been proven effective in reducing predation rates, the use of the lithium chloride could be evaluated as a method available that could be used to managing damage.

3.3 STANDARD OPERATING PROCEDURES FOR PREDATOR DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of activities intended to resolve wildlife damage. The TWSP in the Fort Worth District uses many such SOPs. Those SOPs would be incorporated into activities conducted by the TWSP under the appropriate alternatives when addressing predator damage and threats in the District.

Some key SOPs pertinent to resolving predator damage in the Fort Worth District include the following:

- The WS Decision Model, which is designed to identify effective strategies to managing wildlife damage and their potential impacts, would be consistently used and applied when addressing predator damage.

- Personnel would comply with applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210.

- EPA-approved label directions would be followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects occur to the environment when chemicals are used in accordance with label directions.

- Immobilizing and euthanasia drugs would be used according to the United States Drug Enforcement Agency, United States Food and Drug Administration, and WS' directives and procedures.

- All controlled substances would be registered with the United States Drug Enforcement Agency or the United States Food and Drug Administration.

- Employees would follow approved procedures outlined in the WS' Field Manual for the Operational Use of Immobilizing and Euthanizing Drugs (Johnson et al. 2001).

- Employees that use controlled substances would be trained to use each material and would be certified to use controlled substances.

- Employees who use pesticides and controlled substances would participate in State-approved continuing education to keep current of developments and maintain their certifications.

- Pesticide and controlled substance use, storage, and disposal would conform to label instructions and other applicable laws and regulations, and Executive Order 12898.

- Material Safety Data Sheets for pesticides and controlled substances would be provided to all personnel involved with specific damage management activities.

- All personnel who use firearms would be trained according to WS' Directives.

- Employees participating in any aspect of aerial wildlife operations would be trained and/or certified in their role and responsibilities during the operations. All personnel would follow the policies and directives set forth in WS' Directive 2.620; WS' Aviation Operations Manual; WS' Aviation Safety Manual and its amendments; Title 14 CFR; and Federal Aviation Regulations, Part 43, 61, 91, 119, 133, 135, and 137.

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing predator damage.

- Management actions would be directed toward localized populations, individuals, or groups of target species. Generalized population suppression across the Fort Worth District, or even across major portions of the District, would not be conducted.

- Non-target animals live-captured in traps would be released unless it was determined that the animal would not survive and/or that the animal could not be released safely.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

Several additional SOPs would be applicable to the alternatives and the issues identified in Chapter 2 including the following:

Issue 1 - Effects of Damage Management Activities on Target Predator Populations

- Lethal removal of predators by the TWSP would be reported and monitored by the TWSP to evaluate population trends and the magnitude of lethal removal by the TWSP of predators in the Fort Worth District.

- The TWSP would only target those individuals or groups of target species identified as causing damage or posing a threat of damage where requested.

- The WS' Decision Model, designed to identify the most appropriate damage management strategies and their impacts, would be used to determine strategies for resolving predator damage.

- Preference would be given to non-lethal methods when practical and effective.

Issue 2 - Effects on Non-target Species Populations, Including T&E Species

- Personnel would be experienced and trained to select the most appropriate method(s) for addressing target animals and avoiding risks to non-target species.

- When conducting removal operations via shooting, identification of the target would occur prior to application.

- As appropriate, suppressed firearms would be used to minimize noise impacts.

- Personnel would use lures, trap placements, and capture devices that would be strategically placed at locations likely to capture a target animal and minimize the potential of non-target animal captures.

- Any non-target animals captured in cage traps, nets, or any other restraining device would be released whenever it is possible and safe to do so.

- Personnel would monitor live-capture methods and would check traps in accordance with Texas laws and regulations. This would help ensure non-target species were released in a timely manner or were prevented from being captured.

- Traps and snares would not be set within 30 feet of exposed carcasses that are used to attract predators to prevent the capture of scavenging birds, such as bald eagles. The only exception would be the use of foot snares to capture mountain lions. Because of the weight of the mountain lion, the tension adjustments to trigger a foot snare can be set to exclude the capture of smaller non-target animals, such as scavenging birds.

- Foot snare triggers and foothold trap underpan-tension devices would be used by personnel, as appropriate, to reduce the capture of non-target wildlife that weigh less than the target species. The TWSP will also use pan-tension devices on foothold traps to minimize the potential for capturing a lesser prairie chicken. Small predators will be captured in cage traps where necessary.

- Breakaway snares, designed to break open and release when tension is exerted by a larger non-target animal, such as deer, antelope, or livestock, have been developed and are being refined. Snares using breakaway locks would be implemented by personnel, as appropriate.

- Pilots conducting aerial operations would abide by the WS Aviation Policy Manual and Federal Aviation Regulations. Non-target wildlife would not be pursued and when seen would be avoided, whenever possible.

- Carcasses of predators retrieved after damage management activities have been conducted would be disposed of in accordance with WS Directive 2.515.

- The TWSP has consulted with the USFWS to evaluate activities to resolve predator damage and threats to ensure the protection of T&E species.

- Personnel would abide by all Reasonable and Prudent Measures and Alternatives and Terms and Conditions of the most current Biological Opinion or Conference Opinion issued by the USFWS regarding a T&E species listed in the Fort Worth District.

- Projects that would be conducted in known habitat of T&E or sensitive species, the TWSP would determine the potential to affect such species and discuss potential impacts with the appropriate agency, such as the USFWS and/or the TPWD.

- The TWSP would monitor activities conducted under the selected alternative, if activities were determined to have no significant impact on the environment and an EIS was not required, to ensure those activities do not negatively impact non-target species.

- The TWSP would enter data into the Texas Natural Diversity Database regarding Species of Greatest Conservation Needs (as determined by the TPWD) encountered during program services, consistent with landowner privacy interests, when feasible.

- The TWSP would report lethal and non-lethal take of Species of Greatest Conservation Needs to the TPWD annually.

- The TWSP would consider the release of target and non-target Species of Greatest Conservation Needs, consistent with WS' policies and directives where such release would not compromise management objectives and would be consistent with other state laws and regulations (*e.g.*, movement of animals to prevent rabies).

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

- Damage management activities would be conducted professionally and in the safest manner possible. Whenever possible, damage management activities would be conducted away from areas of high human activity. If this were not possible, then activities would be conducted during periods when human activity is low (*e.g.*, early morning).

- Shooting would be conducted during times when public activity and access to the control areas were restricted. Personnel involved in shooting operations would be fully trained in the proper and safe application of this method.

- All personnel employing chemical methods would be properly trained and certified in the use of those chemicals. All chemicals used by the TWSP would be securely stored and properly monitored to ensure the safety of the public. Use of chemicals and training requirements to use those chemicals are outlined in WS Directive 2.401 and WS Directive 2.430.

- All chemical methods used by the TWSP or recommended by the TWSP would be registered with the EPA, the United States Drug Enforcement Agency, United States Food and Drug Administration and/or the TDA, as appropriate.

- M-44 devices would only be used by those personnel trained to properly place and set those devices. Only those personnel who receive state certification from the TDA to use sodium cyanide would be allowed to place and set M-44 devices. Personnel would use M-44 devices in accordance with TDA and EPA regulations and label restrictions.

- Conspicuous, bilingual warning signs alerting people to the presence of traps, snares, and M-44 devices would be placed at major access points to the property where those methods were used.

- TWSP would adhere to all established withdrawal times for predators when using immobilizing drugs for the capture of predators that are agreed upon by the TWSP, the TPWD, and veterinarian authorities. Although unlikely, in the event that the TWSP was requested to immobilize predators, during a time when harvest of those species was occurring or during a time where the withdrawal period could overlap with the start of a harvest season, the TWSP would euthanize the animal or mark the animal with a tag. Tags would be labeled with a "*do not eat*" warning and appropriate contact information.

- Carcasses of predators retrieved after damage management activities would be disposed of in accordance with WS Directive 2.515.

Issue 4 - Effects of Damage Management Activities on Recreational Activities

- Damage management activities would only be conducted when requested by the appropriate property owner or land manager. Activities conducted to alleviate damage or threats of damage would occur in accordance with MOUs, Work Initiation Documents, or other comparable documents signed between the TWSP and the entity requesting assistance, including all enacted rules and regulations that are applicable to the TWSP.

- Personnel would comply with applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210 when conducting activities on public and private lands.

- Public land managing agencies would be responsible for reviewing any Work Plans signed between the TWSP and the agency for consistency with other Plans, including any special rules or regulations governing the public lands covered in the Work Plans.

- On public lands, vehicle access would be limited to existing roads, unless off-road travel is specifically allowed by the land managing agency.

- Management actions to reduce or prevent damage caused by predators would be directed toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.

Issue 5 - Humaneness and Animal Welfare Concerns of Method

- Personnel would be well trained in the latest and most humane devices/methods for removing target predators causing damage.

- Personnel would check methods frequently to ensure predators captured would be addressed in a timely manner to minimize the stress of being restrained.

- When deemed appropriate using the WS' Decision Model, WS' use of lethal methods would comply with WS' directives (WS Directive 2.505, WS Directive 2.430).

- The NWRC is continually conducting research to improve the selectivity and humaneness of wildlife damage management devices used by personnel in the field.

- The use of non-lethal methods would be considered prior to the use of lethal methods when managing predator damage.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions when selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as that alternative relates to the issues identified. The following resource values in the Fort Worth District are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, critical habitats (areas listed in T&E species recovery plans), visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions, including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders, including the Clean Air Act and Executive Order 13514.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

This section analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. Therefore, the proposed action alternative (Alternative 2) serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The analysis also takes into consideration mandates, directives, and the procedures of the TWSP.

Issue 1 - Effects of Damage Management Activities on Target Predator Populations

A common issue is whether damage management actions would adversely affect the populations of target predator species, especially when lethal methods were employed. The analysis for magnitude of impact from lethal removal can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. Information on predator populations and trends are often derived from several sources, including published literature and harvest data.

Methods available to address predator damage or threats of damage in the Fort Worth District that would be available for use or recommendation under Alternative 1 (no action alternative), Alternative 2 (proposed action alternative), and Alternative 4 (technical assistance only alternative) would either be lethal methods or non-lethal methods. Those same methods would also be available to other entities under Alternative 3 (no involvement by WS alternative) and Alternative 5 (use of non-lethal methods only by WS). Under Alternative 4, the WS program could recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance. Alternative 1 and Alternative 2 would address requests for assistance received by the TWSP through technical and/or operational assistance where an integrated approach to methods would be employed and/or recommended. Non-lethal methods that would be available would include, but would not be limited to, habitat behavior modification, pyrotechnics, visual deterrents, cage traps, foothold traps, padded foothold traps, foot snares, translocation, exclusionary devices, tracking dogs, decoy dogs, frightening devices, net guns, immobilizing drugs, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods).

Non-lethal methods that would be available under all of the alternatives can disperse or otherwise make an area unattractive to predators causing damage; thereby, reducing the presence of those predators at the site and potentially the immediate area around the site where non-lethal methods were employed. Non-lethal methods would be given priority by the TWSP when addressing requests for assistance under Alternative 1, Alternative 2, Alternative 4, and Alternative 5 (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed or recommended to resolve every request for assistance if deemed inappropriate by personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already used non-lethal methods, the TWSP would not likely recommend or continue to employ those particular methods since their use had already been proven ineffective in adequately resolving the damage or threat.

Many non-lethal methods would be used to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse or exclude predators from the area resulting in a reduction in the presence of those predators at the site where those methods were employed. However, predators responsible for causing damage or threats could be dispersed to other areas with minimal impact on those species' populations. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. The use of non-lethal methods would not have adverse impacts on predator populations in the Fort Worth District under any of the alternatives.

The continued use of many non-lethal methods can often lead to the habituation of predators to those methods, which can decrease the effectiveness of those methods. For any management methods employed, the proper timing would be essential in effectively dispersing those predators causing damage. Employing methods soon after damage begins or soon after threats were identified would increase the likelihood that those damage management activities would achieve success in addressing damage. Therefore, the coordination and timing of methods would be necessary to be effective in achieving expedient resolution of predator damage.

Lethal methods would also be available for use under all the alternatives by the TWSP and/or by other entities. Lethal methods that would be available to address predator damage include live-capture followed by euthanasia, firearms, shooting from aircraft, calling and shooting, neck snares, body-gripping traps, gas cartridges, cable restraints, M-44s (sodium cyanide), Livestock Protection Collars (LPCs; sodium fluoroacetate), and the recommendation of harvest during hunting and/or trapping, where appropriate.

When live-captured target animals were to be euthanized under Alternative 1 and Alternative 2, euthanasia would occur pursuant to WS Directive 2.505 and WS Directive 2.430. Under alternative 4, the WS program would recommend the use of methods to euthanize live-captured or restrained target animals in accordance with WS Directive 2.505. No assistance would be provided by the WS program under Alternative 3 and only non-lethal methods would be recommended or employed by WS under Alternative

5; however, many of those methods available to euthanize live-captured or restrained animals would continue to be available for use by other entities under Alternative 3 and Alternative 5.

The use of lethal methods by any entity could result in local population reductions in the area where damage or threats were occurring since target individuals would be removed from the population. Lethal methods could be employed or recommended to remove predators that have been identified as causing damage or posing a threat to human safety. Therefore, the use of lethal methods could result in local reductions of predators in the area where damage or threats were occurring. The number of predators removed from the population annually by the TWSP using lethal methods under Alternative 1 and Alternative 2 would be dependent on the number of requests for assistance received, the number of predators involved with the associated damage or threat, and the efficacy of methods employed. The number of predators removed by the TWSP without involvement by the WS program and other entities under Alternative 3 would be unknown but would likely be similar to the removal that could occur under Alternative 1 and Alternative 2. The TWSP without involvement by the WS program could continue to use all available methods to manage predator damage under Alternative 4 and Alternative 5.

Most lethal methods would be employed to reduce the number of predators present at a location since a reduction in the number of predators at a location could lead to a reduction in damage, which would be applicable whether using lethal or non-lethal methods. The intent of non-lethal methods would be to harass, exclude, or otherwise make an area unattractive to predators, which disperses those predators to other areas leading to a reduction in damage at the location where those predators were dispersed. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to reduce the number of predators in the area where damage was occurring; thereby, reducing the damage occurring at that location.

Often of concern with the use of lethal methods is that predators that were lethally removed would only be replaced by other predators either during the application of those methods (*e.g.*, predators that relocate into the area) or by predators the following year (*e.g.*, increase in reproduction and survivability that could result from less competition). As stated previously, the TWSP would not use lethal methods during direct operational assistance as population management tools over broad areas. Lethal methods would be employed under Alternative 1 to reduce the number of target animals present at a location where damage was occurring by targeting those animals causing damage or posing threats. The return of predators to areas where methods were previously employed does not indicate previous use of those methods were ineffective since the intent of those methods were to reduce the number of predators present at a site where predation was occurring or could occur at the time those methods were employed.

To adequately determine the magnitude of impacts in relation to predators and their populations, data and known cumulative lethal removal of predators will be analyzed. The authority for management of resident wildlife species has traditionally been a responsibility left to the states. The Texas A&M AgriLife Extension Service is the state agency that manages damage caused by resident predatory wildlife. The TPWD is the state agency with hunting and sport trapping management responsibility for animals classified by state law as protected game or furbearers. The TPWD provided statistics on harvest for many species and population estimates of some species for Texas. Since population estimates are not available for all species and may not have included all of the range for a species, the TWSP used the best available information to produce reasonable, but conservative population estimates to determine the relative impacts of the alternatives on a species population.

When considering the potential effects on a wildlife population, the analysis must consider the status quo for the environment. The states have the authority to manage populations of resident wildlife species with the exception of migratory birds and T&E species as they see fit without oversight or control by federal agencies. Management direction for a given species can vary among states, and state management actions are not subject to compliance with the NEPA. Therefore, the status quo for the environment with respect to state-managed wildlife species is the management direction established by the states. Federal actions that are in accordance with state management have no effect on the status quo. Wildlife populations are typically dynamic and can fluctuate without harvest or control by people. Therefore, the status quo for wildlife populations is fluctuation, both within and among years, which may affect perceptions of the significance of the human impact on such populations.

Maintaining viable populations of all native species is a concern of the public and of biologists within state, tribal, and federal wildlife and land management agencies, including the TWSP. The GAO (1990) analyzed the effects damage management activities conducted by the WS program on predators in the western United States and determined that WS' activities had no overall effect on predator populations. Several species' populations have steadily increased over the past several years due to the adaptability of those wildlife species to human-made environments, and damage from those species has increased accordingly (International Association of Fish and Wildlife Agencies 2004). To address those concerns, the effects of the alternatives on populations for each target species are examined. To fully understand the need for damage management, it is important to have knowledge about the species that cause damage and the likelihood of damage. Full accounts of life histories for these species can be found in mammal reference books. Some background information is given here for the predator species in Texas covered by this EA, especially information pertaining to their range in the Fort Worth District. The species are discussed in order of efforts directed toward them, their subsequent lethal removal, and the occurrence and value of damage that the species cause in the Fort Worth District. Some of the species are combined with other similar species, such as skunks and fox because life history or damage is usually similar. Finally, it should be noted that jurisdiction and management of these species mostly lies with the TPWD, which was discussed in Section 1.1 and Section 1.5. Additionally, most of the predators addressed in this EA could be harvested in Texas by hunters and trappers afield.

Previously, the TWSP data was matched with harvest data from the TPWD to determine statewide population levels. However, the TPWD discontinued their furbearing animal report that provided harvest data citing that the long-term sustained decline in trapping and fur dealer licenses, low rate of survey return, and resulting high degree of variance in confidence intervals, did not allow enough precision to make accurate harvest estimates. Therefore, it should be noted that while the TWSP makes every effort to determine a realistic population estimate for each species, these are only estimates because data is unavailable or incomplete to make precise estimates. The population estimates used is for the breeding population and thought to be very conservative.

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action)

Under the current program alternative, the lethal removal of predators by the TWSP and others would be considered district-wide providing a more comprehensive evaluation of potential impacts to predators.

The Texas A&M AgriLife Extension Service has been given the authority to manage damage caused by predatory wildlife under the State's system of representative government. The TPWD has been given management authority over resident wildlife via the State's system of representative government. That system was established to represent the collective desires of the people of the State of Texas with respect to the management of certain wildlife species. In this way, the State determines its desires for that component of the human environment, which is comprised of resident wildlife species. The TWSP recognizes and honors the right of the State of Texas to manage resident wildlife species. The TWSP therefore has a policy of abiding by applicable state laws and works cooperatively with the State's wildlife management agencies to assure potential effects associated with damage management activities conducted by the TWSP on resident wildlife species occur within those desired by the State.

Damage management activities would target specific species and the potential cumulative effects on populations of those species because of damage management activities and other actions are analyzed to determine the relative significance of impacts. In addition, management direction from the responsible agency is a determining factor. For example, the TPWD may want to reduce a specific predator population. A declining population of a resident wildlife species does not necessarily equate to a significant impact as defined by the NEPA if the decline was condoned or desired by the state management agency representing the people that live in the affected human population. It is reasonable and proper to rely on the representative form of government within a state as the established mechanism for determining the collective desires or endorsements of the people of a state. The TWSP abides by this philosophy and defers to the collective desires of the people of the State of Texas by complying with applicable state laws and regulations that govern the take or lethal removal of resident wildlife.

A viable population can exist at many levels between one that is at carrying capacity (*i.e*., the maximum number of a species that a particular habitat can support) and one that is at only a fraction of carrying capacity. Because rates of increase are generally density dependent (*i.e*., the population grows at a faster rate as the population is reduced in relation to carrying capacity), predator populations have the ability to recover from declines. History has born this out by the fact that efforts in the early half of the 20th century to eradicate some of the predator species being discussed (*i.e*., coyotes and mountain lions) failed to do so. However, the larger predators' numbers were most likely reduced substantially (Evans 1983). Density dependent rates of increase are a built-in mechanism of most wildlife populations that serve to reduce effects of population reductions whether by harvest, localized control, or non-man-induced mortality. This provides additional assurance that a viable population would be maintained in the Fort Worth District, even if a sustainable harvest rate were exceeded in the short term in areas where the objective is to maintain the population.

The methods used by the TWSP to lethal removal target predators under the current program are the same as those that have been used in recent years and were described in Appendix B. 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. The TWSP has previously received requests for assistance primarily associated with ten predator species in the Fort Worth District (see Table 1 and Table 2 in Chapter 1). The primary target species addressed yearly in the Fort Worth District are bobcats, feral cats, coyotes, feral dogs, gray fox, red fox, mountain lions, Virginia opossum, raccoons, and striped skunks. Most of the other target predators are addressed by the TWSP infrequently.

The target predators addressed from FY 2009 to FY 2011 in the Fort Worth District by the TWSP pursuant to the current program alternative are presented in Table 4. Most requests for assistance have been associated with coyotes in the District. From FY 2009 through FY 2011, nearly 93% of the target animals addressed by the TWSP in the District were coyotes. The TWSP also received requests for direct operational assistance to manage damage or threats of damage associated with bobcats, red fox, gray fox, feral dogs, raccoons, striped skunks, and Virginia opossum in the District. Although the TWSP did not receive requests for direct operational assistance associated with mountain lions, feral cats, hooded skunks, hog-nosed skunks, and spotted skunks in the District from FY 2009 through FY 2011, the TWSP could receive requests to provide direct assistance associated with those species.

Table 4 – TWSP' Lethal Removal of Predator Species in the Fort Worth District, FY 2009 – FY 2011

SPECIES	Fiscal Year and Fate of Target Animal						AVERAGE	
	FY 2009		FY 2010		FY 2011			
	Killed	Freed	Killed	Freed	Killed	Freed	Killed	Freed
Coyote	2,137	-	2,259	-	3,063	-	**2,486**	**-**
Bobcat	27	-	22	-	26	-	**25**	**-**
Red Fox	7	-	6	-	10	-	**8**	**-**
Gray Fox	25	-	26	-	33	-	**28**	**-**
Feral Dog	4	-	23	-	20	-	**16**	**-**
Raccoon	33	3	34	-	157	-	**75**	**1**
Striped Skunk	18	-	22	-	64	-	**35**	**-**
Virginia Opossum	5	-	2	-	20	-	**9**	**-**

The potential impacts on the populations of target predator species from the implementation of the current program are analyzed for each species below.

COYOTE POPULATION IMPACT ANALYSIS

Coyotes are classified as a predator by the TPWD in Texas and can be lethally removed year-round, though a limited season could be established at some time in the future. Of the predator species in the Fort Worth District, the reports by the NASS (2001, 2005) show coyotes likely kill the majority of livestock. Therefore, managing damage caused by coyotes is a major focus of efforts by the TWSP in the Fort Worth District. From FY 2009 through FY 2011, coyotes were responsible for an average of $289,700 in damages per year to livestock, crops, pets, zoo animals, and property reported to or verified by the TWSP. The TWSP in the District documented an average of 397 damage occurrences and 93 threat occurrences per year from FY 2009 to FY 2011. Of all the damage and threat occurrences associated with predators in the District, coyotes averaged 79% of all mammalian predator occurrences from FY 2009 to FY 2011. Of all the predator damage to livestock, coyotes caused the highest average monetary losses. Coyotes killed or injured an average of 2,670 livestock annually from FY 2009 to FY 2011.

Coyotes were once found only in western states, but have expanded their range in recent history to much of North America because of changes in habitat, loss of wolves throughout much of their historic range, and possible introductions into other parts of the country where they were previously not found (Bekoff and Wells 1982, Voigt and Berg 1999). However, coyotes were effectively eliminated by 1950 in the Edwards Plateau region and remained so up until the 1960s (Nunley 1995). Thus, the status quo for the human environment in the Edwards Plateau portion of the District for many years was an ecosystem with a very low coyote population. Coyote numbers have increased in the Edwards Plateau since 1960 and are once again fairly common in the region and in the District (Nunley 1995). To discuss the impacts of various environmental constraints and external factors on coyote populations and density, it is essential to understand the basic mechanisms that play a role in the coyote's response to constraints and actions. This species is often characterized by wildlife biologists as having a unique resilience to change because they have a strong ability to adapt to adverse conditions and persevere. Habitat changes that have occurred over the last two hundred years have often favored this species.

Determinations of absolute densities for coyote populations are frequently limited to educated guesses (Knowlton 1972). Coyotes are highly mobile animals with home ranges (territories) that vary seasonally and with the sex, age, and breeding status of the animal (Todd and Keith 1976, Althoff 1978, Pyrah 1984). The literature on coyote spatial organization varies (Messier and Barrette 1982, Windberg and Knowlton 1988). Coyote home ranges may vary from 2.0 mi^2 to 21.3 mi^2 (Andelt and Gipson 1979, Gese et al.1988)[16]. Ozoga and Harger (1966), Edwards (1975), and Danner (1976), though, observed a wide overlap between coyote home range and did not consider coyotes territorial. Each occupied coyote territory may have several nonbreeding helpers at the den during whelping (Allen et al. 1987, Bekoff and Wells 1982). Therefore, each defended coyote territory may have more than just a pair of coyotes. Messier and Barrette (1982) reported that from November through April, 35% of the coyotes were in groups of three to five animals and Gese et al. (1988) reported that coyote groups of 2, 3, 4, and 5 comprised 40%, 37%, 10% and 6% of the resident population, respectively. The presence of unusual food concentrations and nonbreeding helpers at the den can influence coyote densities, and complicate any effort to estimate abundance (Danner and Smith 1980). A positive relationship was established between coyote densities in mid-late winter and the availability of dead livestock (Roy and Dorrance 1985).

Many authors have estimated coyote populations throughout the West and elsewhere (Clark 1972, Knowlton 1972, Camenzind 1978, USFWS 1979, Pyrah 1984, Andelt 1985). Coyote population densities can vary depending on the time of year, food abundance, and habitat. Coyote densities in some studies have ranged from a low of 0.4/mi^2 prior to whelping when populations were low (just prior to the annual period of pup birth) and a high of 3.6 to 5.0 coyotes/mi^2 when populations were high (just after the period of pup birth) (Pyrah 1984, Knowlton 1972). Texas has relatively high densities of coyotes. In general, coyote populations decrease as you travel north in the 13 western states averaging 149 visits/1,000 scent posts in the southern tier of western states, 114/1,000 in central tier of western states, and 83/1,000 in the northwestern tier of states (Knowlton and Stoddart 1983). Coyote densities as high as 5/mi^2 have been reported in the Southwest (Voigt and Berg 1999). Knowlton (1972) estimated coyote densities across the western United States to be an average of 0.5 to 1.0 per square mile over a large portion of the coyote's range. Coyote densities for Texas have been estimated to be 246.2 to 278.3 acres per animal (2.3 to 2.6 coyotes/mi^2) in South Texas and 640 acres per animal (1.0/mi^2) in the Trans Pecos area of the State (TPWD 1993*a*).

The Pineywoods, Post Oak Savannah, Blackland Prairies, and Cross Timbers and Prairies are the primary ecological regions found in the Fort Worth District. Field surveys by the TPWD (1993*a*) indicated moderate coyote densities in the Post Oak Savannah and the Cross Timbers and Prairies regions while low coyote densities were found in the Pineywoods region. Of all the ecoregions in the State, coyote numbers found in the Blackland Prairies region were the second highest densities observed in the State (TPWD 1993*a*). Observations of coyote sign by TWSP personnel indicate densities across the District are moderate on the average, which means densities probably average at least 1.0 coyote per mi^2. Population estimates made by field observations, when based on experience, knowledge of the species being estimated, and intuition, may provide estimates as accurate as those estimates based on more scientific methods (Fritzell 1987). Thus, it is reasonable to conclude that coyote densities conservatively average at least 1.0 coyote per mi^2 in the District, which indicates a population of 42,813 coyotes.

A population model developed by Pitt et al. (2001) assessed the impact of removing a set proportion of the coyote population in one year and then allowing the population to recover (referred to as pulse removal). In the model, all populations recovered within 1 year when <60% of the population was removed. The population recovered within 5 years when 60 to 90% of the population was removed. Pitt et al. (2001) stated that actual coyote populations would recover even more quickly than the model indicated, because the model assumed coyote territories were retained even at low densities, that animals

[16] All literature citations reported in km^2 have been converted to mi^2 for reader convenience and to maintain consistency.

would not move out of their territories to mate, and that animals were not allowed to move in from surrounding areas (no immigration), which all would occur in the natural environment. The model also did not allow for a reduction in natural mortality rates at low population densities. Pitt et al. (2001) also evaluated the impact of removing a set proportion of the population every year for 50 years (sustained removal). When the removal rate was <60% of the population, the population size was the same as for an unexploited population. However, a shift in population structure was noted.

For example, the population with 50% removal had fewer transient animals, a younger age structure, and higher reproduction. Sustained removal rates of >70% of the population resulted in removal of the entire population after 7 years, but the authors acknowledged that annual removal of 70% of the population would become increasingly difficult at low densities. Because of the model limitations described above for pulse removal, natural populations are probably able to withstand greater levels of harvest than indicated by Pitt et al. (2001). These findings are consistent with an earlier model developed by Connolly and Longhurst (1975), and revisited by Connolly (1995) that indicated coyote populations could withstand an annual removal of up to 70% of their numbers and still maintain a viable population. This conclusion is consistent with the GAO (1990) assessment that impacts on coyote populations in the western United States by the WS program could result in rapid occupancy of vacant territories (Windberg and Knowlton 1988). While removing animals from small areas at the appropriate time can protect vulnerable livestock from predation, immigration of coyotes from the surrounding area can quickly replace the animals removed (Stoddart 1984). Connolly (1978) noted that coyotes have survived and even thrived in spite of early 20th century efforts to exterminate them.

In the Fort Worth District, the TWSP lethally removed an average of 2,486 coyotes annually from FY 2009 to FY2011, which represented about 6% of the estimated coyote population in the District (see Table 5). The highest annual removal by the TWSP between FY 2009 and FY 2011 occurred in FY 2011 when the TWSP removed 3,063 coyotes, which represented 7% of the estimated population in the District. In addition, personnel of the TWSP also lethally removed coyotes unintentionally during activities targeting other animals. From FY 2009 through FY 2011, the TWSP removed an average of seven coyotes per year in the District as unintentional non-targets with the highest annual removal occurring during FY 2011 when 18 coyotes were lethally removed unintentionally by the TWSP in the District. The number of coyotes harvested during the hunting and trapping season or removed by other entities to alleviate damage is unknown. However, the annual harvest in the District would have to increase by 23,202 additional coyotes on average or 54% of the coyote population before a sustainable long-term harvest threshold of 60% would be met. Harvest levels would have to increase even higher before a decline in the population would be seen.

Table 5 - Coyote removal in the Fort Worth District by the TWSP from FY 2009 to FY 2011

	FISCAL YEAR			
	FY 2009	**FY 2010**	**FY 2011**	**AVERAGE**
Est. Statewide Population	336,848	336,848	336,848	**336,848**
Est. District Population	42,813	42,813	42,813	**42,813**
TWSP Statewide Removal	20,638	19,213	20,210	**20,020**
TWSP District Removal	2,137	2,259	3,063	**2,486**
TWSP Statewide Removal - % of Statewide Population	6%	6%	6%	**6%**
TWSP District Removal - % of District Population	5%	5%	7%	**6%**
Long-term Sustainable Harvest Level	**60%**	**60%**	**60%**	**60%**

Based on this information, the potential impact on the coyote population in the Fort Worth District of Texas by the TWSP would not affect the general coyote population because the total lethal removal of coyotes in the area is currently far less than 60% of the estimated population. The analysis further suggests annual coyote removal could conservatively be increased substantially before the short-term 70% allowable harvest level would be reached. Therefore, it is reasonable to conclude that impacts on the coyote population within the Fort Worth District, in general, are not substantial and would remain so even if lethal damage management efforts by the TWSP were increased. The TWSP expects the annual lethal removal of coyotes in the District to remain similar to previous years.

FERAL DOG POPULATION IMPACT ANALYSIS

Feral (wild) and free-roaming dogs are somewhat common in Texas and damage associated with dogs can be extensive. Domestic dogs kill or injure livestock and poultry, and present a problem for human health and safety (*e.g.*, attacks and disease threats). From FY 2009 to FY 2011, the TWSP documented an average of 13 damage or threat occurrences per year associated with dogs in the District. Most of the damage or threat occurrences were associated with agricultural resources, primarily livestock. Feral dogs killed 48 head of livestock between FY 2009 and FY 2011 and caused $24,000 in livestock losses. Free-roaming dogs also prey on native wildlife, such as deer and upland game. Primary responsibility for dog control rests with county and municipal authorities or the resource owner/manager. Efforts to address damage associated with feral and free-roaming dogs would be conducted in accordance with TWSP Policy 2.325-TX for controlling dogs. Feral dogs are not part of the native environment, and when left abandoned in the wild, feral dogs are often considered ecological concerns because they can prey on native wildlife. The estimated dog population in the United States is 74.8 million in 44.8 million homes (American Pet Products Manufacturers Association 2008). However, an unknown percentage of those animals have become wild (Bergman 2009).

Requests for help with feral dogs are approved by the appropriate state or local agency as regulated by Texas state and local laws. In response to damage and threat occurrences involving dogs, the TWSP removed an average of 16 target feral dogs from FY 2009 to FY 2011, with the highest annual removal occurring in FY 2010 when 23 feral dogs were removed intentionally (see Table 4). The TWSP also unintentionally lethally removed 11 feral dogs during other damage management activities conducted from FY 2009 and FY 2011. The lethal removal of feral or free-ranging dogs by the TWSP is considered to have little impact on the human environment since dogs are not an indigenous component of ecosystems in the Fort Worth District. In addition, the annual removal of dogs by TWSP is minor in comparison to the thousands killed by animal control and humane organizations in Texas each year. The TWSP addresses feral and free-roaming dogs at the request of the local authority for animal control and, thus, this action would likely occur in the absence of involvement by the TWSP. The TWSP expects the annual lethal removal of feral and free-roaming dogs in the District to remain similar to previous years.

MOUNTAIN LION POPULATION IMPACT ANALYSIS

Between FY 2009 and FY 2011, the TWSP responded to 17 damage occurrences in the District associated with mountain involving agricultural resources, property, and natural resources. In addition, the TWSP responded to 17 threat occurrences in the District associated with mountain lions involving agricultural resources, property, human safety, and natural resources. Most requests for assistance associated with mountain lions in the District involve livestock predation. From FY 2009 through FY 2011, the TWSP verified or agricultural producers reported nearly $19,200 in losses to livestock in the District associated with mountain lions (see Table 3). Livestock losses attributed to mountain lions occurred to cattle and other hooved animals.

Mountain lions have an extensive distribution across western North America including portions of Texas (Young 2009). This species is known by several other names including panther, puma, catamount, and cougar. Mountain lions inhabit many habitat types in Texas from desert to mountain environments, indicating a wide range of adaptability. They are closely associated with deer, elk, javelina, and other large hoofed mammal herds because they rely on these species for food. For example, analysis of 159 mountain lion scats collected in southwestern Arizona from 1987 to 1990 resulted in observation of mule deer remains in 39% of the samples, collared peccaries 25%, cattle 13%, mountain sheep 7%, small rodents 8%, lagomorphs 8%, badgers 5%, skunks 4%, raccoons 2%, porcupines (*Erethizon dorsatum*) 2%, beetles 2%, mountain lion 1%, bobcat 1%, canidae 1%, gila monster (*Heloderma suspectum*) 1%, and chuckwalla (*Sauromalus obesus*) (trace) (Cashman et al. 1992).

Mountain lion densities, based on a variety of population estimating techniques, range from a low of about 1 mountain lion per 100 mi^2 (McBride 1976, Hemker et al. 1984) to a high of 24 mountain lions per 100 mi^2 (Johnson and Strickland 1992). The average density estimate for western states was estimated at 7.5 mountain lions per 100 mi^2 (Johnson and Strickland 1992). Cunningham et al. (1995) determined that mountain lion densities were about 75% higher in the portion of their study area that was subject to greater depredation control and sport hunting. Their estimates of density ranged from 4 to 7 mountain lions per 100 mi^2. However, studies that followed mountain lions for at least 12 months found that densities ranged from 0.013 to 0.13 mountain lions per mi^2 (Lindzey 1999).

Schmidly (2004) stated mountain lions were once distributed across Texas but are now known only in desert mountain ranges in the Trans-Pecos, parts of the Edwards Plateau, and in the Rio Grande Plains. Research on mountain lion populations in Texas has been sporadic with few studies resulting in published data (Harveson et al. 1996, Harveson et al. 1999, Harveson et al. 2000, Pittman et al. 2000, Walker et al. 2000). Population density estimates for South Texas ranged from 0.59 to 0.74 mountain lions per 100 km^2 (1.53 to 1.92 per 100 mi^2) and in the Trans-Pecos from 0.26 to 0.59 mountain lions per 100 km^2 (0.67 to 1.53 per 100 mi^2), respectively (Harveson 1997, Pittman et al. 2000). The population estimated given by Young (2008) in Texas is comparable to estimates for mountain lions in Wyoming (n = 4,532) (Anderson et al. 2004) and Utah (n = 5,732) (Sinclair et al. 2001). Mountain lions outside of the known populations in the Trans-Pecos, parts of the Edwards Plateau, and the Rio Grande Plains of south Texas are considered dispersers, or transient.

Sweanor et al. (2000), in an unexploited population, found that 68% of female recruits came from the local population and an equal or slightly greater proportion of male recruits were immigrants. Home range size for female mountain lions averaged 143 km^2 (55 mi^2) and 307 km^2 (119 mi^2) for male home ranges (Seidensticker et al. 1973, Murphy 1983, Anderson et al. 1992, Ross and Jalkotzy 1992, Spreadbury et al. 1996, Logan and Sweanor 2001). Female home ranges are thought to be based on prey availability, while male home ranges are based on female availability, with breeding opportunities set by the number of females a male's home range overlaps (Ross and Jalkotzy 1992, Murphy 1998).

Young (2008) reported the long-term effective mountain lion population in Texas to be 5,607 animals, which exceeds the 500 lions proposed as the minimum effective population size (Franklin 1980) for long-term population viability. While data from Young (2008) represents the best available scientific and commercial data, the use of those data, derived from genetic analysis, overstates the current population in Texas. Because mountain lions are a widely dispersing species, the genetic population does not reflect the resident population. WS recognizes that genetic contributions contained within the Texas population may be from mountain lions outside of the State.

Ultimately, managers need to understand how environmental conditions (*i.e.*, hunting, immigration, emigration and survival) affect population dynamics. Research has shown that mountain lion populations have a high level of resiliency and can recover quickly following cessation of exploitation or reduced harvest levels, and juvenile and subadult dispersal is common (Lindzey et al. 1992, Logan and Sweanor 2001, Anderson and Lindzey 2005, Robinson and DeSimone 2011).

To refine the population estimate for the State better, WS mapped areas with known breeding mountain lion populations in west Texas. Lions are known to be established in 72,066 km^2 (27,825 mi^2) in the Trans-Pecos. Logan and Sweanor (2001) reported adult populations of 1.16 to 2.10 mountain lions per 100 km^2 (3.01 to 5.44 per 100 mi^2) on their study site in southern New Mexico during the pre-treatment years of the study and 0.84 to 1.99 mountain lions per 100 km^2 (2.18 to 5.16 per 100 mi^2) during the post treatment years. The New Mexico study site used by Logan and Sweanor (2001) was contained wholly in the Chihuahuan Desert ecoregion and is representative of far west portions of the Trans-Pecos, but has less prey than most of the Texas Trans-Pecos. When considering all lions within the population, Logan and Sweanor (2001) reported densities of 2.01 to 3.91 mountain lions per 100 km^2 (5.21 to 10.13 per 100 mi^2) pre-treatment and 2.78 to 4.25 mountain lions per 100 km^2 (7.20 to 11.01 per 100 mi^2) post-treatment. Using extremely conservative population estimates of one adult mountain lion per 100 km^2 (2.59 per 100 mi^2), the adult population would be estimated at 720 mountain lions. Again, using extremely conservative population estimates of 2.5 mountain lions per 100 km^2 (6.48 per 100 mi^2) the overall lion population would be estimated at 1,800 mountain lions.

Request for assistance involving mountain lions are primarily associated with predation or the threat of predation on natural resources, livestock, and pets. Mountain lions were responsible for killing 27 head of livestock valued at $19,200 between FY 2009 and FY 2011 in the District. The cumulative impact of mountain lion harvest would include removal by the TWSP and other human caused mortalities. There are no known established, breeding populations of mountain lions in the Fort Worth District and no lethal removal of mountain lions by the TWSP occurred in this District. WS is unaware of other mountain lion mortality within the District. Any mountain lion in the Fort Worth District is likely a transient and, by definition, a nonbreeding individual.

On a statewide basis, WS removal of mountain lions averages 30.6 per year. Some of those individuals are dispersing sub-adults and nonbreeding individuals. In Texas, the mountain lion is not managed as a big game species and harvest is unrestricted. There is no mandatory reporting of mountain lion mortality in Texas. WS is aware of private mountain lion hunting and trapping in several areas and has queried the known trappers and hunters to estimate the number of non-WS lions removed. Based on our queries and rumored lion take, WS estimates that an additional 80 to 110 mountain lions are intentionally targeted. Incidental lethal removal by deer hunters or landowners may total another 20 per year (many of these are transients in areas not occupied by breeding mountain lions). Cumulatively, WS estimates total lethal removal of about 130 to 160 mountain lions in any one year in Texas.

Because mountain lion harvest in Texas does not target adult animals and many of the animals lethally removed are subadults, impacts to populations should be evaluated on the overall population as a whole. WS' lethal removal of mountain lions represents 1.7% of a conservatively estimated population of 1,800 individuals. Cumulative lethal removal represents about 7.2 to 8.9% of the conservatively estimated population. Impacts to the breeding population would be expected to be less.

Impacts may also be mitigated through established refugia, which serve as source populations. WS and some private hunter lethal removal seem to bear this out, as numerous mountain lions are lethally removed on or near the International Border. For the west Texas population, refugia exist in three National Parks: Big Bend National Park (801,163 acres), Guadalupe National Park (86,367 acres) and Carlsbad Caverns National Park (46,766 acres). The 520,000-acre Maderas del Carmen biosphere reserve in northern Mexico also serves as a refuge and compliments the Big Bend National Park.

WS does not expect to lethally remove any mountain lions for the protection of livestock in the Fort Worth District. Any mountain lion lethally removed by the TWSP in the District would likely be a transient animal taken for human safety purposes or an incidental capture in equipment set for coyotes. Based on the past history of no mountain lions being lethally removed by the TWSP in the Fort Worth

District, the low magnitude of the statewide removal of mountain lions by the TWSP on the population, and the estimated cumulative take of lions in the State, there would be no impacts under this alternative.

SKUNK POPULATION IMPACT ANALYSES

The striped skunk, hooded skunk, hog-nosed skunk, western spotted skunk, and the eastern spotted skunk are the five species of skunks that inhabit Texas. Texas is the only state where all five types of skunks occur. Those species can be differentiated by their markings. All species of skunks have white on black pelage and have short, stocky legs with long claws on their feet for digging. Their most notable characteristic is the ability to discharge nauseating musk from their paired anal glands. The striped skunk is by far the most common in Texas. It is a large skunk, up to 10 pounds, with two white stripes down its back. The hooded skunk looks similar to a striped skunk but is sleeker, has a longer tail, and generally weighs less. Its pelage also has white stripes, but these can vary from large white stripes to almost none. The hooded skunk gets its name from a ruff of long hair on its upper neck, which distinguishes it from the other skunks. The hog-nosed skunk is similar in size to the striped skunk. It is distinguished by its elongated naked snout. It spends most of its time rooting for food. Hog-nosed skunks typically have one large white stripe down their back. The spotted skunk is the smallest, typically not weighing much more than a pound, and has a number of white spots covering their backs, sides, and head.

Striped skunks are found throughout the United States, including Texas and have expanded their range with the encroachment of people. Spotted skunks, and to lesser extent hog-nosed skunks, will climb to elude danger and search for food. Skunks are found in a variety of habitats including woodlands, grasslands, desert, and chaparral. The striped skunk is mostly associated with farmland and urban areas whereas the others are mostly associated with rocky areas such as in canyons and outcrops, or grasslands (Rosatte 1999). The spotted skunk prefers mountainous areas. Skunks eat a variety of food including small rodents, insects, fruits, and eggs, and sometimes kill poultry. Skunks nest in underground dens, hollow logs, under buildings, and in rock crevices. During the winter, they will go through periods of inactivity, especially while it is bitter cold. They typically are solitary, except they may communally roost in the winter, especially the females, for warmth.

The home range of striped skunks is not sharply defined over space and time, but is altered to accommodate life history requirements such as raising young, winter denning, feeding activities, and dispersal (Rosatte 1999). Home ranges reported averaged between 0.85 to 1.9/mi^2 for striped skunks in rural areas (Houseknecht 1971, Storm 1972, Bjorge et al. 1981, Rosatte and Gunson 1984). The range of skunk densities reported in the literature was from 0.85 to 67/mi^2 (Jones 1939, Ferris and Andrews 1967, Verts 1967, Lynch 1972, Bjorge et al. 1981). Many factors may contribute to the widely differing population densities. Habitat type, food availability, disease, season of the year, and geographic area are only but a few of the reasons (Storm and Tzilkowski 1982).

The hooded skunk is chiefly a low desert animal, but can be found in ponderosa habitat at higher elevations where it seems to prefer rocky slopes, bases of cliffs, or rocky sides of arroyos, and are often found along watercourses. Not much is known about hooded skunks because few studies have been conducted on them (Rosatte 1999). Hog-nosed skunks occur in creosote desert to at least the pine-oak forest, and are most common in warm woodlands, grasslands, and deserts in their preferred habitat of rocky areas for denning (Rosatte 1999). Residential areas and farmlands are classified as secondary habitat (Thompson et al. 1992). Not much is known about hog-nosed skunks because few studies have been conducted on them (Rosatte 1999).

Skunks primarily cause odor problems around homes, potentially transmit diseases, such as rabies to humans and domestic animals, and sometimes prey on poultry and their eggs. Skunks are primarily targeted to reduce those types of damage situations. The TWSP could conduct some damage management activities associated with rabies in skunks, and assist with skunk-rabies research activities. The majority of damage complaints are related to odor in and around residences, which can be displeasing. Most of the complaints are from striped skunks that are commonly found in urban settings, but the other skunk species can also be associated with damage situations. Although skunks usually do not cause considerable damage, the striped skunk is consistently responsible for a high number of requests for assistance in the Fort Worth District. From FY 2009 through FY 2011, the TWSP in the District recorded an average of 61 damage occurrences per year associated with striped skunks and 41 damage threats associated with striped skunks. Between FY 2009 and FY 2011, the TWSP recorded $25 in damages to poultry associated with striped skunks and $1,300 in damages to property. The TWSP in the District infrequently receives requests for assistance associated with hog-nosed skunks, hooded skunks, and spotted skunks.

The majority of requests for assistance to alleviate damage or threats of damage associated with skunks are associated with striped skunks. If striped skunk densities occur at 0.85 skunks per mi^2, the population in the Fort Worth District could be estimated at 36,400 skunks based on the land area of the District. The TWSP killed an average of 35 striped skunks intentionally from FY 2009 through FY 2011 in the Fort Worth District (see Table 4). Additionally, the TWSP in the Fort Worth District unintentionally killed an average of four striped skunks per year as non-targets during other damage management activities from FY 2009 through FY 2011. The highest annual lethal removal occurred in FY 2011 when 71 striped skunks were lethally removed by the TWSP in the District. Skunk populations can reportedly sustain a 60% annual harvest level indefinitely (Boddicker 1980). The lethal removal of 39 skunks by the TWSP per year on average would represent 0.1% of a population estimated at 36,400 skunks in the District. The TWSP expects the annual lethal removal of striped skunks to remain similar to previous activities. Based on the findings of Boddicker (1980), the number of striped skunks lethally removed by the TWSP is unlikely to reach a magnitude where adverse effects would occur to the striped skunk population.

The TWSP in the Fort Worth District did not receive requests for assistance associated with hooded skunks, hog-nosed, and spotted skunks from FY 2009 through FY 2011. No intentional lethal removal of hooded skunks, hog-nosed skunks, or spotted skunks occurred by the TWSP in the Fort Worth District from FY 2009 through FY 2011. As mentioned previously, the TWSP infrequently receives requests for assistance associated with hog-nosed skunks, hooded skunks, and spotted skunks. The TWSP does not anticipate the lethal removal of those skunk species to increase substantially. Based on the limited and infrequency of lethal removal that could occur, impacts would be nonexistent or of very low magnitude.

FERAL CAT POPULATION IMPACT ANALYSIS

Feral cats are common in many parts of the Fort Worth District, especially close to human habitation. Feral cats are not part of the native environment, and when left abandoned in the wild, they are considered an ecological pest and very efficient predators killing millions of native wildlife annually (ABC 2011) and competing with native predators. Cats have been cited as having a negative effect on several wildlife species (ABC 2011). Primary responsibility for addressing damage or threats of damage caused by feral cats occurs with county agencies, local authorities, or the resource owner/manager. There are an estimated 30 million feral cats (Luoma 1997) and an estimated 63 million pet cats (Nassar and Mosier 1991) in the continental United States (Pimentel et al. 2000).

The TWSP in the Fort Worth District infrequently receives requests for assistance associated with feral cats. In the Fort Worth District, the TWSP documented one damage occurrences and one threat occurrences associated with damage caused by feral cats between FY 2009 through FY 2011. Between FY 2009 and FY 2011, no intentional removal of feral cats occurred by the TWSP. The TWSP could receive requests for assistance to manage damage or threats of damage to livestock, natural resource, property, and human safety associated with feral cats in the District. The TWSP in the District could also lethally remove feral cats unintentionally during damage management activities targeting other animals. However, no unintentional removal of feral cats occurred by the TWSP in the District between FY 2009 and FY 2011. However, three feral cats were live-captured unintentionally and released by the TWSP.

The TWSP does not anticipate the lethal removal of feral cats to increase substantially. Based on the limited and infrequency of lethal removal that could occur, including non-target removal, impacts would be nonexistent or of very low magnitude. The limited removal of feral cats by the TWSP would have minimal effects on local populations in the District. Some local populations may be temporarily reduced at a local site if cats were removed using non-lethal or lethal methods. In those cases where feral cats were causing damage or were creating a nuisance and complete removal of the local population could be achieved, this could be considered as providing some benefit to the natural environment since feral cats are not considered part of the native ecosystem. The lethal removal of cats that could occur by the TWSP would be minor compared to the number killed by animal control and humane organizations in Texas each year.

RACCOON POPULATION IMPACT ANALYSIS

Raccoons are considered a furbearer in Texas and the TPWD is responsible managing the population. Raccoons are abundant throughout North America, except much of Canada, the Rocky Mountains, and Great Basin regions. They are typically associated with waterways and forested habitats, but are especially common in urban areas. In Texas, they are found mostly in urban areas, along waterways, and in forests of the less arid portions, but sometimes they can be found a long way from water in a variety of habitats including desert scrub. Raccoons are an omnivore, feeding on carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, a wide variety of grains, various fruits, other plant materials, and most or all foods prepared for human or animal consumption (Sanderson 1987). From FY 2009 to FY 2011, the TWSP recorded an average of 19 damage occurrences and 9 threat occurrences per year associated with raccoons, including damage to agricultural resources, property damage, and human health and safety concerns. Between FY 2009 and FY 2011, raccoons caused $60 in damages to sheep in the District. Raccoons also caused $13,485 in damages to property and $50 in damages to crops in the District from FY 2009 through FY 2011. The raccoon population in the Fort Worth District has increased largely due to an increase in manmade habitat where raccoons often thrive.

Densities of raccoons can be very high especially along watercourses and suburban areas. Twichell and Dill (1949) reported one of the highest densities where 100 raccoons were removed from a winter tree den area on 101 acres of a waterfowl refuge in Missouri. Other studies have found raccoon densities that ranged from 9.3/mi^2 to 80/mi^2 (Yeager and Rennels 1943, Urban 1970, Sonenshine and Winslow 1972, Hoffman and Gottschang 1977, Rivest and Bergerson 1981).

The raccoon is recognized by the TPWD as the most abundant and widely distributed of all furbearers (TPWD 1993*a*). As discussed previously, the Pineywoods, Post Oak Savannah, Blackland Prairies, and Cross Timbers and Prairies are the primary ecological regions in the District. Population densities of raccoons in the Post Oak Savannah region of the State have been reported to be about 9.4 acres per animal (68/mi^2) (TPWD 1993*a*). Surveys have indicated the highest raccoon densities in the State occur in the Blackland Prairies ecological region (TPWD 1993*a*). Therefore, it would be reasonable to assume raccoon densities average at least 2/mi^2 across at the District, which would indicate a very conservative population estimate of more than 85,600 raccoons.

Between FY 2009 and FY 2011, the TWSP in the Fort Worth District intentionally lethally removed an average of 75 raccoons each year. Additionally, the TWSP unintentionally lethally removed an average of 14 raccoons as non-targets from FY 2009 to FY 2011. The highest annual lethal removal by the TWSP between FY 2009 and FY 2011 occurred in FY 2011 when 169 raccoons were removed (target and non-target removal), which represents less than 0.2% of a population in the District estimated at 85,600 raccoons. The annual allowable harvest level for raccoons has been estimated to range from 49 to 59% for the long-range maintenance of the species (Sanderson 1987). The TWSP expects the annual lethal removal of raccoons to remain similar to previous activities, including non-target removal. The TWSP does not anticipate the lethal removal of raccoons to increase substantially. Based on the limited removal that could occur, impacts would be of very low magnitude.

RED FOX AND GRAY FOX POPULATION IMPACT ANALYSES

The TPWD is the agency responsible for managing populations of fox, which are classified as fur-bearers/predators in Texas. Gray fox are found throughout Texas, but tend to prefer coniferous forests, chaparral, and rimrock country with scattered pinyon-juniper and agricultural habitats. Gray fox primarily feed on small mammals, birds, including poultry, mast, and insects. Gray fox have three to seven pups and den in hollow logs, under rocks, and sometimes in underground dens. Published estimates of gray fox densities range from 31.2 to 206 acres per animal (3.1 to 20.5/mi^2) (TPWD 1993*a*). Using the lowest density, the minimum population in the Fort Worth District could be estimated at 132,700 gray fox. From FY 2009 through FY 2011, the TWSP recorded an average of four damage or threat occurrences per year associated with gray fox, mostly associated with damage to agricultural resources and property. Between FY 2009 and FY 2011, gray fox killed or injured five adult sheep or lambs valued at $100 in the District. In addition, gray fox caused $200 in damages to pets and zoo animals and $900 in damages to property in the District.

Red fox are found throughout much of North America, and they can be found in North-central and Eastern Texas. Much debate has occurred about the distribution of native versus non-native red fox in the United States (Voigt 1987, Kamler and Ballard 2002). Through the 20th century, it is believed that the European red fox expanded their range in the United States because of their adaptability to living in close association with people. Those fox were brought from Europe for fox hunting because the native gray fox were not as sporting (they often climb trees to escape) and for the fur market. However, the population that inhabits Texas is within the native range of the red fox (Kamler and Ballard 2002). The red fox prefers to live in mixed woodlands, farm and open country, but can be found in close association with human activities, such as agricultural lands and suburban developments.

Red fox prey mostly on small mammals, birds, insects and mast, and will feed on small livestock and poultry. Red fox have a home range of 1 to 2 mi^2, but often travel outside this area. Red fox usually den on slopes in porous soils and have one litter per year of four to nine pups. Densities range from 0.3 per mi^2 in tundra habitat to 80 per mi^2 in urban habitats with abundant food (Voigt 1987). Published estimates of population densities for red fox in Texas range between 246.1 to 2,133 acres per animal (0.3 to 2.6/mi^2) (TPWD 1993*a*). Thus, using the lowest population density, a minimum population estimate would be 12,800 red fox in the Fort Worth District. The TWSP received an annual average of four requests for assistance associated with red fox in the Fort Worth District from FY 2009 to FY 2011. Between FY 2009 and FY 2011, red fox killed or injured 7 sheep or lambs valued at $470, four goats valued at $100, and 14 poultry valued at $310 in the District. In addition, red fox caused $40 in damages to pets or zoo animals in the District.

From FY 2009 to FY 2011, the TWSP received 23 requests for assistance associated with gray fox and red fox in the District, which is an average of eight requests for assistance per year. The TWSP lethally removed an average of 28 gray fox and 8 red fox in the Fort Worth District from FY 2009 to FY 2011. The highest annual lethal removal of gray fox between FY 2009 and FY 2011 occurred during FY 2011 when 33 fox were removed. The highest annual removal of red fox between FY 2009 and FY 2011 occurred during FY 2011 when 10 red fox were lethally removed. Fox could also be lethally removed unintentionally as non-targets during other damage management activities. Between FY 2009 and FY

2011, the TWSP in the District lethally removed six gray fox and five red fox unintentionally during activities targeting other animals or about two red fox and two gray fox removed unintentionally per year.

The lethal removal of 33 gray fox by the TWSP during FY 2011 would represent 0.03% of a population estimated at 132,700 fox in the District. The lethal removal of 10 red fox by the TWSP during FY 2011 would represent 0.1% of a population estimated at 12,800 fox in the District. The annual allowable harvest level for gray fox has been estimated to be 25% (Fritzell 1987) and 70% for red fox (Davis 1974) for the long-range maintenance of those species. Voigt (1987) stated, "*The high fecundity and dispersal potential of foxes enable populations to withstand a high level of mortality*". The TWSP expects the annual lethal removal of gray fox and red fox to remain similar to previous activities, including non-target removal. The number of gray fox and red fox lethally removed by the TWSP is unlikely to reach a magnitude where adverse effects would occur to the populations of those fox species. The TWSP does not anticipate the lethal removal of fox to increase substantially. Based on the limited and infrequency of lethal removal that could occur, impacts would be of very low magnitude.

BOBCAT POPULATION IMPACT ANALYSIS

The bobcat is managed as a predator by the TPWD in Texas. They prey mostly on small mammals in Texas, such as lagomorphs (rabbits) and rodents, but will also take lizards, birds, carrion, and potentially larger mammals. Bobcats were responsible for $8,802 in damage to livestock in the District, primarily exotic pen-raised animals. In addition, bobcats caused $1,765 in damages to pets and zoo animals in the District between FY 2009 and FY 2011. From FY 2009 through FY 2011, the TWSP in the District recorded an average of 74 damage occurrences per year associated with bobcats and 31 damage threats associated with bobcats.

Bobcats are found in much of North America, excluding most of Canada and the East, and are most abundant in western states. They are typically associated with rimrock and chaparral habitat, but can be found in other habitats such as forests. They are found statewide in Texas. Bobcats reach reproductive maturity at approximately 9 to 12 months of age and may have one to six kittens following a two-month gestation period (Crowe 1975, Koehler 1987). They may live up to 14 years, but annual mortality is as high as 47% (Rolley 1985).

Annual population estimates are not maintained by the TPWD. However, based on deer spotlight surveys, bobcat population trends appear to be stable throughout the State (TPWD 1993*a*). The sustainable harvest level for bobcats has been estimated at 20% of a given total population (Rolley 1985), which is close to the allowable harvest level of 19% indicated by the TPWD (1993*b*) and Bluett and Tewes (1988). The TPWD determined a maximum allowable harvest for bobcats in the State to be 26,902 (TPWD 1993*b*). Roberts and Crimmins (2010) listed an estimated statewide population ranging from 287,444 to 1,357,928 bobcats with their status listed as stable.

To alleviate requests for assistance, the TWSP lethally removed an average of 25 bobcats annually in the District from FY 2009 through FY 2011. The highest annual removal occurred in FY 2009 when 27 bobcats were lethally removed by the TWSP in the District. From FY 2009 through FY 2011, five bobcats were lethally removed unintentionally during other damage management activities in the District, which is an average removal of two bobcats unintentionally per year.

Bobcat populations can reportedly sustain a 20% annual harvest level (Rolley 1985). The lethal removal of 27 bobcats by the TWSP would represent 0.01% of a population estimated at 287,444 bobcats in the State and 0.1% of the allowable harvest level for bobcats in the State. The TWSP expects the annual lethal removal of bobcats to remain similar to previous activities. Based on the findings of Rolley (1985) and the TPWD (1993*b*), the number of bobcats lethally removed by the TWSP is unlikely to reach a magnitude where adverse effects would occur to the bobcat population.

VIRGINIA OPOSSUM POPULATION IMPACT ANALYSIS

Opossum often will cause damage to residential property and create human safety concerns living in attics or under houses. They can also cause damage to agricultural resources. The TPWD manages the opossum as a fur-bearing mammal, which can be harvested year round. They typically are associated with riparian areas and inhabit deciduous woodlands, cottonwood forests, pinyon-juniper woodlands, farmlands, old fields, grasslands, marshlands, agricultural and forested edges, and desert plains. Opossum have also been reported in mountainous areas. Opossums are omnivorous and have a wide-ranging diet. Females breed the first season following their birth and produce potentially two litters per year in Texas. They may have as many as 25 young, but average between six and nine young. Most opossums die in their first year and turnover is expected by their third year. Gehrt et al. (1997) estimated opossum densities in Southern Texas to be 0.4 to 2.6 opossum per mi^2.

From FY 2009 to FY 2011, the Fort Worth District received an average of three requests for assistance with opossum damage and an average of three requests for assistance associated with threats of damage. Opossums were responsible for causing $150 in damages to property in the District from FY 2009 through FY 2011. In response to requests for assistance, the TWSP lethally removed an average of nine opossums annually from FY 2009 through FY 2011 with the highest annual removal occurring in FY 2011 when 20 opossum were removed. In addition, an average of one opossum has been lethally removed unintentionally per year as non-targets during other damage management activities conducted from FY 2009 through FY 2011. The TWSP also live-captured one opossum unintentionally but released the opossum unharmed.

A sustainable harvest rate has not been determined for opossum. However, the allowable annual harvest is likely high as long as refuges (areas where they are not hunted) are maintained (Seidensticker et al. 1999). The TWSP expects the annual lethal removal of opossum to remain similar to previous activities, including non-target removal. The TWSP does not anticipate the lethal removal of opossum to increase substantially. Based on the limited removal that could occur, impacts would be of very low magnitude.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

Under this alternative, methods used for predation management would be similar to those used under the current program, with restrictions on resources protected only applicable to registered pesticides. Predation management may be implemented for the protection of livestock or wildlife. Wildlife protection may be requested by private landowners, the TPWD, or the USFWS, depending on land ownership and management authority.

In making decisions based on multiple resources, the TWSP would consider the potential impacts of predation management methods on wildlife populations. In some instances, predation management methods and timing may be adjusted to protect wildlife as well as livestock. As an example, the TWSP may be requested to protect calves from coyote predation. If the area also serves as critical pronghorn habitat and pronghorn are significantly below population objectives established by the TPWD, damage management might extend beyond cattle producer boundaries to adjacent cooperators to provide reduce predation rates on pronghorn. The TWSP would only conduct activities on adjacent cooperators with permission from the appropriate landowner or manager. Similarly, damage management may extend beyond calving season if needed to protect pronghorn fawns. Conversely, the TWSP would coordinate with land managing agencies and the TPWD to prevent predation management from negatively affecting other natural resources. For example, if lethally removing mountain lions in a specific area to manage livestock predation would prevent adequate lion predation rates that regulate wild burro populations, lion predation may be managed in an alternative manner.

The TWSP would not have impacts on wildlife species unless the TWSP intentionally were trying to suppress a predator population in a targeted area, such as at fawning/lambing grounds at the request of or in concert with the TPWD. For example, if the TPWD or another entity requested coyote removal to enhance localized antelope or deer herds, an increase in local populations would be desired and considered as providing some benefit to the human environment. In this situation, the removal of coyotes could be beneficial to deer and antelope by reducing predation rates, but mostly in fawning and wintering areas and removing coyotes to prevent predation on deer and antelope would be ended when herd management goals were met.

Restrictions exist on the use of pesticides to protect wildlife. M-44 devices may not be used to protect wildlife species that were not federally listed under the ESA as threatened or endangered species. LPCs are labeled for use to protect sheep or goats only and may not be used to protect any wildlife. The TWSP could continue to use M-44s and LPCs to prevent predation on livestock under this alternative; however, those methods would not be used during times when activities were conducted to prevent predation on other wildlife species, except for M-44s to prevent predation on T&E species. All other methods, lethal and non-lethal, may be used in an integrated program to protect both livestock and wildlife under this alternative.

The TWSP may also integrate the protection of human health or safety into decisions regarding predation management. For example, rabies management projects include active surveillance of potential vectors/reservoirs of the rabies virus. Gray fox, coyotes, bobcats, raccoons, and striped skunks removed during predation management efforts may be sampled to determine the presence and extent of rabies outbreaks. Similarly, if surveillance of those species were critical for rabies management purposes, they may be removed during predation management programs even if they pose little risk to livestock (*e.g.*, skunks could be targeted during activities to prevent coyote predation on livestock).

However, the potential effects on target predator populations from activities conducted under this alternative would be similar to Alternative 1. While the timing of activities could differ and the locations where activities could occur may differ under Alternative 2, the TWSP does not anticipate substantial increases in the number of individuals removed annually from the populations of each target species. Therefore, the effects on target species populations under this alternative would be similar to those addressed under Alternative 1.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the WS program would not provide assistance with managing damage associated with predators; therefore, the WS program would not have any effect on target predator populations in the Fort Worth District. However, Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of assistance provided by the WS program. The Texas A&M AgriLife Extension Service is directed by state law to conduct predation management; however, under this alternative there would be no assistance provided by the WS program.

While the WS program would provide no assistance under this alternative, the TWSP and other individuals or entities could conduct lethal damage management resulting in lethal removal levels similar to Alternative 1 and Alternative 2. Therefore, local predator populations could decline, stay the same, or increase depending on actions taken by those persons experiencing predator damage. Some resource/property owners may take illegal, unsafe, or environmentally harmful action against local populations of predators out of frustration or ignorance. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal take, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g*., see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

For example, in Kentucky a corporation was fined for illegally using carbofuran to destroy unwanted predators, including coyotes and raptors, at a private hunting club (Porter 2004). Similarly, on a Georgia quail plantation, predatory birds were being killed by eggs that had been injected with carbofuran (The Federal Wildlife Officer 2000). In Oklahoma, federal agents charged 31 individuals with illegally trapping and killing hawks and owls to protect fighting chickens (USFWS 2003). The TDA (2009) has a website and brochure devoted solely to preventing pesticide misuse in controlling agricultural pests.

Since predators could still be lethally removed under this alternative, the potential effects on the populations of those predator species in the Fort Worth District would be similar to the other alternatives for this issue. WS' involvement would not be additive to lethal removal that could occur since the cooperator requesting WS' assistance could conduct damage management activities without WS' direct involvement or seek assistance from the TWSP or other entities. Therefore, any actions to resolve damage or reduce threats associated with predators could occur by other entities despite WS' lack of involvement under this alternative.

For the reasons discussed in the population impacts analysis under Alternative 1, it is highly unlikely that predator populations would be affected by implementation of this alternative. However, the potential for use of illegal chemical toxicants caused by frustration could lead to unknown, but potentially high impacts, on carnivore populations. Additionally, if no agency, groups, or individuals were able to respond to damage complaints, much of the public could become intolerant of wildlife as a whole (International Association of Fish and Wildlife Agencies 2004).

Alternative 4 – The WS Program Provides Technical Assistance Only

Under this alternative, the WS program would only provide advice or guidance on damage management methods and activities; however, the Texas A&M AgriLife Extension Service and the TWDMA, along with other entities, could continue to provide assistance similar to Alternative 1 and Alternative 2. The WS program would not conduct any direct operational assistance to resolve damage or threats of damage, and therefore, would not have any impact on predators in the District. As discussed under Alternative 3, the Texas A&M AgriLife Extension Service and the TWDMA would likely continue to conduct damage management activities similar to Alternative 1 and Alternative 2 with increased effort in proportion to those activities that would have been conducted by the WS program. In addition, other entities, including private entities, could provide assistance in the absence of any involvement by the WS program. Therefore, under this alternative the number of predators lethally removed annually would likely be similar to the other alternatives since removal could occur by other entities or by those persons experiencing damage. WS' participation in a management action would not be additive to an action that would occur in the absence of WS' participation.

If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal take, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e*.*g*., see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

Alternative 5 – Use of Only Non-lethal Methods by the WS program

This alternative would require personnel from the WS program to use only non-lethal methods to resolve damage or threats of damage. In accordance with WS Directive 2.101, preference would be given to non-lethal methods where practical and effective under the other alternatives. Therefore, the WS program would have no effect on predator populations in the Fort Worth District under this alternative.

Many livestock producers already use non-lethal methods to reduce predation (NASS 2000, NASS 2001, NASS 2005, NASS 2011). The NASS (2005) reported that many Texas sheep and goat producers used non-lethal methods to reduce predator damage, such as fencing (32%), guard dogs (29%), night penning (24%), donkeys (24%), frequent checks (17%), lamb shed (16%), culling (11%), llamas (11%), bedding change (7%), herding (5%), carrion removal (5%), other non-lethal methods (4%), and frightening tactics (1%). The NASS (2011) also reported that Texas cattle producers used non-lethal methods to reduce predator damage; producers used guard animals (50%), culling (31%), frequent checks (30%), and exclusion fencing (24%). Mitchell et al. (2004) indicated that non-lethal methods to alleviate predation could be effective. However, Mitchell et al. (2004) and others, such as Knowlton et al. (1999), indicate that, although certain non-lethal methods have shown promise, further research is needed to determine their effectiveness and practicality. Non-lethal methods are an important part of the mix of current strategies used to meet the need for action; however, in some cases, the use of only non-lethal methods would not keep damage or threats of damage at a level that would be acceptable to some people. Andelt (1992) reported that about a third of sheep producers using guard dogs indicated that the use of dogs did not reduce their reliance on other predator control techniques or on predator control agencies.

The TWSP (*i*.*e*., the Texas A&M AgriLife Extension Service and the TWDMA) and other entities could continue to use lethal methods under this alternative. If those non-lethal methods employed by the WS program did not reduce damage or threats of damage to levels acceptable to the requester, the requester could seek assistance from the TWSP, could seek assistance from other entities, or could conduct damage management activities on their own. In some cases, property owners or managers may misuse some methods or use some methods in excess of what was necessary, which could then become hazardous and pose threats to the safety of people and wildlife species. The WS program could refer those persons experiencing damage or threats of damage to the TWSP and/or other entities for information and implementation of lethal methods. Therefore, similar to Alternative 3 and Alternative 4, if the TWSP and other entities increased their efforts in proportion to those activities that would have been conducted by the WS program using lethal methods, the potential effects on target predator populations would be similar to Alternative 1 and Alternative 2.

Issue 2 - Effects on Non-target Species Populations, Including T&E Species

Non-target species could be lethally removed unintentionally during damage management activities whether implemented by the TWSP, other agencies, or the public. As discussed previously, a concern is often raised about the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by predators. The potential effects on the populations of non-target wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action)

The potential for adverse effects to non-targets occurs from the employment of methods to address predator damage. Under the no action alternative, the TWSP could provide both technical assistance and direct operational assistance to those persons requesting assistance. The risks to non-targets from the use of non-lethal methods as part of an integrated direct operational assistance program would be similar to those risks to non-targets discussed in the other alternatives. Personnel from the TWSP would be experienced with managing wildlife damage and would be trained in the employment of methods, which would allow employees to use the WS Decision Model to select the most appropriate methods for taking targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, the TWSP would employ the most selective methods for the target species, would employ the use of attractants that are as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. Improved padded-jaw traps, pan-tension devices, trap lures, breakaway snares, and other tools allow the TWSP to be more efficient and effective at targeting animals causing damage while minimizing the lethal removal or live-capture of non-target animals. SOPs to prevent and reduce any potential adverse impacts on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target exposure to methods during program activities, the potential for the TWSP to disperse or lethally remove non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, and dispersal. Potential impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal removal would occur. Although non-lethal methods do not result in lethal removal of non-targets, the use of non-lethal methods could restrict or prevent access of non-targets to beneficial resources. However, non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods would generally be regarded as having minimal impacts on overall populations of wildlife since individuals of those species were unharmed. Overall, potential impacts to non-targets from the use of non-lethal methods would not adversely affect populations since those methods are often temporary.

Non-lethal methods may only be effective for a short time as animals become habituated to those methods (Pfeifer and Goos 1982, Conover 1982). Generally, non-lethal methods would only be practical for small areas (Arhart 1972, Rossbach 1975, Shirota et al. 1983, Schmidt and Johnson 1984, Mott 1985, Dolbeer et al. 1986, Graves and Andelt 1987, Tobin et al. 1988, Bomford 1990). Therefore, the TWSP could also employ and/or recommend lethal methods under the no action alternative to alleviate damage, when those methods were deemed appropriate for use using the WS Decision Model. Available methods and the application of those methods to resolve predator damage is further discussed in Appendix B. While every precaution would be taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by predators, the use of such methods could result in the incidental lethal removal of unintended species. The unintentional lethal removal of non-targets by the TWSP in the Fort Worth District is shown in Table 6.

From FY 2009 to FY 2011, the TWSP lethally removed unintentionally 21 different non-target species; averaging 14 different species per year (see Table 6). Many of those species lethally removed by the TWSP as non-targets (8 of 21 species removed from FY 2009 to FY 2011) are also known to cause damage and could be addressed to alleviate damage or threats of damage by the TWSP when requested under the no action alternative. The potential exists for the TWSP to lethally remove other non-target species unintentionally during damage management activities conducted under this alternative. Species that are of similar size or weight of target species could be lethally removed unintentionally during damage management activities. In addition, the TWSP also live-captured and released non-target animals in the District from FY 2009 through FY 2011 (see Table 6). On average, the TWSP live-captured and released six non-target animals per year between FY 2009 and FY 2011.

The Fort Worth District of the TWSP lethally removed unintentionally relatively few non-target species while conducting damage management activities from FY 2009 through FY 2011. The lethal removal of non-targets by the TWSP from FY 2009 through FY 2011 was similar to the previous levels of non-target lethal removal. The minimal lethal removal of non-target species also provides a good indication of the selectiveness of the methods used. As methods have improved in the last few decades, the incidence of non-target lethal removal has decreased. Those SOPs discussed in Chapter 3 would also ensure that non-target lethal removal in the Fort Worth District would remain relatively low. The non-targets lethally removed previously by the TWSP are representative of non-targets that could be lethally removed by the TWSP under the no action alternative. Although additional species of non-targets could be lethally removed by the TWSP, lethal removal of individuals from any species is not likely to increase substantively above the number of non-targets removed annually by the TWSP during previous damage management activities. In addition, nine of the species lethally removed are also considered target species in this EA and the level of lethal removal analyzed for each species under Issue 1 includes non-target removal that could occur by the TWSP. Therefore, the lethal removal of those species is evaluated cumulatively under Issue 1, including removal that could occur when a species is considered a target or non-target.

Table 6 – TWSP' non-target species taken in the Fort Worth District, FY 2009 – FY 2011

SPECIES	Fiscal Year and Fate of Non-Target Animal						AVERAGE	
	FY 2009		FY 2010		FY 2011			
	Killed	Freed	Killed	Freed	Killed	Freed	Killed	Freed
Armadillo	1	-	-	-	-	-	**1**	**-**
Beaver	-	-	1	-	-	-	**1**	**-**
Black Vulture	1	-	3	-	-	-	**1**	**-**
Bobcat	2	-	2	-	1	-	**2**	**-**
Caracara	2	-	-	-	-	-	**1**	**-**
Common Snapping Turtle	-	-	-	-	1	-	**1**	**-**
Coyote	2	-	-	-	18	-	**7**	**-**
Feral Cat	-	-	-	1	-	2	**-**	**1**
Feral Dog	8	3	2	-	1	-	**3**	**1**
Feral Goat	-	-	1	-	-	-	**1**	**-**
Feral Swine	1	-	-	-	-	-	**1**	**-**
Gray Fox	2	-	2	-	2	-	**2**	**-**
Fish (other)	-	-	-	-	1	-	**1**	**-**
Porcupine	1	-	-	-	-	-	**1**	**-**
Mourning Dove	-	-	7	-	-	-	**2**	**-**
Raccoon	25	-	4	-	12	-	**14**	**-**
Red Fox	2	-	2	-	1	-	**2**	**-**
River Otter	19	-	14	-	9	-	**14**	**-**
Striped Skunk	5	-	-	-	7	-	**4**	**-**
Turtle (other)	1	-	1	-	4	1	**2**	**1**
Virginia Opossum	-	-	1	-	2	1	**1**	**1**
White-tailed Deer	17	4	17	2	17	4	**17**	**3**

Between FY 2009 and FY 2011, the TWSP in the Fort Worth District has lethally removed unintentionally an average of 74 animals per year as non-targets. The majority of the animals removed as non-targets were white-tailed deer, raccoons, and river otter. Raccoons, bobcats, feral dogs, gray fox, coyotes, red fox, striped skunks, and Virginia opossum that were lethally removed or live-captured unintentionally by WS are also target species in this EA and the level of removal analyzed for each of those species under Issue 1 included the unintentional removal that could occur by WS or the unintentional removal was evaluated as part of the cumulative analysis. Therefore, the lethal removal of those species was evaluated cumulatively under Issue 1, including removal that could occur when a species was considered a target or non-target.

Armadillos (*Dasypus novemcinctus*), bobcats, coyotes, porcupines (*Erethizon dorsatum*) and turtles are considered non-game animals in the State and can be lethally removed at any time. Similarly, feral swine (*Sus scrofa*) and feral goats can also be removed at any time within the State. Beaver (*Castor canadensis*) and river otter (*Lontra canadensis*) are considered a furbearer in the State and can be harvested during annual harvest seasons. White-tailed deer can also be harvested in the State during annual harvest seasons. In addition, one fish was lethally removed unintentionally in the District between FY 2009 and FY 2011. Non-target take by the TWSP from FY 2009 through FY 2011 of those harvestable species would be a minor component of the annual harvest levels of those species. The TWSP anticipates the unintentional take of those species would continue to be a minor component of the annual harvest of those species and the populations of those species in the Fort Worth District. Some evidence exists that small carnivore abundance typically increases in areas where populations of larger predators, such as the coyote, have been reduced (Robinson 1961, Nunley 1977).
Four black vultures (*Coragyps atratus*), two crested caracaras (*Caracara cheriway*), and seven mourning doves (*Zenaida macroura*) were lethally removed unintentionally from FY 2009 through FY 2011 by the TWSP during damage management activities. The limited take did not reach a magnitude that would adversely affect the populations of those species in the District. Although, the take of the black vultures, mourning doves, and caracaras was unintentional, the take occurred within the take level allowed by the USFWS. The TWSP in the Fort Worth District does not anticipate any substantial increase in non-target take under the no action alternative.

When using fumigants, burrows and dens would be observed for the presence of non-targets before the use of fumigants. If non-target activity (*e.g.*, tracks, scat) were observed, the fumigation of those burrows or dens would not occur. Since non-targets are known to occur in burrows or dens, some risks of unintentional take of non-targets does exist from the use of fumigants. For example, burrows of woodchucks can be used by a variety of non-target species, such as the Eastern cottontail (*Sylvilagus floridanus*), striped skunk, raccoon, red fox, coyote, white-footed mouse (*Peromyscus leucopus*), house mouse (*Mus musculus*), and short-tailed shrew (*Blarina brevicauda*) (Hamilton 1934, Grizzell 1955, Dolbeer et al. 1991).

Fumigants would be used in active burrows or dens only, which would minimize risk to non-targets. Dolbeer et al. (1991) found a total of one cottontail rabbit and three mice (*Permyscus* spp.) in three of the 97 woodchuck burrows treated with gas cartridges during the late summer. During 2,064 trap nights at 86 woodchuck burrow entrances targeting small mammals, Swihart and Picone (1995) captured 99 individuals of four small mammal species, which included short-tailed shrews (*Blarina brevicauda*), meadow voles (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), and white-footed mice (*Peromyscus leucopus*). Risks to non-targets can be minimized by treating only burrows that appear to be active (Dolbeer et al. 1991). There are no secondary poisoning risks involved with the use of gas cartridges as the gas produced dissipates into the atmosphere shortly after activation. Primary risks to non-targets would be minimized by treating only active burrows or dens, by covering entrances of burrows or dens, and by following the pesticide label. Although non-targets could be present in burrows or dens, even after a TWSP employee conducts site investigations, the risks would be relatively low and unintentional take from the use of fumigants would be limited.

An issue that has arisen is the potential for low-level flights to disturb wildlife, including T&E species. Aerial operations could be an important method of damage management in the Fort Worth District when used to address damage or threats associated with predators in remote areas where access was limited due to terrain and habitat. Aerial operations involving shooting would only occur in those areas where a Work Initiation Document allowing the use of aircraft had been signed between the TWSP and the cooperating landowner or manager. Aircraft could also be used for aerial surveys of wildlife or radio telemetry. Aerial operations would typically be conducted with aircraft when the foliage has fallen; however, aircraft could be used at any time of year. The amount of time spent conducting aerial operations would vary depending on the survey area, severity of damage, the size of the area where damage or threats were occurring, and the weather, as low-level aerial activities would be restricted to visual flight rules and would be impractical in high winds or at times when animals were not easily visible.

Table 7 shows data on the number of hours conducting aerial operations for the counties in which aerial operations occurred between FY 2009 and FY 2011. From FY 2009 to FY 2011, the TWSP flew an average of 83.7 hours in helicopters and fixed-wing airplanes (see Table 7) over about 238 mi^2 of properties that were under agreements (see Table 8) or less than 0.6% of the land area in the District. Thus, aerial operations conducted by the TWSP in the District are minor in terms of geographic scope because more than 99% of the land area in the District is not exposed to any such activity. The average amount of time flying over properties amounted to an average of 21.1 minutes per mi^2. Therefore, on the small proportion of the landscape exposed to aerial operations, only a tiny fraction of the time in an entire year is generally exposed to aerial overflights.

Table 7 – Hours flown by the TWSP during aerial operations by county, FY 2009-FY 2011

County	Hours Flown			Yearly Average	County	Hours Flown			Yearly Average
	2009	2010	2011			2009	2010	2011	
Archer	12.5	-	-	**4.2**	**Hill**	-	10.3	-	**3.4**
Bell	-	3.5	-	**1.2**	**Hopkins**	-	1.1	-	**0.4**
Clay	20.7	-	-	**6.9**	**Hunt**	-	2.9	-	**1.0**
Coryell	-	3.4	20.0	**7.8**	**Jack**	4.0	-	-	**1.3**
Delta	-	34.6	39.3	**24.6**	**Lamar**	-	1.5	16.3	**5.9**
Ellis	-	1.5	1.5	**1.0**	**Navarro**	-	1.5	-	**0.5**
Fannin	-	3.5	-	**1.2**	**Wichita**	21.1	-	-	**7.0**
Freestone	-	14.3	-	**4.8**	**Young**	19.0	-	-	**6.3**
Hamilton	12.3	-	6.4	**6.2**	**TOTAL**	**89.6**	**78.1**	**83.5**	**83.7**

Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying 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 1976), and colonial waterbirds (Speich 1986). Low-level flights also occur 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 (1995) reviewed the effects of aircraft overflights on wildlife and suggested that adverse effects could occur to certain species. Some species will frequently or at least occasionally show an adverse response to even minor overflights. In general though, it appears that the more serious potential adverse effects occur when overflights are chronic (*i.e*., they occur daily or more often over long periods). Chronic exposures generally involve areas near commercial airports and military flight training facilities. Aerial operations conducted by the TWSP rarely occur in the same areas on a daily basis and little time is actually spent flying over those particular areas.

Table 8 – Acreage under agreement with the TWSP for aerial operations by county, FY 2009-FY 2011

County	Acres Flown			Yearly Average	County	Fiscal Year			Yearly Average
	2009	2010	2011			2009	2010	2011	
Archer	25,431	-	-	**8,477**	**Hill**	-	7,735	-	**2,578**
Bell	-	12,900	-	**4,300**	**Hopkins**	-	1,160	-	**387**
Clay	52,813	-	-	**17,604**	**Hunt**	-	3,000	-	**1,000**
Coryell	-	3,035	21,793	**8,276**	**Jack**	3,200	-	-	**1,067**
Delta	-	50,791	61,534	**37,442**	**Lamar**	-	1,005	50,230	**17,078**
Ellis	-	7,800	3,500	**3,767**	**Navarro**	-	10,400	-	**3,467**
Fannin	-	1,900	-	**633**	**Wichita**	11,193	-	-	**3,731**
Freestone	-	46,500	-	**15,500**	**Young**	34,590	-	-	**11,530**
Hamilton	28,025	-	18,010	**15,345**	**TOTAL**	**155,252**	**146,226**	**155,067**	**152,182**

Examples of species or species groups that have been studied with regard to the issue of aircraft-generated disturbance are as follows:

Waterbirds and Waterfowl**:** Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no "*drastic*" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). 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. Belanger and Bedard (1989, 1990) observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "*time-activity budgets*" of the species. Low-level aerial operations conducted by the TWSP would not be conducted over federal, state, or other governmental agency property without the concurrence of the managing entity. Those flights, if requested, would be conducted to reduce threats and damages occurring to natural resources and should not result in impacts to bird species. Thus, there is little to no potential for any adverse effects on waterbirds and waterfowl.

Raptors**:** The Air National Guard analyzed and summarized the effects of overflight studies conducted by numerous federal and state government agencies and private organizations (Air National Guard 1997). Those studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (see Ellis 1981, Fraser et al. 1985, Lamp 1989, United States Forest Service 1992 as cited in Air National Guard 1997). A study conducted on the impacts of overflights to bald eagles (*Haliaeetus leucocephalus*) suggested that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggested that golden eagles (*Aquila chrysaetos*) were 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 (see Awbrey and Bowles 1990 as cited in Air National Guard 1997). Therefore, there is considerable evidence that eagles would not be adversely affected by overflights during aerial operations.

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

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

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

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

Passerines**:** Reproductive losses have been reported in one study of small territorial passerines ("*perching*" birds that included sparrows, blackbirds) after exposure to low altitude overflights (see Manci et al. 1988 as cited in Air National Guard 1997), 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 indicated quieter noise would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988, United States Forest Service 1992). Those studies and reviews indicated there is little or no potential for aerial operations to cause adverse effects on passerine bird species.

Pronghorn (antelope) and Mule Deer**:** Krausman et al. (2004) found that Sonoran pronghorn (*Antilocapra americana sonoriensis*) were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. Krausman et al. (1986) reported that fixed-wing overflights by Cessna 172 and 182 model small aircraft ≥ 100 feet above ground level (AGL) did not generally disturb desert mule deer in Arizona. Krausman et al. (1986) reported that only three of 70 observed responses of mule deer to small fixed-wing aircraft overflights at 150 to 500 feet AGL resulted in the deer changing habitats. Krausman et al. (1986) believed that the deer might have been accustomed to overflights because the study area was near an interstate highway that was followed frequently by aircraft. Krausman et al. (2004) also reported that pronghorn and mule deer do not hear noise from military aircraft as well as humans, which potentially indicates why they appeared not to be disturbed as much as previously thought.

The aircraft they evaluated are larger and noisier than the J3 Supercub and Huskey airplanes used in most aerial operations conducted by the TWSP. Therefore, TWSP would assume the airplanes used in aerial hunting would be even less disturbing to mule deer than the aircraft used in the above study that concluded minimal disturbance. VerCauteren and Hygnstrom (2002) noted in a study that included aerial censuses of deer that deer typically just stood up from their beds, but did not flush, when the aircraft passed overhead. In addition, TWSP aerial hunting personnel frequently observe deer and antelope standing apparently undisturbed beneath or just off to one side of TWSP aircraft.

One particular concern with overflights is the potential to affect mule deer on their winter range during winter months in years when conditions, such as heavy snow and poor forage availability have already stressed the deer to the point that heavy winterkill losses are likely. The TWSP has conducted aerial hunting to protect sheep in several known areas of deer winter range. The WS program in Colorado looked at this very issue in detail and found no significant impacts to deer in their winter range including areas where aerial hunting was concentrated (USDA 2005). The EA found no evidence to suggest aerial hunting overflights contributed in some way to declining deer numbers. In areas where herds have declined or remained substantially below the Colorado Division of Wildlife's herd objectives, drought, which results in poor forage availability for pregnant does and subsequent poor survival of fawns, was believed to be the major factor responsible (USDA 2005).

***Mountain Sheep*:** Krausman and Hervert (1983) reported that, of 32 observations of the response of mountain sheep to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 81% in no or "*slight*" disturbance, and 19% in "*great*" disturbance. Krausman and Hervert (1983) concluded that flights less than 150 feet AGL could cause mountain sheep to leave an area. Another study (Krausman et al. 1998) found that 14% of bighorn sheep had elevated heart rates that lasted up to 2 minutes after an F-16 flew over at an elevation of 400 feet, but it did not alter the behavior of the penned bighorns. When Weisenberger et al. (1996) evaluated the effects of simulated low altitude jet aircraft noise on desert mule deer (*Odocoileus hemionus crooki*) and mountain sheep (*Ovis canadensis mexicana*), they found that heart rates of the ungulates increased according to the dB levels, with lower noise levels prompting lesser increases. When they were elevated, heart rates rapidly returned to pre-disturbance levels suggesting that the animals did not perceive the noise as a threat. Responses to the simulated noise levels were found to decrease with increased exposure.

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

Elk: Espmark and Langvatn (1985) found that elk become habituated to noise. The TWSP could find no other studies of the potential impacts of aerial overflights on elk.

***Domestic Animals and Small Mammals*:** A number of studies with laboratory animals (*e.g.*, rodents [Borg 1979]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National

Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992). As discussed above, the noise levels of the aircraft used by the TWSP are low in comparison to other aircraft. Small mammals, such as field rodents and rabbits, have small home ranges and those species are generally widely distributed. The TWSP would stay at least 500 feet from livestock when conducting aerial operations, which is effective in avoiding livestock disturbance for the most part based on personal observations of TWSP aerial crews.

Although many of those wildlife species discussed above are not present in the Fort Worth District, the information was provided to demonstrate the relative tolerance most wildlife species have of overflights, even those that involve noise at high decibels, such as from military aircraft. In general, the greatest potential for impacts to occur would be expected to exist when overflights are frequent, such as hourly and over many days that could represent "*chronic*" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species often become habituated to overflights, which would naturally minimize any potential adverse effects where such flights occur on a regular basis. Therefore, aircraft used by the TWSP should have far less potential to cause any disturbance to wildlife than military aircraft because the military aircraft produce much louder noise and would be flown over certain training areas many more times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997).

The TWSP would use small fixed-wing aircraft and small helicopters for aerial operations. The fixed-wing aircraft used by the TWSP would be relatively quiet, whereas helicopters would be somewhat noisier. In comparison, the F-16 fighter jet has a sound level of 103 dB at 500 feet AGL while the B-2 bomber aircraft has a sound level of 114 dB (United States Air Force 2000). 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 two miles away from an F-16 and more than 3.7 miles away from the B-1B flying at 200 to 1000 feet AGL (from data presented in Appendix I of Air National Guard 1997). The effects on wildlife from those and other similar types of military aircraft have been studied extensively as shown in the information presented in this section and by the Air National Guard (1997). The effects on wildlife from military-type aircraft have been studied extensively (Air National Guard 1997), and were found to have no expected adverse effects on wildlife. Therefore, it is logical to conclude that the aircraft used in aerial operations by the TWSP should have far less potential to cause any adverse disturbance effects on wildlife when compared to military aircraft. Military aircraft produce much louder noise and are flown over certain training areas as many as 2,500 times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997). The TWSP only conducts aerial operations on 0.6% of the land area in the Fort Worth District, which indicates that most animal populations would not even be exposed to aerial overflights conducted by the TWSP. In addition, such flights occur only a few days per year.

Available information indicates that wildlife generally are not adversely affected by overflights (Air National Guard 1997) indicating that even frequent overflights totaling more than several hundred per year by the military in specific areas do not cause adverse effects on wildlife populations. Therefore, the much more infrequent aerial overflights conducted by the TWSP would have little or no potential to result in adverse effects on non-target wildlife in the District. If the TWSP were requested to provide assistance on properties owned or managed by a federal entity, the coordination of activities would occur through work plans. During such coordination, the federal land manager would provide the TWSP with specific locations where minimization efforts or restrictions on damage management activities might be necessary to reduce or eliminate the potential for adverse effects on specific resources. The TWSP would rely on the coordination process to assist in avoiding substantive adverse effects on relevant components of the human environment.

Some persons may be concerned that the noise from gunfire when using firearms during aerial operations might result in significant disturbance impacts on wildlife species. Time spent shooting from aircraft during aerial operations would be an exceedingly small proportion of overflight times. For example, the TWSP aerial operations data for the District shows an average of two coyotes killed per hour of aerial hunting. In a typical situation, shots at target coyotes would occur for only a few seconds and would usually involve two to three shots fired a 12-gauge shotgun. It generally takes an average of just more than one pass to successfully shoot and kill a coyote (because most are killed on the first pass). It has been estimated that on average no more than about 30 to 45 seconds of every hour spent flying are involved in making passes and shooting during aerial operations (L. Burraston, National Aviation Manager, WS, pers. comm. 2006), which means that only about 1 to 2% of the time spent during aerial operations is actually spent shooting at target animals and generating gunshot noises.

A few studies have indicated gunshot noise can alter behavior of some wildlife species, including waterfowl (Meltofte 1982) and eagles (Stalmaster and Newman 1978). It has been suggested that firearms noise affects species that are hunted due to their association of such noise with being pursued and shot at by people (Larkin 1996). As part of the existing human environment (*i.e*., environmental status quo), an average of over 346,000 persons participated in hunting quail and dove (*Zenaida* spp.) in Texas during the 2011-2012 season and killed about 8.3 million birds (TPWD 2013). Aerial operations conducted by the TWSP involving shooting accounted for 464 predators shot in FY 2011. If four shots on average for each animal killed, the number of shots fired in FY 2011 during aerial operations was 1,856 shots. The number of shots fired by private hunters each year for just quail and doves would, at a highly conservative estimate of two shots fired per animal killed, would be nearly 16.6 million shots fired. Considering all additional small and big game harvested in the State, the shooting by the TWSP would be a small proportion of the shots fired by sportsmen. Therefore, the TWSP would add only exceedingly small amounts of gunshot noise to that which occurs annually as part of the existing human environment in wildlife habitat areas of Texas.

Gunshot noise from aerial operations conducted by the TWSP would likely have no discernible or at most only minor potential to adversely affect wildlife populations because of the infrequency and duration of aerial overflights. As shown in Table 8, aerial operations that could have involved shooting from an aircraft occurred over less than 1% of the land area in the District, which means only small proportions of non-target wildlife populations would ever hear any noise from gunshots. In addition, shooting from aircraft is virtually always at an extreme downward angle towards the ground. Pater (1981) (as 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 serve to lessen the noise in lateral directions from the aircraft. Personnel from the TWSP on the ground observing aerial hunting training passes in which shots are taken report that the gunshot noise heard at a distance of 150 yards or more is more like a pop-noise rather than the sound of an explosion (L. Burraston, National Aviation Manager, WS, pers. comm. 2006). This indicates shotgun noise from the airplane is not loud enough to cause much of a startling or disturbance effect at a distance. Animals that happen to be directly beneath or in close proximity to the aircraft when shooting passes are made would undoubtedly hear the firearm noise as much louder, but the low frequency of occurrence of flights and small fraction of aerial hunting time actually spent firing the shotgun, along with the very small proportion of the geographic area over which shooting passes would be made suggests only very small proportions of wildlife populations would be exposed to any close-proximity shotgun firing noise.

Consideration of Impacts to T&E and Sensitive Species in the Fort Worth District

Special efforts would be made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. SOPs to avoid effects to T&E species are described in Chapter 3 of this EA.

Section 2.2 of this EA identified and discussed potential impacts from damage management activities to T&E and sensitive species in the Fort Worth District. The USFWS and the TPWD monitor several species considered threatened, endangered, or sensitive in the Fort Worth District (see Appendix C). The USFWS and the TPWD monitor those species' populations to determine if different activities, singly or combined, would affect those species (*i.e*., a cumulative impact analysis). Mortality for T&E and sensitive species would be monitored where feasible by the USFWS and the TPWD. Mortalities due to road kill, loss of habitat (*e.g*., land development, construction, housing, industrial complexes, road, mining, and oil and gas development), and natural disasters (*e.g*., fires, floods, lightning, hard winters, and drought) would be the same under all alternatives and would be considered the environmental status quo. Mortality or population limiting factors associated with those events would be difficult to determine. These factors are not likely to be determined sufficiently, even with unlimited funding, and, thus, can only be estimated based on how well a population is doing (*e.g*., increasing, decreasing, stable). The availability of habitat is often the most critical concern because the available habitat determines the carrying capacity of an area. The TWSP has consulted with the USFWS and the TPWD and would continue to consult with those agencies, as necessary, to provide information regarding potential effects on T&E species associated with damage management activities.

SOPs to avoid T&E and sensitive species impacts were described in Section 3.4. Those SOPs should ensure that the alternatives would minimize impacts on T&E species. The TWSP has reviewed those species listed by the TPWD in the District and has determined this alternative would have no effect on those species based on the use patterns of the methods and locations where activities could occur in the District. The TWSP would continue to abide by the reasonable and prudent alternatives and measures and would abide by the terms and conditions established in a 1992 Biological Opinion issued by the USFWS to avoid adverse impacts to the bald eagle and listed species. Based on the use patterns of methods available and the locations where damage management activities could occur, the TWSP has determined this alternative would have no effect on threatened or endangered species that may occur in the District, including any designated critical habitat. The use patterns of methods would not result in affects to water and wetlands; therefore, no effects would occur to fish, amphibians, mollusks, and crustacean species listed within the District. In addition, the use patterns of methods would not modify or affect habitat; therefore, no effects would occur to invertebrate and plant species. Based on the use pattern of methods and the conclusions in the 1992 Biological Opinion issued by the USFWS, the TWSP would have no effect on those bird species listed in Appendix C. Based on the use pattern of methods and the known geographical extent of those mammal species listed as threatened or endangered, the activities conducted pursuant to this alternative would have no effect on the status of those species, including any designated critical habitat. The TWSP also initiated consultation with the USFWS for the ocelot and jaguar and the USFWS issued a Biological Opinion and amendment in 1999. The USFWS issued a *"may affect, but not likely to jeopardize"* opinion with reasonable and prudent alternatives and measures to avoid take.

The Louisiana black bear (*Ursus americana*) historically occurred in 53 counties of eastern Texas, with 16 of those counties occurring in the Fort Worth District[17]. The Louisiana black bear is listed as a threatened species pursuant to the ESA. The TWSP consulted with the USFWS pursuant to Section 7 of the ESA to facilitate interagency cooperation between the TWSP and the USFWS. During the consultation process, the TWSP was notified by the USFWS that consultations pursuant to Section 7 of the ESA are not necessary for programs within Texas because no known breeding populations of Louisiana black bears exist within the State. While the USFWS does not require consultations pursuant

[17]The Louisiana black bear historically occurred in Anderson, Bowie, Cass, Cherokee, Delta, Fannin, Gregg, Harrison, Hopkins, Lamar, Marion, Morris, Nacogdoches, Panola, Rusk, and Upshur Counties within the District.

to Section 7 of the ESA for the Louisiana black bears in Texas, WS recognizes its responsibility to prevent "*take*" of black bears pursuant to Section 9 of the ESA. SOPs have been developed to preclude adversely affecting the Louisiana black bear in the District (see Chapter 3).

The TWSP has not taken any T&E species in the District, and it is expected such take would continue to be avoided under the current program. The lack of take of any T&E species and the incorporation of SOPs (see Section 3.4) to protect non-target wildlife indicates that current management of the program poses no risk to T&E species. The TWSP would continue to monitor take and coordinate with the TPWD and the USFWS on future listings to minimize any adverse impacts.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

The potential effects to non-targets associated with this alternative would be similar to those threats addressed under the no action alternative (Alternative 1). Under this alternative, methods used for predation management would be similar to those used under the current program, with restrictions on resources protected only applicable to registered pesticides. Although additional activities could be conducted under this alternative to reduce damage or threats of damage across multiple resource types, those additional activities would not likely result in a substantial increase in the unintentional take of non-targets or non-target species. The TWSP would continue to implement those SOPs discussed in Chapter 3 to minimize the unintentional take of non-targets. Threats to T&E species under this alternative would also remain the same as those addressed under Alternative 1 and activities conducted pursuant to this alternative would have the same effects as those addressed under Alternative 1.

Under this alternative, the TWSP could provide assistance to enhance survival and recruitment of some wildlife species by reducing predation rates. In addition, this alternative would allow the TWSP to conduct activities to monitor disease prevalence in wildlife populations and to conduct disease surveillance activities. Information from disease monitoring and surveillance activities could then be used to implement measures to limit the spread of disease to benefit other wildlife or to minimize potential impacts associated with disease outbreaks.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the WS program would not be directly involved with damage management activities in the Fort Worth District. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. However, Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of assistance provided by the WS program. Risks to non-targets and T&E species would continue to occur from activities conducted by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own.

The ability to reduce negative impacts caused by predators to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The Texas A&M AgriLife Extension Services, the TWDMA, and the TPWD would still provide some level of professional assistance, but without assistance and supervision by the WS program. Those entities would likely continue to lethal removal minimal numbers of non-targets. If the assistance provided by those entities increased in proportion to assistance that the WS program would have provided, the effects on non-targets would likely be similar to Alternative 1 and Alternative 2. If those entities did not increase assistance in proportion to the assistance that the WS program would have provided, those activities conducted by private entities could increase. This could result in less experienced persons implementing methods and could lead to greater lethal removal of non-target wildlife than Alternative 1 and Alternative 2. Other entities could use methods where the personnel of the WS program may not because WS' personnel would follow those SOPs outlined in Chapter 3, such as WS' self-imposed restrictions on trap placement (*e.g*., not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds or using pan-tension devices to exclude smaller animals). Therefore, hazards to raptors, including bald eagles, and other non-targets could be greater under this alternative.

SOPs that would be followed by the TWSP, if the WS program were involved, to avoid T&E impacts were described in Chapter 3. Whereas the TWSP would adhere to these measures, private citizens might or might not be required to act in accordance with them. This could lead to a much greater impact on T&E species than under Alternative 1 and Alternative 2. It is anticipated that private efforts to lethal removal target predators could result in potential adverse impacts for T&E and sensitive species. This potential could be much higher than Alternative 1 and Alternative 2. The illegal use of methods often results in loss of both target and non-target wildlife (*e.g*., see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate lethal removal of wildlife species. Therefore, the potential for effects on non-target wildlife would be higher under this alternative than Alternative 1 and Alternative 2.

Alternative 4 – The WS Program Provides Technical Assistance Only

Under a technical assistance by the WS program alternative, WS would have no direct impact on non-target species, including T&E species. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize non-target impacts associated with the methods being recommended or loaned. Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations. Similar to Alternative 3, the Texas A&M AgriLife Extension Service and the TPWD along with private entities or organizations (*e.g*., TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of direct assistance provided by the WS program. Risks to non-targets and T&E species would continue to occur from activities conducted by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3.

Alternative 5 – Use of Only Non-lethal Methods by the WS program

A non-lethal management alternative would require the WS program to only recommend and use non-lethal methods to manage and prevent predation by nest predators. WS would provide technical assistance and direct operational assistance under this alternative recommending and using only non-lethal methods. Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected; therefore, individual non-target species excluded from areas may potentially be adversely affected if the area excluded was large enough. The use of auditory and visual dispersal methods would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential impacts on non-target species would be temporary with target and non-target species often returning after the cessation of dispersal methods.

Live traps (*e.g.*, cage traps, foothold traps) restrain wildlife once captured and are considered live-capture methods. Live traps have the potential to capture non-target species. Trap placement in areas where target species were active and the use of target-specific attractants could minimize the capture of non-targets. If traps were attended to appropriately, any non-targets captured could be released on site unharmed.

WS' involvement in the use of or recommendation of non-lethal methods would ensure non-target impacts were considered under WS' Decision Model. Most non-lethal methods would be available under all the alternatives analyzed. Impacts to non-targets from the use of non-lethal methods would be similar to the use of those non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal removal would occur from their use. Similar to Alternative 3 and Alternative 4, the Texas A&M AgriLife Extension Service and the TPWD along with private entities or organizations (*e.g.*, TWDMA) could and would likely continue to use lethal methods and those activities could increase in proportion to the reduction of assistance using lethal methods provided by the WS program. Risks to non-targets and T&E species would continue to occur from activities conducted by Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3 and Alternative 4.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

A common concern is the potential adverse effects that methods available could have on human health and safety. The threats to human safety of methods available under the alternatives are evaluated below by each of the alternatives.

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action)

The cooperator requesting assistance would be made aware through a MOU, Work Initiation Document, or a similar document that those methods agreed upon could potentially be used on property owned or managed by the cooperator. Therefore, the cooperator would be made aware of the possible use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods. Cooperators would be made aware by signing a MOU, cooperative service agreement, or another similar document, which would assist the TWSP and the cooperating entity with identifying any risks to human safety associated with methods at a particular location.

Under the no action alternative, those methods discussed in Appendix B could be singularly or in combination to resolve and prevent damage associated with predators in the District. The TWSP would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under the no action alternative. The TWSP would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from predators. Those non-lethal methods that could be used as part of an integrated approach to managing damage, that would be available for use by TWSP as part of direct operational assistance, would be similar to those risks associated with the use of those methods under the other alternatives.

Those lethal methods available under the no action alternative would also be available under the other alternatives. Employees of the TWSP who conduct activities to manage damage caused by predators would be knowledgeable in the use of those methods available, the wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by predators. When employing lethal methods, employees of the TWSP would consider risks to human safety when employing those methods based on location and method. For example, risks to human safety from the use of methods would likely be lower in rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property could be controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at public parks or near other public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. Activities would generally be conducted when human activity was minimal (*e.g.*, early mornings, at night) or in areas where human activities was minimal (*e.g.*, remote rural areas, in areas closed to the public).

Additionally, warning signs would be prominently posted to alert the public when and where, in the general area, methods were deployed. The TWSP in the Fort Worth District would coordinate with cooperators or landowners about where and when methods would be used, thereby decreasing the likelihood of conflicts with the public.

The use of live-capture traps, snares, and body-gripping traps has been identified as a potential issue. Live-capture traps available for predators would typically be walk-in style traps or foothold traps where predators enter but are unable to exit. Live-traps, snares, and body-gripping traps would typically be set in situations where human activity was minimal to ensure public safety. Those methods rarely cause serious injury and would only be triggered through direct activation of the device. Therefore, human safety concerns associated with live-traps, snares, and body-gripping traps used to capture wildlife, including predators, would require direct contact to cause bodily harm. Therefore, if left undisturbed, risks to human safety would be minimal. Signs warning of the use of those tools in the area could be posted for public view at access points to increase awareness that those devices were being used and to avoid the area, especially pet owners.

Safety issues related to the misuse of firearms and the potential human hazards associated with the use of firearms were issues identified. To help ensure the safe use of firearms and to increase awareness of those risks, employees of the TWSP who use firearms during official duties would be required to attend an approved firearm safety-training course and to remain certified for firearm use must attend a safety training course in accordance with WS Directive 2.615. As a condition of employment, WS' employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC § 922(g)(9)). A safety assessment based on site evaluations, coordination with cooperating and local agencies (if applicable), and consultation with cooperators would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. The TWSP would work closely with cooperators requesting assistance to ensure all safety issues were considered before firearms would be deemed appropriate for use. The use of all methods, including firearms, would be agreed upon with the cooperator to ensure the safe use of those methods. The security of firearms would also occur pursuant to WS Directive 2.615.

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods could include immobilizing drugs, euthanasia chemicals, sodium cyanide, sodium fluoroacetate, fumigants, and repellents.

The use of immobilizing drugs would only be administered to predators that have been live-captured using other methods or administered through injection using a projectile (*e.g*., dart gun). Immobilizing drugs used to sedate wildlife would be used to temporarily handle and transport animals to lessen the distress of the animal from the experience. Drug delivery would likely occur on site with close monitoring of the animal to ensure proper care of the animal. Immobilizing drugs would be reversible with a full recovery of sedated animals occurring. Drugs used in capturing and handling wildlife that would be available include ketamine, a mixture of ketamine/xylazine, and telazol.

If predators were immobilized for sampling or translocation and released, risks could occur to human safety if harvest and consumption occurred. SOPs employed by the TWSP to reduce risks are discussed in Chapter 3 and in Appendix B. SOPs that would be part of the activities conducted include:

- All immobilizing drugs used in capturing and handling wildlife would be under the direction and authority of state veterinary authorities, either directly or through procedures agreed upon between those authorities and the TWSP.
- As determined on a state-level basis by those veterinary authorities (as allowed by AMDUCA), wildlife hazard management programs may choose to avoid capture and handling activities that utilize immobilizing drugs within a specified number of days prior to the hunting or trapping season for the target species to avoid release of animals that may be consumed by hunters prior to the end of established withdrawal periods for the particular drugs used. Ear tagging or other marking of animals drugged and released to alert hunters and trappers that they should contact state officials before consuming the animal.
- Most animals administered immobilizing drugs would be released well before hunting/trapping seasons, which would give the drug time to completely metabolize out of the animals' systems before they might be taken and consumed by people. In some instances, animals collected for control purposes would be euthanized when they are captured within a certain specified time period prior to the legal hunting or trapping season to avoid the chance that they would be consumed as food while still potentially having immobilizing drugs in their systems.

Meeting the requirements of the AMDUCA should prevent any adverse effects to human health with regard to this issue.

Euthanizing chemicals would be administered under similar circumstances to immobilizing drugs. Euthanizing chemicals would be administered to animals live-captured using other methods. Euthanasia chemicals would include sodium pentobarbital, potassium chloride, and Beuthanasia-D. Euthanized animals would be disposed of in accordance with WS Directive 2.515; therefore, would not be available for harvest and consumption. Euthanasia of target animals would occur in the absence of the public to minimize risks, whenever possible.

The EPA (1994) "*…does not anticipate significant environmental exposure to sodium cyanide when used as an encapsulated material together with the M-44 ejector device and when the directions specified on the label are followed*". In addition, the EPA (1994) stated, "*The risk of cyanide poisoning from the current pesticidal uses to workers is minimal because of the current label restrictions*" and the "*…environmental impact of the pesticidal use of sodium cyanide is expected to be minimal because of its mode of application*". In regards to sodium fluoroacetate used in LPCs, the EPA (1995) stated, "*Under the current limited use pattern, no sodium fluoroacetate exposure to the general population is expected*". Those statements were re-affirmed by the EPA during a recent review of the registration of sodium cyanide in the M-44 device (EPA 2009).

The EPA (1994) concluded that the encapsulated use of sodium cyanide in M-44 ejectors would pose minimal risks to the environment based on the use pattern and the degradation pattern of sodium cyanide. Sodium cyanide readily reacts with moisture and atmospheric carbon dioxide to produce hydrogen cyanide gas. If a spill occurs or when the ejector is fired, the reaction of the sodium cyanide with moisture and carbon dioxide produces hydrogen cyanide gas that would diffuse into the atmosphere and be diluted into the air (EPA 1994). Reactions with soil components convert sodium cyanide to carbon dioxide and ammonia or other nitrogen containing compounds (EPA 1994). Microorganisms are also known to decompose cyanide in soils by producing carbon dioxide and ammonia as end products. Therefore, the EPA (1994) determined that groundwater contamination by cyanide from M-44 ejectors was not anticipated.

Based on available data, the EPA (1995) found that the modes of dissipation for Compound 1080 (sodium fluoroacetate) in the environment were leaching and metabolism through biological mediated processes. Limited data is available on the potential for sodium fluoroacetate to leach through the soil column. Using the solubility of Compound 1080 in water to determine the potential for mobility in soil, the EPA (1995) concluded that undegraded fluoroacetate might tend to leach in soil. The absorption of fluoroacetate by organic matter, clay particles, and plants likely reduces the potential for leaching (EPA 1995). Despite the potential for sodium fluoroacetate to leach to groundwater, no detections of the compound occurred in groundwater from 1971 to 1991 (EPA 1995) when the use of sodium fluoroacetate was much higher based on registered products available compared to the use of the compound today (labeled for use in LPCs only). However, if leaching occurs, toxicity studies of Compound 1080 have classified the compound as practically non-toxic to freshwater invertebrates (EPA 1995).

Gas cartridges could be available to fumigate burrows and den sites of woodchucks, coyotes, fox, and skunks in areas where damages were occurring. Gas cartridges act as a fumigant by producing carbon monoxide gas when ignited. The cartridges contain sodium nitrate, which when burnt, produces carbon monoxide gas. The TWSP would place the cartridges inside active burrows and dens at the entrance, ignite the cartridge, and seal the entrance to the burrow or den with dirt, which allows the burrow or den to fill with carbon monoxide. The carbon monoxide would dissipate into the atmosphere and be diluted by the air (EPA 1991). The TWSP would follow label instructions when employing gas cartridges. Therefore, no risks to human safety would occur from the use of gas cartridges.

The recommendation of repellents or the use of those repellents registered for use to disperse predators in the District could occur under the proposed action as part of an integrated approach to managing predator damage. Repellents for many mammal species contain different active ingredients with most ingredients occurring naturally in the environment. The most common ingredients of repellents are coyote urine, putrescent whole egg solids, and capsaicin. Those chemical repellents that would be available to recommend for use or that could be directly used by the TWSP under this alternative would also likely be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. Risks to human safety would be similar across all the alternatives. Involvement by the TWSP, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents were discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by personnel of the TWSP. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through participation by the TWSP.

No adverse effects to human safety have occurred from the use of methods by the TWSP to alleviate predator damage in the District from FY 2009 through FY 2011. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, would be considered low. Based on the use patterns of methods available to address damage caused by predators, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Consequences of Aerial Wildlife Operations Accidents

Aerial wildlife operations, like any other flying, may result in an accident. Pilots and crewmembers of the TWSP would be trained and experienced to recognize the circumstances that 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 Flight Training Center and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences should be evaluated.

Major Ground or Forest Fires: Although fires could result from aircraft-related accidents, no such fires have occurred from aircraft incidents previously involving government aircraft and low-level flights. The period of greatest fire danger typically occurs during the summer months, but the TWSP ordinarily conducts few, if any, aerial operations during the summer months.

Fuel Spills and Environmental Hazard from Aviation Accidents: A representative of the National Transportation Safety Board has stated previously 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 (USDA 2005). Helicopters used for aerial wildlife operations carry less fuel than fixed-wing aircraft (52-gallon maximum in a fixed-wing aircraft and 91-gallon maximum in the helicopters used by the TWSP). In some cases, little or none of the fuel would be spilled if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

Oil and Other Fluid Spills: With the size of aircraft used by the TWSP, the quantities of oil (*e.g.*, 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of being spilled in any accident would be small with minimal chance of causing environmental damage. Aircraft used by the TWSP would be single engine models, so the greatest amount of oil that could be spilled in one accident would be about 8 quarts.

Petroleum products degrade 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 to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents were not cleaned up, the oil does not persist in the environment or persists in such small quantities that no adverse effects would be expected. In addition, accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

Human Safety Consequences of Aerial Hunting Accidents: Beyond environmental consequences, other issues related to aviation accidents include the loss of aircraft and risks to the public and crewmembers. The use of aircraft by the TWSP would be quite different from general aviation (GAV) use. The environment in which the TWSP would conduct aerial operations would be inherently a higher risk environment than that for GAV. Low-level flights introduce hazards, such as power lines and trees, and the safety margin for error during maneuvers is higher compared to high-level flights. In 1998, the WS program commissioned an independent review of its aerial hunting operations because of several accidents. The panel made several recommendations to WS regarding enhanced aerial safety. The WS program implemented most all of those recommendations by 2001. WS has implemented an Aviation

Safety Program to support aerial activities and recognizes that an aggressive overall safety and training program is the best way to prevent accidents. While the goal of the aviation program is to have no accidents, accidents may still occur, especially those involving mechanical failure. Pilots and contractors would be highly skilled with commercial pilot ratings that have passed proficiency tests in the flight environment encountered by the TWSP. Pilots, gunners, and ground crews would be trained in hazard recognition and shooting would only be conducted in safe environments. Federal aviation regulations require pilots to fly a minimum distance of 500 feet from structures and people, and all employees involved in those operations would adhere to this requirement. Because of the remote locations in which the TWSP conducts aerial operations, the risk to the public from aviation operations or accidents would be minimal.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

The potential effects to human safety associated with this alternative would be similar to those threats addressed under the no action alternative (Alternative 1). Under this alternative, methods used for predation management would be the same as those used under the current program, with restrictions on resources protected only applicable to registered pesticides. Additional activities could be conducted under this alternative to reduce damage or threats of damage across multiple resource types; however, those additional activities would not likely result in a substantial increase in threats to human safety. The TWSP would continue to implement those SOPs discussed in Chapter 3 to minimize the effects of methods on human safety. Threats to human safety associated with methods under this alternative would remain the same as those addressed under Alternative 1.

Under this alternative, the TWSP may integrate the protection of human health or safety into decisions regarding predation management. For example, rabies management projects could include active surveillance of potential vectors/reservoirs of the rabies virus. Gray fox, coyotes, bobcats, raccoons, and striped skunks that could be removed during predation management efforts could be sampled to determine the presence and extent of rabies outbreaks. Those species could also be removed to reduce threats of disease transmission.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the WS program would not be directly involved with damage management activities in the Fort Worth District. Therefore, no direct impacts to human safety from methods would occur by WS under this alternative. However, like Alternative 4 and Alternative 5, Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of assistance provided by the WS program. Threats to human safety would continue to occur from methods used by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own.

The ability to reduce threats to human safety posed by available methods would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The Texas A&M AgriLife Extension Services, the TWDMA, and the TPWD would still provide some level of professional assistance, but without assistance and supervision by the WS program. Those entities would likely continue to employ those methods discussed in Appendix B. If the assistance provided by those entities increased in proportion to assistance that the WS program would have provided, the potential threats to human safety from methods available would be similar to Alternative 1 and Alternative 2. If those entities did not increase assistance in proportion to the assistance that the WS program would have provided, those activities conducted by private entities could increase. This could result in less experienced persons implementing methods and could lead to greater risks to human safety than Alternative 1 and Alternative 2. Other entities could use methods where the personnel of the WS program may not because WS' personnel would follow those SOPs outlined in Chapter 3 to reduce threats to human safety. Methods employed by those persons not experienced in the use of methods or are not trained in their proper use, could increase threats to human safety.

SOPs that would be followed by the TWSP, if the WS program were involved, to reduce threats to human safety were described in Chapter 3. Whereas the TWSP would adhere to these measures, private citizens might or might not be required to act in accordance with them. This could lead to a higher risk to human safety than under Alternative 1 and Alternative 2.

The TPWD currently issues aerial hunting permits for private shooting predators from aircraft. It is expected that private flying would increase under this alternative, as well as Alternative 4 and Alternative 5. So the chance of accidents would likely increase because private pilots would most likely not receive the same level of training as pilots from the TWSP and low-level flying has inherent risks associated with it. It is expected that more aircraft accidents could occur under this Alternative.

Alternative 4 – The WS Program Provides Technical Assistance Only

Under a technical assistance by the WS program alternative, the WS program would have no effect on human safety since the WS program would not directly employ methods. Technical assistance recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Therefore, the cooperator requesting assistance would be made aware of threats to human safety associated with the use of those methods recommended by the WS program. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available.

Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations. Similar to Alternative 3, the Texas A&M AgriLife Extension Service and the TPWD along with private entities or organizations (*e.g.*, TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of direct assistance provided by the WS program. Threats to human safety would continue to occur from activities conducted by Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3.

The TPWD would continue to issue aerial hunting permits for private shooting predators from aircraft and it is expected that more aircraft accidents could occur under this Alternative as addressed under Alternative 2.

If misused or applied inappropriately, any of the methods available to alleviate predator damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety. The recommendation of methods by WS to people requesting assistance and the pattern of use recommended by WS would comply with Executive Order 12898 and Executive Order 13045.

Alternative 5 – Use of Only Non-lethal Methods by the WS Program

A non-lethal management alternative would require the WS program to only recommend and use non-lethal methods to manage and prevent damage caused by predators. WS, as part of the TWSP, would provide technical assistance and direct operational assistance under this alternative recommending and using only non-lethal methods. Similar to Alternative 3 and Alternative 4, the Texas A&M AgriLife Extension Service and the TPWD along with private entities or organizations (*e.g*., TWDMA) could and would likely continue to use lethal methods and those activities could increase in proportion to the reduction of assistance using lethal methods provided by the WS program. Threats to human safety would continue to occur from activities conducted by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3 and Alternative 4.

Non-lethal methods recommend or employed by the WS program have the potential to threaten human safety. Threats to human safety associated with non-lethal methods that would be available under this alternative were address under Alternative 1. The threats to human safety associated with non-lethal methods under this alternative would be the same as those threats addressed under Alternative 1. The recommendation and use of non-lethal methods by WS would comply with Executive Order 12898 and Executive Order 13045 under this alternative.

The Texas A&M AgriLife Extension Services, the TWDMA, and the TPWD would still provide assistance using lethal methods under this alternative. Those entities would likely continue to employ those lethal methods discussed in Appendix B. If the assistance using lethal methods provided by those entities increased in proportion to assistance that the WS program would have provided using lethal methods, the potential threats to human safety from methods available would be similar to Alternative 1 and Alternative 2. If those entities did not increase assistance using lethal methods in proportion to the assistance that the WS program would have provided, those activities conducted by private entities using lethal methods could increase. This could result in less experienced persons implementing lethal methods and could lead to greater risks to human safety than Alternative 1 and Alternative 2. Other entities could use lethal methods where the personnel of the WS program may not because WS' personnel would follow those SOPs outlined in Chapter 3 to reduce threats to human safety. Lethal methods employed by those persons not experienced in the use of methods or were not trained in their proper use, could increase threats to human safety. The TPWD would continue to issue aerial hunting permits for private shooting predators from aircraft and it is expected that more aircraft accidents could occur under this Alternative as addressed under Alternative 2.

SOPs that would be followed by the TWSP, if the WS program were involved, to reduce threats to human safety were described in Chapter 3. Whereas the TWSP would adhere to these measures, private citizens might or might not be required to act in accordance with them. This could lead to a higher risk to human safety than under Alternative 1 and Alternative 2.

Issue 4 - Effects of Damage Management Activities on Recreational Activities

Recreation encompasses a wide variety of outdoor entertainment in the form of consumptive and non-consumptive uses. Consumptive uses include activities such as hunting, fishing, and rock-hounding. Non-consumptive uses include activities such as bird watching, photography, camping, hiking, biking, rock climbing, winter sports, and water sports. Recreationists are members of the general public that use public lands for one of the above or other activities. Recreation on private lands would likely be restricted by landowners and, thus, activities would not likely be impacted as much as on public lands.

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action)

The TWSP program in the Fort Worth District would only conduct damage management activities on properties when requested by the appropriate property owner or manager. The TWSP would only conduct activities after the TWSP and the entities requesting assistance signed a MOU, Work Initiation Document, or a comparable document. Therefore, the requesting entity would determine what activities would be allowed and when assistance was required. Because the TWSP would only conducted activities when requested by the appropriate property owner or manager and the requesting entity would determine what methods would be used to alleviate damage, no conflict with recreational activities would likely occur.

Under this alternative, activities to alleviate damage would have only marginal effects on recreation. The TWSP uses practical and efficient techniques that do not typically conflict with other land uses. The TWSP would only employ methods in accordance with landowner permission. During previous activities to alleviate damage, no measurable disruption to recreation was observed by the TWSP or was identified by other entities.

Most of the Fort Worth District consists of private properties where the owner or manager would have the discretion to determine what occurs or does not occur on property they own or manage. When assistance was requested on federal and/or state properties by the land management agency, the TWSP would coordinate activities with the agency through work plans or similar documents, which would be intended to identify potential conflicts with recreational use of those areas. For example, high-use recreational areas would be identified and avoided when the TWSP conducted damage management activities. The TWSP would not conduct damage management activities in high-use recreational areas, except when specifically requested by the appropriate manager or property owner. For example, the TWSP could conduct activities to alleviate immediate threats to human safety or in recreational areas if recreational use in an area was seasonal. High use recreation and other sensitive areas would be identified at the site-specific level on work plan maps or comparable documents, which would be modified as new damage situations arise. Human safety zones, planned control areas, and restricted or coordinated control areas would be identified through interagency communications.

In some cases, such as with the placement of traps, signs would be used to notify the public as required by WS Directive 2.450. Personnel would post signs in prominent places to alert the public that damage management activities were occurring in an area. On private lands, the landowner or manager would be aware of what methods were being used on their property; therefore, the landowner or manager could alert guests using the property that methods were being used on the property. Landowners would determine the areas and timing of equipment placement; thereby, avoiding conflicts with recreationists. For public lands, the TWSP would abide by all applicable laws and regulations regarding the use of different methods. The TWSP would coordinate with the different land management agencies requesting assistance to determine high public use areas and times of the year when activities would be conducted (*e.g*., after hunting seasons).

No effect on wildlife viewing, hunting, fishing, or other recreational activities would be expected because of involvement by the TWSP under this alternative. As previously stated, the level of access to certain areas is determined by land managers regardless of involvement by the TWSP. Wildlife viewing could be affected in a minor way. Because the objectives of reducing predation would be to remove or disperse predators from areas, this would mean that less individuals of the target species would be available to be observed. It would be expected that only resident and transient predators would be removed or dispersed. Those individuals that occupy adjacent home ranges would not be affected and would still be available for viewing opportunities. In addition, the magnitude of lethal removal addressed in the proposed action would be low when compared to the mortality of those species from all known sources. When the proposed lethal removal of predators by the TWSP was included as part of the known mortality of those species and compared to the estimated populations, the impact on those species' populations was below the level of removal required to lower population levels. Therefore, threats to recreational use of areas where the TWSP was requested to provide assistance would be minimal to non-existent under this alternative.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

The activities conducted and the methods used to manage damage under this alternative would be similar to those used under the current program, with restrictions on resources protected only applicable to registered pesticides. Therefore, the effects on this issues associated with this alternative would be similar to those addressed under Alternative 1. Additional activities could be conducted under this alternative to reduce damage or threats of damage across multiple resource types; however, those additional activities would not likely result in a substantial increase in activities that adverse effects to recreational activities would result. The TWSP would continue to implement those SOPs discussed in Chapter 3 to minimize the effects on recreational activities. Threats to recreational activities under this alternative would remain the same as those addressed under Alternative 1.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the WS program would not be directly involved with damage management activities in the Fort Worth District. Therefore, no direct impacts to recreational activities would occur by the WS program under this alternative. The Texas A&M AgriLife Extension Services, the TWDMA, and the TPWD would still provide some level of professional assistance, but without assistance and supervision by the WS program. Those entities could increase activities in proportion to the reduction of assistance provided by the WS program. Threats to recreational activities could continue to occur from activities conducted by those entities, including from those people who implement damage management activities on their own.

If the assistance provided by those entities increased in proportion to assistance that the WS program would have provided, the effects on recreational activities would likely be similar to Alternative 1 and Alternative 2. If those entities did not increase assistance in proportion to the assistance that the WS program would have provided, those activities conducted by private entities could increase. This could result in less experienced persons implementing methods and could lead to greater threats to recreational activities than Alternative 1 and Alternative 2. Other entities could use methods where the personnel of the WS program may not because WS' personnel would follow those SOPs outlined in Chapter 3.

This could lead to a much greater threat to recreational activities than under Alternative 1 and Alternative 2. The illegal use of methods often results in loss of both target and non-target wildlife (*e.g*., see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate lethal removal of wildlife species. Therefore, the potential threats to recreational activities could be higher under this alternative than Alternative 1 and Alternative 2.

Alternative 4 – The WS Program Provides Technical Assistance Only

Under a technical assistance by the WS program alternative, WS would have no direct impact on recreational activities. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations. Similar to Alternative 3, the Texas A&M AgriLife Extension Service and the TPWD along with private entities or organizations (*e.g*., TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of direct assistance provided by the WS program. Risks to non-targets and T&E species would continue to occur from activities conducted by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3.

Alternative 5 – Use of Only Non-lethal Methods by the WS program

The effects to recreation under a non-lethal only approach by the WS program would be similar to the effects associated with those non-lethal methods identified under Alternative 1. Non-lethal methods would be available under all the alternatives analyzed. Impacts to recreational activities from the use of non-lethal methods would be similar to the use of those non-lethal methods under any of the alternatives. Similar to Alternative 3 and Alternative 4, other entities could and would likely continue to use lethal methods and those activities could increase in proportion to the reduction of assistance using lethal methods provided by the WS program. Risks to recreational activities would continue to occur from activities conducted by Texas state agencies (*e.g*., Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g*., TWDMA), including from those people who implement damage management activities on their own similar to Alternative 3 and Alternative 4.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness of methods available under the alternatives for resolving predator damage and threats. The issues of method humaneness relating to the alternatives are discussed below.

Alternative 1 - Continue the Current Adaptive Integrated Predator Damage Management Program (No Action/Proposed Action)

Under the proposed action, the TWSP would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by the TWSP. Under this alternative, non-lethal methods would be used by the TWSP that were generally regarded as humane. Non-lethal methods that would be available include resource management methods (*e.g.*, cultural practices, modification of human behavior), translocation, exclusion devices, frightening devices, cage traps, foothold traps, immobilizing drugs, and repellents (see Appendix B for a complete list of methods).

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. Schmidt and Brunson (1995) conducted a public attitude survey in which respondents were asked to rate a variety of methods on humaneness based on their individual perceptions of the methods. Schmidt and Brunson

(1995) found that the public believes that the non-lethal methods, such as animal husbandry, fences, and scare devices, were the most humane and traps, snares, and shooting from aircraft was the least humane. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. With the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, agencies are challenged with conducting activities and employing methods that are perceived to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of the TWSP would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. The TWSP would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some methods have been stereotyped as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. For instance, a cage trap would generally be considered by most members of the public as "*humane*", since the animal would be alive and generally unharmed. Yet, without proper care, live-captured wildlife in a cage trap could be treated inhumanely if not attended to appropriately.

Therefore, the goal would be to effectively address requests for assistance using methods in the most humane way possible that minimizes the stress and pain to the animal. Overall, the use of resource management methods, harassment methods, and exclusion devices are regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals is likely temporary.

Although some issues of humaneness could occur from the use of cage traps, foothold traps, reproductive inhibitors, translocation, immobilizing drugs, nets, and repellents, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods would be from injuries to animals while those animals were restrained and from the stress of the animal while being restrained or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

If predators were to be live-captured by the TWSP, personnel would be present on-site during capture events or capture devices would be checked frequently to ensure predators captured were addressed in a timely manner and to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the no action alternative, lethal methods could also be employed to alleviate or prevent predator damage and threats, when requested. Lethal methods would include shooting, body-gripping traps, cable restraints, fumigants, euthanasia chemicals, sodium cyanide (M-44 device), sodium fluoroacetate (LPC), and the recommendation of harvest during hunting and/or trapping seasons. In addition, target species live-captured using non-lethal methods could be euthanized by the TWSP. The use of lethal methods by the TWSP under the no action alternative would follow those required by WS' directives (see WS Directive 2.505, WS Directive 2.430).

The euthanasia methods being considered for use under the no action alternative for live-captured predators would be carbon dioxide, carbon monoxide, gunshot, and barbiturates or potassium chloride in conjunction with general anesthesia. Those methods are considered acceptable methods by the AVMA for euthanasia and the use of those methods would meet the definition of euthanasia (AVMA 2013). The use of carbon dioxide, carbon monoxide, barbiturates, and potassium chloride for euthanasia would occur after the animal had been live-captured and would occur away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2013). WS' personnel that employ firearms to address predator damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

Research and development by the WS program has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods were used in situations where non-lethal damage management methods were not practical or effective. Personnel from the TWSP would be experienced and professional in their use of management methods. Consequently, management methods would be implemented in the most humane manner possible. Many of the methods discussed in Appendix B to alleviate predator damage and/or threats in the District could be used under any of the alternatives by those persons experiencing damage regardless of involvement by the TWSP. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives since those methods could be employed by other entities in the absence of involvement by the TWSP. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into activities conducted by the TWSP to ensure methods were used as humanely as possible are listed in Chapter 3.

Alternative 2 - Continue the Current Damage Management Program across Multiple Resource Types (Proposed Action)

Under this alternative, methods available would be the same as those methods used under the current program (Alternative 1), with restrictions on resources protected only applicable to registered pesticides. Additional activities could be conducted under this alternative to reduce damage or threats of damage across multiple resource types; however, those additional activities would not likely result in substantial humaneness concerns that would not arise from the use of those same methods under Alternative 1. The TWSP would continue to implement those SOPs discussed in Chapter 3 to ensure methods were used as humanely as possible. The humaneness associated with methods under this alternative would remain the same as those addressed under Alternative 1.

Alternative 3 - No Involvement by WS with the TWSP

Under this alternative, the WS program would not be involved with any aspect of predator damage management in the Fort Worth District. Like Alternative 4 and Alternative 5, Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA) could and would likely continue to conduct damage management activities and those activities could increase in proportion to the reduction of assistance provided by the WS program. The issue of humaneness would continue to occur from methods used by Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA), including from those people who implement damage management activities on their own. Those entities and people experiencing damage or threats associated with predators could continue to use those methods legally available.

Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods. The humaneness of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by the WS program under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to use to resolve damage and threats caused by predators. Under this alternative, euthanasia or killing of live-captured animals would also be determined by those persons employing methods to live-captured wildlife.

In addition, the WS program would be accountable to the public. The WS program makes information available to the public on the activities of the program. The public would be less aware of methods and activities that private individuals use and conduct to alleviate damage because there would be no reporting of activities. The people that perceive some methods as inhumane would be less informed about the activities being conducted by private individuals because private individuals would not be required to provide information under any policies or regulations similar to those of the WS program. Therefore, the perception of inhumane activities could be reduced because the activities of private individuals would not be publicly available, although the actual occurrence of activities may increase because private individuals would likely increase damage management activities in the absence of assistance.

Alternative 4 – The WS Program Provides Technical Assistance Only

The issue of humaneness of methods under this alternative would be similar to the humaneness issues discussed under Alternative 1 and Alternative 2. This perceived similarity would be derived from WS' recommendation of methods that some people may consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to Alternative 1 and Alternative 2. Under Alternative 4, WS would recommend the use of euthanasia methods pursuant to WS Directive 2.505. However, the person requesting assistance would determine what methods to use to euthanize or kill a live-captured animal under Alternative 4.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target predator species and to ensure methods were used in such a way as to minimize pain and suffering. However, the efficacy of methods employed by a cooperator would be based on the skill and knowledge of the requestor in resolving the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of predators or improperly identifying the damage caused by predators along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the potential for pain and suffering would likely be regarded as greater than discussed in the proposed action.

In addition, the issue of humaneness would continue to occur from methods used by Texas state agencies (*e.g.*, Texas A&M AgriLife Extension Service, and TPWD), and private entities or organizations (*e.g.*, TWDMA), including from those people who implement damage management activities on their own. Those entities and people experiencing damage or threats associated with predators could continue to use those methods legally available.

Alternative 5 – Use of Only Non-lethal Methods by the WS Program

Under this alternative, only non-lethal methods would be used by the WS program, which would generally be regarded as humane. Non-lethal methods would include resource management methods (*e.g.*, minor habitat modification, modification of human behavior), translocation, exclusion devices, frightening devices, live traps, foothold traps, cable restraints, and repellents.

Although some issues of humaneness could occur from the use of non-lethal methods, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of wildlife. Concerns from the use of those non-lethal methods would be from injuries to animals while restrained, from the stress of the animal while being restrained, or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

Overall, the use of resource management methods, harassment methods, live-capture methods, and exclusion devices would be regarded as humane when used appropriately. Although some concern arises from the use of live-capture methods, the stress of animals would likely be temporary and would cease once the animal was released. Similar to Alternative 3 and Alternative 4, the Texas A&M AgriLife Extension Service, TPWD, and/or private entities or organizations (*e.g*., TWDMA) could continue to use lethal methods.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

Cumulative impacts, as defined by the CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

Under Alternative 1, Alternative 2, Alternative 4, and Alternative 5, the WS program, as part of the TWSP, would address damage associated with predators either by providing technical assistance only (Alternative 4) or by providing technical assistance and direct operational assistance (Alternative 1, Alternative 2, Alternative 5) in the Fort Worth District. The WS program would be the primary federal agency conducting direct operational predator damage management in the District under Alternative 1, Alternative 2, Alternative 4, and Alternative 5. However, other federal, state, and private entities could also be conducting predator damage management in the Fort Worth District.

The TWSP does not normally conduct direct damage management activities concurrently with other agencies or other entities in the same area, but may conduct damage management activities at adjacent sites within the same period. In addition, commercial companies may conduct damage management activities in the same area. The potential cumulative impacts could occur from either damage management activities over time by the TWSP or from the aggregate effects of those activities combined with the activities of other agencies and private entities. Damage management activities in the Fort Worth District would be monitored to evaluate and analyze activities to ensure they were within the scope of analysis of this EA.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur because of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

Issue 1 - Effects of Damage Management Activities on Target Predator Populations

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on predator populations when targeting those species responsible for damage at the levels addressed in this EA. Actions of the TWSP would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but would not be limited to:

- Natural mortality of predators
- Mortality through vehicle strikes, aircraft strikes, and illegal harvest
- Human-induced mortality of predators through annual hunting and trapping seasons
- Human-induced mortality of predators through private damage management activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of predator populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage would be constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. The TWSP would use the Decision Model to evaluate damage occurring, including other affected elements and the dynamics of the damaging species; to determine appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process would allow the TWSP to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

The lethal removal of predators by the TWSP to alleviate damage or threats of damage from FY 2009 through FY 2011 was of a low magnitude when compared to the total known take of those species and the populations of those species. The analysis herein indicates predator populations are not being impacted to the point of causing a substantial decline. If, at some point in the future, wildlife populations declined due to harvest or damage management activities, then such a decline would not necessarily constitute a significant impact as defined by the NEPA. Such a decline would not constitute a significant effect so long as the actions that caused the decline were in accordance with the responsible management agency's goals and objectives, with applicable state law, and concomitantly, with the collective desires of the people of the District or State.

From the standpoint of the NEPA, justification for a finding of no significant impact on the quality of the human environment with respect to the lethal removal of most predators in the Fort Worth District is that WS' involvement has no adverse effect on the environmental status quo. If the WS program provided no assistance, under state authority, virtually the same predators that could have been lethally removed by the WS program could be removed by other agencies or private actions. Other agency personnel believe the involvement by the WS program, as part of the TWSP, actually benefits their ability to manage most predator mortality by encouraging livestock owners to rely on assistance in resolving depredation problems instead of killing predators themselves as allowed is allowed under state law. This suggests that, if the WS program stopped its involvement in most predator management in the District, there would be virtually no change in predator removal or in cumulative environmental effects. Additionally, landowners that are given assistance with damage problems are much more likely to have a favorable view of wildlife (International Association of Fish and Wildlife Agencies 2004).

No cumulative adverse effects on target and non-target wildlife would be expected from damage management activities based on the following considerations:

Historical outcomes of damage management activities on wildlife

The TWSP would conduct damage management activities associated with predators only at the request of a cooperator to reduce damage that was occurring or to prevent damage from occurring and only after methods to be used were agreed upon by all parties involved. The TWSP would monitor activities to ensure any potential impacts were identified and addressed. The TWSP would work closely with resource agencies to ensure damage management activities would not adversely affect predator populations and that activities were considered as part of management goals established by those agencies. Historically, the activities of the TWSP to manage damage or threats of damage associated with predators have not reached a magnitude that would cause adverse effects to predator populations in the District.

SOPs built into the program

SOPs are designed to reduce the potential negative effects of actions on predators, and have been tailored to respond to changes in wildlife populations that could result from unforeseen environmental changes. This would include those changes occurring from sources other than the TWSP. Alterations in programs would be defined through SOPs, and implementation would be insured through monitoring, in accordance with the WS' Decision Model (see WS Directive 2.201; Slate et al. 1992).

Issue 2 - Effects on Non-target Species Populations, Including T&E Species

Potential effects on non-target species from conducting predator damage management arise from the use of non-lethal and lethal methods to alleviate or prevent those damages. The use of non-lethal methods during activities to reduce or prevent damage caused by predators has the potential to exclude, disperse, or capture non-target wildlife. However, the effects of non-lethal methods are often temporary and often do not involve the lethal removal of non-target wildlife species. When using exclusion devices and/or repellents, both target and non-target wildlife can be prevented from accessing the resource being damaged. Since exclusion and repellents do not involve lethal removal, cumulative impacts on non-target species from the use of exclusionary methods or repellents would not occur but would likely disperse those individuals to other areas. Exclusionary methods and repellents can require constant maintenance to ensure effectiveness. Therefore, the use of exclusionary devices and repellents would be somewhat limited to small, high-value areas and not used to the extent that non-targets would be excluded from large areas that would cumulatively impact populations from the inability to access a resource, such as potential food sources or denning sites. The use of visual and auditory harassment and dispersion methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the lethal removal of non-target species and similar to exclusionary methods would not be used to the extent or at a constant level that would prevent non-targets from accessing critical resources that would threaten survival of a population.

The use of lethal methods or those methods used to live-capture target species followed by euthanasia also have the potential to affect non-target wildlife through the lethal removal or capture of non-target species. Capture methods used are often methods that would be set to confine or restrain target wildlife after being triggered by a target individual. Capture methods would be employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target wildlife, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-targets from capture. Most methods described in Appendix B are methods that would be employed to confine or restrain wildlife that would be subsequently euthanized using humane methods. With all live-capture devices, non-target wildlife captured could be released on site if determined to be able to survive following release. SOPs are intended to ensure take of non-target wildlife is minimal during the use of methods to capture target wildlife.

The use of firearms and euthanasia methods would essentially be selective for target species since identification of an individual would be made prior to the application of the method. Euthanasia methods would be applied through direct application to target wildlife. Therefore, the use of those methods would not affect non-target species.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according to WS' Directives and relevant federal, state, and local regulations. Chemical methods available for use under the proposed action would include repellents, sodium cyanide, sodium fluoroacetate, fumigants, immobilizing drugs, and euthanasia chemicals, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource, those chemical methods available for use would be employed using baits that were highly attractive to target species, used in known burrow/den sites, and/or used in areas where exposure to non-targets would be minimal. All chemicals would be used according to product labels, which would ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals would also ensure non-target hazards would be minimal.

The methods described in Appendix B have a high level of selectivity and could be employed using SOPs to ensure minimal impacts to non-target species. The unintentional take of wildlife would likely be limited and would not reach a magnitude where adverse effects would occur. Based on the methods available to resolve predator damage and/or threats, the TWSP does not anticipate the number of non-targets taken to reach a magnitude where declines in those species' populations would occur. Therefore, take under the proposed action of non-targets would not cumulatively affect non-target species. The TWSP has reviewed the T&E species listed by the USFWS in the Fort Worth District.

Some concerns have been raised regarding the cumulative effects on wildlife populations associated with aerial overflights when added to other types of low-level overflights.

Texas has nine military air bases with routine aerial activity: Naval Air Station (NAS) Corpus Christi, NAS Kingsville, NAS Fort Worth, Randolph Air Force Base (AFB) in Universal City, Laughlin AFB in Del Rio, Sheppard AFB in Wichita , Dyess AFB in Abilene, Goodfellow AFB in San Angelo, and Fort Bliss Army Post in El Paso. Not all military bases in Texas fly training missions. The Air National Guard in Colorado finalized an EIS (Air National Guard 1997) on a proposal to expand military training flights. That EIS contains considerable analysis on the potential for military training overflights by jet aircraft to adversely affect numerous wildlife species.

Many studies exist that have documented behavioral responses in wildlife associated with aerial overflights, but those studies have not provided evidence that wildlife species populations have been adversely affected to any substantial degree. The Air National Guard (1997) concluded that their Preferred Alternative (the Colorado Airspace Initiative), which involved from 62 to 2,461 sorties (military training flights) on 14 separately identified airspace components per year, was not expected to result in any significant environmental impacts. The Air National Guard (1997) concluded that no adverse effects were expected on any wildlife species in any of the airspace components where the training flights would occur.

Aircraft overflights within 650 to 1,640 feet have been shown to increase the heart rates and cortisol levels of large herbivores (United State Forest Service 1992). However, even when animals flee temporarily from approaching aircraft, available evidence suggests risks of damage are low as animals take care not to injure themselves when startled or frightened. Studies of wildlife subjected to aircraft overflights have not shown evidence of compromised reproduction, either directly or indirectly (United State Forest Service 1992). A majority of the literature reviewed led to the conclusion that numerous wildlife species have the ability to adapt to the presence of man and various man-made sound sources, including jet aircraft noise. Although initially startling, habituation to jet aircraft noise occurs with most wildlife species. No published scientific evidence was identified that indicated harm may occur to wildlife as a result of exposure to the levels of noise generated by military aircraft that would utilize the airspace associated with military training flight areas. It can be concluded that aircraft overflights will not adversely affect wildlife species within the region of influence. The Air National Guard (1997) analysis thus shows that military overflights, even where they occur on a regular basis up to many hundreds of times a year over specific areas, are not likely to result in adverse effects on wildlife.

There is no obvious threshold of significance when it comes to the cumulative effects of overflights on wildlife. This is because our analysis and the considerable analysis of the Air National Guard (1997) show that, despite considerable research on numerous wildlife species, no scientific evidence exists that indicates any substantive adverse effects on wildlife populations would occur as a result of any of the types of low level or other overflights that do or may occur. It is apparent that aerial operations activities that have occurred in Texas, or may occur in the future, even with the potential of other commercial or military training flights in the same area, would be inconsequential to what has already been found by analysis in an EIS to have little to no potential for causing adverse impacts on any wildlife species populations, despite the fact that the military training flights are far more numerous and produce far greater noise levels than the small aircraft used by the TWSP.

The analysis indicates that the scientific evidence does not support the conclusion that aerial overflights by the TWSP, or cumulatively when added to other types of overflights, have significant impacts on wildlife. There is considerable scientific evidence presented herein that overflights do not adversely affect wildlife. In conclusion, the TWSP has found no evidence to suggest that overflights effects on wildlife, even cumulatively, would result in significant impacts on wildlife species populations, let alone result in effects on such populations that would rise to the level of causing a significant impact on the quality of the human environment.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

Non-chemical methods described in Appendix B would be used within a limited period, would not be residual, and do not possess properties capable of inducing cumulative effects on human health and safety. Non-chemical methods would be used after careful consideration of the safety of those persons employing methods and to the public. When possible, capture methods would be employed where human activity was minimal to ensure the safety of the public. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed, would have no effect on human safety. All methods would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, Work Initiation Document, or other comparable document between the TWSP and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or lethal removal wildlife. Firearms used to alleviate or prevent damage, though hazards do exist, would be employed to ensure the safety of employees and the public.

Personnel employing non-chemical methods would continue to be trained to be proficient in the use of those methods to ensure the safety of the applicator and to the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse predators from areas of application would be available. Repellents must be registered with the EPA according to the FIFRA and with the TDA. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents were applied according to label requirements, no effects to human safety would be expected. Similarly, fumigants must also be registered for use with the EPA and the TDA. Given the use patterns of repellents and fumigants, no cumulative effects would occur to human safety.

The TWSP has received no reports or documented any effects to human safety from damage management activities conducted from FY 2009 through FY 2011. No cumulative effects from the use of those methods discussed in Appendix B would be expected given the use patterns of those methods for resolving predator damage in the Fort Worth District.

Issue 4 - Effects of Damage Management Activities on Recreational Activities

Based on a review of activities, it is not likely that alleviating predation risks in public-use areas would cause adverse effects to recreational activities. The TWSP program in Fort Worth District would only conduct damage management activities properties when requested by the appropriate property owner or manager. The TWSP would attempt to minimize conflicts with public-use areas by coordinating activities with the requesting land management agency (*e.g*., by developing work plans). Therefore, the requesting entity would determine what activities would be allowed and when assistance was required. Because the TWSP would only conducted activities when requested by the appropriate property owner or manager and the requesting entity would determine what methods would be used to alleviate damage, no conflict with recreational activities would likely occur.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The TWSP would continue to seek new methods and ways to improve current technology to improve the humaneness of methods used to manage damage caused by wildlife. Cooperation with individuals and organizations involved in animal welfare continues to be an agency priority for the purpose of evaluating strategies and defining research aimed at developing humane methods.

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked in accordance with Texas laws and regulations to ensure any wildlife confined or restrained were addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured predators would be applied according to WS' directives. Shooting would occur in some situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of predators lethally removed by this method.

The TWSP would employ methods as humanely as possible by applying SOPs to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide the TWSP in the use of methods to address damage and threats associated with predators in the Fort Worth District, the cumulative impacts on the issue of method humaneness would be minimal. All methods would be evaluated to ensure SOPs were adequate and that wildlife captured were addressed in a timely manner to minimize distress.

CHAPTER 5: LIST OF PREPARERS, PERSONS CONSULTED, AND REVIEWERS

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APPENDIX A
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APPENDIX B
METHODS AVAILABLE FOR RESOLVING OR PREVENTING PREDATOR DAMAGE

The most effective approach to resolving wildlife damage problems would be to integrate the use of several methods, either simultaneously or sequentially. An adaptive plan would integrate and apply practical methods of prevention and reduce damage by predators while minimizing harmful effects of damage reduction measures on people, other species, and the environment. An adaptive plan may incorporate resource management, physical exclusion and deterrents, and population management, or any combination of these, depending on the characteristics of specific damage problems.

In selecting damage management techniques for specific damage situations, consideration would be given to the responsible species and the magnitude, geographic extent, duration and frequency, and likelihood of wildlife damage. Consideration would also be given to the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. Those factors would be evaluated in formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to manage or reduce damage from predators. Various federal, state, and local statutes and regulations and WS directives would govern the use of damage management methods by the TWSP. The TWSP would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach there may be available a number of specific methods or techniques. The following methods could be recommended or used by the TWSP in the Fort Worth District. Many of the methods described would also be available to other entities in the absence of any involvement by the WS program.

Non-chemical Wildlife Damage Management Methods

Non-chemical management methods consist primarily of tools or devices used to repel, capture, or kill a particular animal or local population of wildlife to alleviate damage and conflicts. Methods may be non-lethal (*e.g.*, fencing, frightening devices) or lethal (*e.g.*, firearms, body gripping traps). If personnel of the TWSP apply those methods, a MOU, cooperative service agreement, or other similar document must be signed by the landowner or administrator authorizing the use of each damage management method.

Resource management includes a variety of practices that may be used by agriculture producers and other resource owners to reduce their exposure to potential predator depredation losses. Implementation of these practices is appropriate when the potential for depredation can be reduced without increasing the cost of production significantly or diminishing the resource owner’s ability to achieve land management and production goals. Changes in resource management are usually not conducted operationally by the TWSP, but usually implemented by producers. Many of these techniques can require the producer to devote significant time and initial expense towards implementing, but can be very effective (Knowlton et al. 1999, Conover 2002, Mitchell et al. 2004). The TWSP could assist producers in implementing some of these changes to reduce problems. Non-chemical methods used or recommended by the TWSP could include:

Exclusion pertains to preventing access to resources through fencing or other barriers. Fencing of small critical areas can sometimes prevent animals that cannot climb from entering areas of protected resources. Fencing installed with an underground skirt can prevent access to areas for many mammal species that dig, including coyotes, fox, feral cats, and striped skunks. Areas such as airports, yards, or gardens may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent the entry of mammals into buildings through existing holes or gaps. Electric fences of various constructions have been used effectively to reduce damage to various crops by raccoons (Boggess 1994).

Fences are widely used to prevent damage from predators. Exclusionary fences constructed of woven wire or multiple strands of electrified wire can be effective in keeping predators from some areas such as a sheep pasture or an airport. The size of the wire grid and height of the fence must be able to keep the predators out. In addition, an underground apron (*e.g.*, fencing in the shape of an "*L*" going outward) about 2 feet down and 2 feet out helps make a fence more wildlife proof; the "*L*" keeps predators out that dig crawl holes under the fence. However, fencing has limitations. Even an electrified fence is not always wildlife-proof and the expense of the fencing can often exceed the benefit. In addition, if large areas are fenced, the wildlife being excluded has to be removed from the enclosed area to make it useful. Some fences inadvertently trap, catch or affect the movement of non-target wildlife and may not be practical or legal in some areas (*e.g.*, restricting access to public land).

Netting consists of placing wire nets (chicken wire-mesh) or heavy-duty plastic, around or over resources, likely to be damaged or that have a high value. Netting is typically used to protect areas such as livestock pens, fish ponds and raceways, and structures. Complete enclosure of ponds and raceways to exclude all predatory wildlife such as raccoons typically requires wire mesh secured to frames or supported by overhead wires. Gates and other openings must also be covered. Complete enclosure of areas with netting can be very effective at reducing damage by excluding all problem species, but can be costly.

Cultural Methods includes the application of practices that seek to minimize exposure of the protected resource to damaging animals through processes other than exclusion. They may include animal husbandry practices, such as employing guard dogs, herders, shed lambing, carcass removal, or pasture selection. Strategies may also include minimizing cover where damaging predators might hide, manipulating the surrounding environment through barriers or fences to deter animals from entering a protected area, or planting lure crops on fringes of protected crops.

For example, the TWSP may talk with residents of an area to eliminate the feeding of wildlife that occurs in parks, recreational sites, or residential areas to reduce damage by certain predators, such as coyotes. Some predators that cause damage in urban environments are attracted to homes by the presence of garbage or pet food left outside and unprotected. Removal or sealing of garbage in tight trash receptacles, and elimination of all pet foods from outside areas can reduce the presence of unwanted mammals. If raccoons are a problem, making trash and garbage unavailable, and removing all pet food from outside during nighttime hours can reduce their presence. However, many people who are not directly affected by problems caused by wildlife enjoy wild animals and engage in activities that encourage their presence.

Another example of human behavior modification consists of assisting people that have a fear of an animal. The TWSP receives calls about species, such as large carnivores, that are not causing damage. Their mere presence is perceived as a threat to the callers even though the animal is in its natural habitat. Personnel of the TWSP provide educational information and reassurance about these species.

Guard Animals are used in damage management to protect a variety of resources, primarily livestock, and can provide adequate protection at times. Guard animals (*e.g.*, dogs, burros, and llamas) have proven successful in many sheep and goat operations. The effectiveness of guarding animals may not be sufficient in areas where there is a high density of wildlife to be deterred, where the resource (*e.g.*, sheep foraging on open range) is widely scattered, or where the guard animal to resource ratios are less than recommended. In addition, some guard animals intended for protection against small to medium size predators, like coyotes, may be prey to larger predators like mountain lions and black bears. The TWSP often recommends the use of guard dogs, but does not have an operational guard dog program.

Habitat Management would involve localized manipulation of habitats to minimize the presence of predators. Localized habitat management is often an integral part of damage management. The type, quality, and quantity of habitat are directly related to the wildlife produced or attracted to an area. Habitat can be managed to not produce or attract certain wildlife species. Habitat management is typically aimed at eliminating cover used by particular predators at specific sites. Limitations of habitat management as a method of reducing predator damage are determined by the characteristics of the species involved, the nature of the damage, economic feasibility, and other factors. Legal constraints may also exist that preclude altering particular habitats. Most habitat management recommended by the TWSP would be aimed at reducing wildlife aircraft strike hazards at airports (*e.g*., managing brush and grass cover at airports to reduce field rodent populations that are a prey-base attractant) or reducing cover for predators near lambing or calving pens and grounds to reduce predation. The last is particularly important because predators are more likely to be successful if the area is conducive to ambush or allows the predator to approach the prey species under the cover of dense brush. Removal or thinning of the brush can discourage predator activity. In addition, opening the area allows for better monitoring and increases the value of shooting. The TWSP provides recommendations at airports to modify the habitat, but generally does not engage in habitat management directly. The TWSP generally does not modify habitats nor recommend any sort of habitat modifications in T&E species habitat. Habitat modifications may require additional NEPA analysis if conducted by the TWSP, depending on the size of the project and the proposed method.

Animal Husbandry Techniques includes modifications in the level of care and attention given to livestock, shifts in the timing of breeding and births, selection of less vulnerable livestock species to be produced, and the introduction of human custodians (herders) to protect livestock. The level of care or attention given to livestock may range from daily to seasonal. Generally, as the frequency and intensity of livestock handling increase, so does the degree of protection (Robel et al. 1981). In operations where livestock are left unattended for extended periods, the risk of depredation is greatest. The risk of depredation can be reduced when operations permit nightly gathering so livestock are unavailable during the hours when predators are most active. It is also possible to reduce predation of sheep by concentrating sheep in smaller areas (Sacks and Neale 2002). Additionally, the risk of depredation is usually greatest with immature livestock. This risk diminishes as age and size increase and can be minimized by holding expectant females in pens or sheds to protect births and by holding newborn livestock in pens for the first two weeks. Shifts in breeding schedules can also reduce the risk of depredation by altering the timing of births to coincide with the greatest availability of natural prey to predators or to avoid seasonal concentrations of predators. The use of herders can also provide some protection from predators, especially those herders accompanying bands of sheep on open range where they are highly susceptible to predation.

Animal behavior modification refers to tactics that deter or repel damaging mammals and thus, reduce damage to the protected resource. Those techniques are usually aimed at causing target animals to respond by fleeing from the site or remaining at a distance. They usually employ extreme noise or visual stimuli. Unfortunately, many of these techniques are only effective for a short time before wildlife habituate to them (Conover 1982). Devices used to modify behavior in mammals include electronic guards (siren strobe-light devices), propane exploders, pyrotechnics, laser lights, human effigies, effigies of predators, and the noise associated with the discharge of a firearm.

The success of frightening methods depends on an animal's fear of, and subsequent aversion to, offensive stimuli (Shivak and Martin 2001). A persistent effort is usually required to effectively apply frightening techniques and the techniques must be sufficiently varied to prolong their effectiveness. Over time, animals often habituate to commonly used scare tactics and ignore them (Dolbeer et al. 1986, Graves and Andelt 1987, Bomford 1990). In addition, in many cases, animals frightened from one location become a problem at another. Scaring devices, for the most part, are directed at specific target species and operated by private individuals or personnel of the TWSP working in the field. However, several of these devices, such as scarecrows and propane exploders, are automated.

Harassment and other methods to frighten animals are probably the oldest methods of combating wildlife damage. These devices may be either auditory or visual and provide short-term relief from damage. A number of sophisticated techniques have been developed to scare or harass wildlife from an area. The use of noise-making devices (*e.g.*, electronic distress sounds, alarm calls, propane cannons, and pyrotechnics) is the most popular. Other methods include harassment with visual stimuli (*e.g.*, flashing or bright lights, scarecrows, human effigies, balloons, mylar tape, wind socks), vehicles, or people. Some methods such as the Electronic Guard use a combination of stimuli (siren and strobe light). These are used to frighten predators from the immediate vicinity of the damage prone area. As with other damage management efforts, these techniques tend to be more effective when used collectively in a varied regime rather than individually. However, the continued success of these methods frequently requires reinforcement by limited shooting or other local population reduction methods.

Other frightening methods in use are rubber bullets and beanbags that are shot from shotguns. Rubber bullets and beanbags do not kill or pass through an animal, but are intended to hurt them enough to avoid a particular activity again. Rubber bullets and beanbags have been used mostly for nuisance predators (*e.g.*, raccoons in garbage cans). When a predator associates being shot with raiding a garbage can or other nuisance activity, it is hoped that they will avoid that activity in the future.

Live Capture and Translocation can be accomplished using hand capture, hand nets, net guns, catch poles, cage traps, cable restraints, or with foothold traps to capture some predator species for the purpose of translocating them for release in other areas. The TWSP could employ those methods when the target animal(s) can legally be translocated or can be captured and handled with relative safety by personnel. Live capture and handling of mammals poses an additional level of human health and safety threat if target animals are aggressive, large, or extremely sensitive to the close proximity of people. For that reason, the TWSP may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. The AVMA, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission, particularly for small mammals such as raccoons or skunks (CDC 1990). Although translocation is not necessarily precluded in all cases, it would be logistically impractical, in most cases, and biologically unwise due to the risk of disease transmission. High population densities of some animals may make this a poor wildlife management strategy for those species. Translocation would be evaluated by the TWSP on a case-by-case basis; however, translocation would only occur when permitted by State law.

Trapping can utilize a number of devices, including nets, foothold traps, cage-type traps, and body-gripping traps, foot snares, and neck/body snares. Those techniques would be implemented by the TWSP because of the technical training required to use such devices.

Net Guns of various sizes have occasionally been used, primarily for research purposes, to catch target predators from aircraft or on the ground. The nets shoot from a rifle with prongs, go about 20 yards, and wrap around the target animal. This technique is mostly used in research to capture animals that will be sampled or equipped with radio telemetry devices. These would most likely be used to assist in capturing particular species such as coyotes for management purposes.

Foothold Traps can be effectively used to capture a variety of mammals. Foothold traps can be placed beside, or in some situations, in travel ways being actively used by the target species. Placement of traps is contingent upon the habits of the respective target species, habitat conditions, and presence of non-target animals. Effective trap placement and adjustment, and the use and placement of appropriate baits and lures by trained personnel also contribute to the selectivity of foothold traps. An additional advantage is that foothold traps can allow for the on-site release of non-target animals since animals are captured alive. The use of foothold traps requires more skill than some methods. Target animal live-captured in foothold traps are often euthanized humanely.

Cable Restraints are typically made of wire or cable, and can be set to capture an animal by the neck, body, and foot. They can be used effectively to catch most species, but are most frequently used to capture coyotes, fox, and mountain lions. Cable restraints are much lighter and easier to use than other methods and are not generally affected by inclement weather. Cable restraints may be used as either lethal or live-capture devices depending on how or where they are set. Cable restraints set to capture an animal by the neck are usually lethal but stops can be attached to the cable to increase the probability of a live capture depending on the trap check interval. Snares positioned to capture the animal around the body can be a useful live-capture device, but are more often used as a lethal control technique. Snares can incorporate a breakaway feature to release non-target wildlife and livestock where the target animal is smaller than potential non-targets (Phillips 1996). Snares can be effectively used wherever a target animal moves through a restricted travel lane (*e.g.*, under fences or trails through vegetation). When an animal moves forward into the loop formed by the cable, the noose tightens and the animal is held. Snares must be set in locations where the likelihood of capturing non-target animals is minimized.

The foot or leg snare can be set as a spring-powered non-lethal device, activated when an animal places its foot on the trigger or pan. Foot snares are used effectively to capture large predators, such as mountain lions. Additionally, several foot snare designs have been developed to capture smaller predators such as coyotes and bobcats. In some situations, using snares to capture wildlife is impractical due to the behavior or morphology of the animal, or the location of many wildlife conflicts. Snares must be set in locations where the likelihood of capturing non-target animals is minimized.

Cage traps come in a variety of styles to live-capture animals. The most commonly known cage traps are box traps. Box traps are usually rectangular and are made from various materials, including metal, wire mesh, plastic, and wood. These traps are used to capture animals alive and can often be used where many lethal tools were impractical. These traps are well suited for use in residential areas and work best when baited with foods attractive to the target animal. Box traps are generally portable and easy to set-up.

Cage traps of some disadvantages. Some individual target animals may avoid cage traps (*i.e.*, become trap shy). Some non-target animals may associate the traps with available food and they purposely enter the traps to eat the bait, making the trap unavailable to catch target animals. Cage traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions. Some animals will fight to escape, which may cause injuries to the animal. Cage traps can be expense to purchase.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed and alerts field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a string or wire and then placed away from the trap in a tree or shrub. When the monitor is hung above the ground, it can be detected from several miles away, depending on the terrain in the area. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area.

Trap monitoring devices would be employed, when applicable, that indicate when a trap has been activated. Trap monitoring devices would allow personnel to prioritize trap checks and decrease the amount of time required to check traps, which decreases the amount of time captured target or non-targets would be restrained. By reducing the amount of time targets and non-targets are restrained, pain and stress can be minimized and captured wildlife can be addressed in a timely manner, which could allow non-targets to be released unharmed. Trap monitoring devices could be employed where applicable to facilitate monitoring of the status of traps in remote locations to ensure any captured wildlife was removed promptly to minimize distress and to increase the likelihood non-targets could be released unharmed.

Body-grip Traps are designed to cause the quick death of the animal that activates the trap. Body-grip traps are not often used during predator damage management, except for smaller predators (*e.g.*, raccoons). One type of body-grip trap that is often used for smaller predators is the conibear trap. The conibear trap consists of a pair of rectangular wire frames that close like scissors when triggered, killing the captured animal with a quick body blow. For conibear traps, the traps should be placed so ensure the rotating jaws close on either side of the neck of the animal to ensure a quick death. Conibear traps are lightweight and easily set. WS policy prohibits the use of body-grip traps with a jaw spread exceeding 8 inches (*e.g.*, 330 Conibears®) for land sets. Safety hazards and risks to people are usually related to setting, placing, checking, or removing the traps. Body-grip traps present a minor risk to non-target animals. Selectivity of body-grip traps can be enhanced by placement, trap size, trigger configurations, and baits. When using body-grip traps, risks of non-target capture can be minimized by using recessed sets (placing trap inside a cubby, cage, or burrow), restricting openings, or by elevating traps. Choosing appropriately sized traps for the target species can also exclude non-targets by preventing larger non-targets from entering and triggering the trap. The trigger configurations of traps can be modified to minimize non-target capture.

Catchpoles are made of a coated cable on a pole that can be tightened around an animal to capture a predator by hand (typically diseased or entrapped animals) or safely handle a predator or non-target animal to remove it from a trap. This device consists of a hollow pipe with an internal cable or rope that forms an adjustable noose at one end. The free end of the cable or rope extends through a locking mechanism on the end opposite the noose. By pulling on the free end of the cable or rope, the size of the noose is reduced sufficiently to hold an animal. Catchpoles are used primarily to remove live animals from traps without danger to or from the captured animal, but they may be used to remove predators confined in small areas.

Shooting with firearms is very selective for the target species and would be conducted with rifles, handguns, and shotguns. Methods and approaches used by the TWSP may include use of vehicles or aircraft, illuminating devices, bait, firearm suppressors, night vision/thermal equipment, and elevated platforms. Shooting is an effective method in some circumstances, and can often provide immediate relief from the problem. Shooting may at times be one of the only methods available to effectively and efficiently resolve a wildlife problem.

Ground shooting is sometimes used as the primary method to alleviate damage or threats of damage. Shooting predators is frequently performed in conjunction with calling, particularly for coyotes, bobcats, and fox. Vocal calls, handheld mouth-blown calls, and electronic calls could be used to mimic target species (*e.g.*, coyote howls and raccoons fighting) or prey (*e.g.*, injured jackrabbit and chicken) vocalizations. Shooting would be limited to locations where it is legal and safe to discharge a weapon. A shooting program, especially conducted alone, can be expensive because it often requires many staff hours to complete.

Shooting can also be used in conjunction with an illumination device at night, which is especially useful for nocturnal mammals, such as raccoons, coyotes, and bobcats. Spotlights may or may not be covered with a red lens, which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot mammals at night, and is often the preferred equipment due to the ability to detect and identify animals in complete darkness. Night vision and FLIR equipment aid in locating wildlife at night when wildlife may be more active. Night vision and FLIR equipment could be used during surveys and in combination with shooting to remove target mammals at night. Personnel of the TWSP most often use this technology to target predators in the act of causing damage or likely responsible for causing damage. Those methods aid in the use of other methods or allow other methods to be applied more selectively and efficiently. Night vision and FLIR equipment allow for the identification of target species during night activities, which reduces the risks to non-targets and reduces human safety risks. Night vision equipment and FLIR devices only aid in the identification of wildlife and are not actual methods of take. The use of FLIR and night vision equipment to remove target predators would increase the selectivity of direct management activities by targeting those predators most likely responsible for causing damage or posing threats.

Aerial Shooting or aerial hunting (*i.e.*, shooting from an aircraft) is a commonly used coyote damage management method; it can be especially effective in removing offending predators (*e.g.*, coyote, bobcat) that have become "*bait-shy*" to trap sets or are not susceptible to calling and shooting. Aerial hunting consists of visually sighting target animals in the problem area and shooting them from an aircraft. Local depredation problems (*e.g.*, lamb and calf predation by coyotes) can often be resolved quickly through aerial hunting. Aerial hunting is mostly species-selective (there is a slight potential for misidentification) and can be used for immediate control to reduce livestock and natural resource losses if weather, terrain, and cover conditions are favorable. WS has also used aerial hunting for disease surveillance (*e.g.*, taking deer samples for chronic wasting disease and searching for carcasses in areas where an anthrax outbreak has occurred). Fixed-wing aircraft are most frequently used in flat and gently rolling terrain whereas helicopters with better maneuverability have greater utility and are safer over brush covered ground, timbered areas, steep terrain, or broken land where animals are more difficult to spot.

Cain et al. (1972) rated aerial hunting as "*very good*" in effectiveness for problem solving, safety, and lack of adverse environmental impacts. Connolly and O'Gara (1987) documented the efficacy of aerial hunting in taking confirmed sheep-killing coyotes. Wagner (1997) and Wagner and Conover (1999) found that aerial hunting might be an especially appropriate tool as it reduces risks to non-target animals and minimizes contact between damage management operations and recreationists. They also stated that aerial hunting was an effective method for reducing livestock predation and that aerial hunting 3 to 6 months before sheep are grazed on an area was cost-effective when compared with areas without aerial hunting.

Good visibility and relatively clear and stable weather conditions are required for effective and safe aerial hunting. Summer conditions limit the effectiveness of aerial hunting as heat reduces coyote activity and visibility is greatly hampered by vegetative ground cover. Air temperature (high temperatures), which influences air density affects low-level flight safety and may restrict aerial hunting activities. In broken timber or deciduous cover, aerial hunting is more effective in winter when snow cover improves visibility and leaves have fallen or in early spring before the leaves emerges. The WS program aircraft-use policy helps ensure that aerial hunting is conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must be certified under established WS program procedures and only properly trained WS' employees are approved as gunners. Ground crews are often used with aerial operations for safety reasons. Ground crews can also assist with locating and recovering target animals, as necessary.

Aircraft overflights have created concerns about disturbing wildlife. The National Park Service (1995) reviewed studies on the effects of aircraft overflights on wildlife. Their report revealed that a number of studies documented responses by certain wildlife species that could suggest adverse impacts may occur. Few, if any studies, have proven that aircraft overflights cause significant adverse impacts to wildlife populations, although the report stated it is possible to draw the conclusion that affects to populations could occur. It appears that some species will frequently, or at least occasionally, show adverse responses to even minor overflight occurrences. In general, it appears that the more serious potential impacts occur when overflights are frequent, such as hourly, and over long periods of time, which represents chronic exposure. Chronic exposure situations generally occur in areas near commercial airports and military flight training facilities. The use of firearms from aircraft would occur in remote areas where tree cover and vegetation allows for visibility of target animals from the air. The TWSP spends relatively little time over any one area.

The TWSP has used fixed-wing aircraft and helicopters for aerial hunting in areas inhabited by wildlife for years. The TWSP conducts aerial activities on areas only under signed agreement and concentrates efforts during certain times of the year and to specific areas. WS' Predator Damage Management Environmental Assessments (*e.g.*, see USDA 2005) that have looked at the issue of aerial hunting overflights on wildlife have found that WS has annually flown less than 10 min./mi.^{2} on properties under agreements. WS flies very little over any one property under agreement in any given year. As a result, no known problems to date have occurred with WS' aerial hunting overflights on wildlife, nor are they anticipated in the future.

Denning is the practice of locating coyote or fox dens and killing the young, adults or both to stop an ongoing predation problem or prevent future depredation of livestock. Denning is used in coyote and fox damage management, but is limited because dens are often difficult to locate and den use by the target animal is restricted to about 2 to 3 months during the spring. Coyote and red fox depredations on livestock and poultry often increase in the spring and early summer due to the increased food requirements associated with feeding and rearing litters of pups (Till and Knowlton 1983, Till 1992). Removal of pups will often stop depredations even if the adults are not taken (Till 1992). When the adults are taken at or near a known den location, it is customary to euthanize the pups to prevent their starvation because they would be unable to survive on their own. Pups are typically euthanized in the den using a registered gas fumigant cartridge or by digging out the den and euthanizing the pups with sodium pentobarbital (see discussion of gas cartridges and sodium pentobarbital). Den hunting for adult coyotes and their young is often combined with calling and shooting and aerial hunting. Denning is labor intensive with no guarantee of finding the den of the target animal. Denning is very target-specific and is most often used in open terrain where dens are comparatively easy to find.

Hunting/Trapping is sometimes recommended by the TWSP to resource owners. The TWSP could recommend resource owners consider legal hunting and trapping as an option for reducing predator damage. Although legal hunting/trapping is impractical and/or prohibited in many urban-suburban areas, it can be used to reduce some local populations of predators.

Aerial Surveying is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of wildlife. The WS uses aerial surveying throughout the United States to monitor damages and/or populations of coyotes, fox, wolves, feral swine, feral goats, feral dogs, bobcats, mountain lions, white-tailed deer, pronghorn antelope, elk, big-horn sheep, and wild horses but any wildlife species big enough to see from a moving aircraft could be surveyed using this method. As with aerial shooting, the WS program aircraft-use policy helps ensure that aerial surveys are conducted in a safe and environmentally sound manner, in accordance with federal and state laws. Pilots and aircraft must also be certified under established WS program procedures and policies.

Aerial Telemetry is used in research projects studying the movements of various wildlife species. Biologists will frequently place radio-transmitting collars on selected individuals of a species and then monitor their movements over a specified period. Whenever possible, the biologist attempts to locate the research subject using a hand-held antennae and radio receiver, however, occasionally animals will make large movements that prevent biologists from locating the animal from the ground. In these situations, the TWSP can utilize either fixed wing aircraft or helicopters and elevation to conduct aerial telemetry and locate the specific animal wherever it has moved to. As with any aerial operations, the WS aircraft-use policy helps ensure that aerial surveys would be conducted in a safe and environmentally sound manner, in accordance with federal and state laws.

Hunting Dogs are frequently used in predator damage management to locate, pursue, or decoy animals. The TWSP could use trailing/tracking, decoy, and trap-line companion dogs. Training and maintaining suitable dogs requires considerable skill, effort, and expense.

Tracking Dogs or trailing dogs are commonly used to track and "*tree*" target wildlife species, such as mountain lions, bobcats, and raccoons. Although not as common, they sometimes are trained to track coyotes (Rowley and Rowley 1987, Coolahan 1990). Dogs commonly used are different breeds of hounds, such as blue tick, red-bone, and Walker. They become familiar with the scent of the animal they are to track and follow, and the dogs strike (howl) when they detect the scent. Tracking dogs are trained not to follow the scent of non-target species. Personnel of the TWSP typically find the track of the target species at fresh kills or drive through the area of a kill site until the dogs strike. Personnel would then put their dogs on the tracks of the target predator. Typically, if the track is not too old, the dogs can follow the trail and tree the animal. The animal usually seeks refuge up a tree, in a thicket on the ground, on rocks or a cliff, or in a hole. The dogs stay with the animal until personnel arrive and dispatch, tranquilize, or release the animal, depending on the situation. A possibility exists that dogs could switch to a fresher trail of a non-target species while pursuing the target species. This could occur with any animal that they have been trained to follow, and could occur with an animal that is similar to the target species. For example, dogs on the trail of a mountain lion could switch to a bobcat, if they cross a fresher track. With this said, this risk can be minimized greatly by the personnel of the TWSP looking at the track prior to releasing the dogs and calling them off a track if it is determined that they have switched tracks.

Decoy Dogs are primarily used in coyote damage management in conjunction with calling. Dogs are trained to spot and lure coyotes into close shooting range for personnel of the TWSP. Decoy dogs are especially effective for territorial pairs of coyotes. Decoy dogs are typically medium-sized breeds that are trained to stay relatively close to personnel.

Trap-line Companion Dogs could accompany personnel of the TWSP in the field while they were setting and checking equipment. They would be especially effective in finding sites to set equipment by alerting their owners to areas where coyotes or other predators have traveled, urinated, or defecated, which are often good sites to make sets. Trap-line companion dogs stay with personnel and most always have no effect on non-target animals. Trap-line dogs may increase the selectivity towards territorial coyotes by identifying territorial canine scent locations.

Chemical Wildlife Damage Management Methods

Chemical Pesticides are widely used because they are often very effective at reducing or stopping damage. Although some pesticides are specific to certain taxonomic groups (*e.g*. birds vs. mammals), pesticides are typically not species specific, and their use may be hazardous to non-target species unless they are used with care by knowledgeable personnel. The proper placement, size, type of bait, and time of year are keys to selectivity and successful use of pesticides for damage management. When a pesticide is used according to its EPA registered label, it poses minimal risk to people, the environment, and non-target species.

All pesticides used by the TWSP would be registered under the FIFRA and administered by the EPA and the TDA. All personnel of the TWSP who apply restricted-use pesticides would be certified pesticide applicators by TDA and have specific training by WS for pesticide application. The EPA and the TDA require pesticide applicators to adhere to all certification requirements set forth in the FIFRA. Pharmaceutical drugs, including those used in wildlife capture and handling, are administrated by United States Food and Drug Administration and/or the United States Drug Enforcement Agency. Employees of the TWSP that use immobilizing drugs and euthanasia chemicals would be certified for their use and follow the guidelines established in the WS Field Operational Manual for the Use of Immobilization and Euthanasia Drugs.

Chemicals would not be used by the TWSP on public or private lands without authorization from the land management agency or property owner or manager. Under certain circumstances, personnel of the TWSP could be involved in the capture of animals where the safety of the animal, personnel, or the public could be compromised and chemical immobilization would provide a good solution to reduce those risks. For example, chemical immobilization could be used to capture mountain lions, coyotes, and raccoons in residential areas where public safety was at risk. Immobilizing drugs are most often used by the TWSP to remove animals from cage traps to be examined (*e.g*., for disease surveillance) or in areas such as urban, recreational, and residential areas where the safe removal of a problem animal is most easily accomplished with a drug delivery system (*e.g*., darts from rifle, pistol, blowguns, or syringe pole). Immobilization is usually followed by release (*e.g*., after radio collaring a mountain lion for a study), translocation, or euthanasia. Chemically euthanized animals would be disposed of by incineration or deep burial to avoid secondary hazards. Immobilizing drugs and euthanasia chemicals would be monitored closely and stored in locked boxes or cabinets according to WS' policies and Drug Enforcement Administration guidelines. Most drugs fall under restricted-use categories and must be used under the appropriate license from the Drug Enforcement Administration. The following chemical methods have been proven selective and effective in reducing damage by predators.

Ketamine (Ketamine HCl) is a fast acting dissociative anesthetic (*i.e*., loss of sensation with or without loss of consciousness) that is used to capture wildlife. Ketamine produces catatonia (*i.e*., lack of movement, activity, or expression) and profound analgesia (*i.e*., insensibility to pain without loss of consciousness), but not muscle relaxation. It is used to eliminate pain, calm fear, and allay anxiety. Ketamine is possibly the most versatile drug for chemical capture, and it has a wide safety margin (Fowler and Miller 1999). When used alone, this drug may produce muscle tension, resulting in shaking, staring, increased body heat, and, on occasion, seizures. Usually, ketamine is combined with other drugs, such as xylazine. The combination of such drugs is used to control an animal, maximize the reduction of stress and pain, and increase human and animal safety.

Telazol is a more powerful anesthetic and usually used for larger animals. Telazol is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride (a tranquilizer). Tiletamine hydrochloride is a dissociative anesthetic drug that disrupts the central nervous system to produce a cataleptic state. Zolazepam hydrochloride is a muscle relaxant that when combined with tiletamine produces a state of immobility, muscle relaxation, freedom from reflex movement, and analgesia. The product is generally supplied sterile in vials, each containing 500 mg of active drug, and when dissolved in sterile water has a pH of 2.2 to 2.8. Telazol produces a state of unconsciousness in which protective reflexes, such as coughing and swallowing, are maintained during anesthesia. Schobert (1987) listed the dosage rates for many wild and exotic animals. Before using Telazol, the size, age, temperament, and health of the animal are considered. Following a deep intramuscular injection of Telazol, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after the administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol administered, but usually requires several hours.

Xylazine is a sedative (*i.e*., tending to calm, moderate, or tranquilize nervousness or excitement) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with ketamine to produce a relaxed anesthesia. It can also be used alone to facilitate physical restraint. Because xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel should be even more attentive to minimizing sight, sound, and touch. When using ketamine/xylazine combinations, xylazine will usually overcome the tension produced by ketamine, resulting in a relaxed, anesthetized animal (Fowler and Miller 1999). This reduces heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions.

Sodium Pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after deer have been live-captured and properly immobilized to allow for direct injection. There are Drug Enforcement Agency restrictions on who can possess and administer this drug. Some states may have additional requirements for personnel training and particular sodium pentobarbital products available for use in wildlife. Certified personnel are authorized to use sodium pentobarbital and dilutions for euthanasia in accordance with Drug Enforcement Agency and state regulations. All animals euthanized using sodium pentobarbital and all of its dilutions (*e.g.* Beuthanasia-D, Fatal-Plus) would be disposed of immediately through incineration or deep burial to prevent secondary poisoning of scavenging animals and introduction of these chemicals to non-target animals.

Potassium Chloride used in conjunction with prior general anesthesia is used as a euthanasia agent for animals, and is considered acceptable and humane by the AVMA (2013). Animals that have been euthanized with this chemical experience cardiac arrest followed by death, and are not toxic to predators or scavengers.

Beuthanasia®-D combines pentobarbital with another substance to hasten cardiac arrest. Intravenous (IV) and intracardiac (IC) are the only acceptable routes of injection. As with pure sodium pentobarbital, IC injections with Beuthanasia®-D are only acceptable for animals that are unconscious or deeply anesthetized. With other injection routes, there are concerns that the cardiotoxic properties may cause cardiac arrest before the animal is unconscious completely. It is a Schedule III drug, which means it can be obtained directly from the manufacturer by anyone with a United States Drug Enforcement Agency registration. However, Schedule III drugs are subject to the same security and record-keeping requirements as Schedule II drugs.

Fatal-Plus® combines pentobarbital other substances to hasten cardiac arrest. IV is the preferred route of injection; however, IC is acceptable as part of the two-step procedure used by the TWSO. Animals are first anesthetized and sedated using a combination of ketamine/xylazine and once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered. Like Beuthanasia®-D, it is a Schedule III drug requiring a United States Drug Enforcement Agency registration for purchase and is subject to the security and record-keeping requirements of Schedule II drugs.

Carbon dioxide is sometimes used to euthanize mammals that are captured in live traps and when relocation is not a feasible option. Live mammals are placed in a sealed chamber. CO_2 gas is released into the chamber and the animal quickly dies after inhaling the gas. This method is approved as a euthanizing agent by the AVMA. CO_2 gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is the gas released by dry ice. The use of CO_2 by the TWSP for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

Repellents are usually naturally occurring substances or chemicals formulated to be distasteful or to elicit pain or discomfort for target animals when they are smelled, tasted, or contacted. Repellents are non-lethal chemical formulations used to discourage or disrupt particular wildlife behaviors. Olfactory repellents must be inhaled to be effective. These are normally gases, or volatile liquids and granules, and require application to areas or surfaces that need protecting. Taste repellents are compounds (*e.g.*, liquids, dusts, granules) that are normally applied to trees, shrubs, and other materials that are likely to be eaten or gnawed by the target species. Tactile repellents are normally thick, liquid-based substances that are applied to areas or surfaces to discourage travel of wildlife by causing irritation such as to the feet.

Only a few repellents are commercially available for mammals, and are registered for only a few species. The only repellents available for predators are unrestricted chemicals, such as tobacco dust (*e.g.*, F&B Rabbit and Dog Chaser®) and capsaicin from hot pepper (*e.g.*, Hot Sauce®, Miller®) that are sold over-the-counter to the general public to repel dogs and cats from areas where they are not wanted (*e.g.*, flower beds, gardens). Repellents would not be available for many species that may present damage problems, such as some predators or furbearing species. Repellents are variably effective and depend largely on resource to be protected, time and length of application, and sensitivity of the species causing damage. Again, acceptable levels of damage control would usually not be realized unless repellents were used in conjunction with other techniques.

Gas cartridges (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are often used to treat dens of coyotes, fox, or skunks. When ignited, the cartridge burns in the den of an animal and produces large amounts of carbon monoxide, a colorless, odorless, and tasteless, poisonous gas. The combination of oxygen depletion and carbon monoxide exposure kills the animals in the den. Sodium nitrate is the principle active chemical in gas cartridges and is a naturally occurring substance. Although stable under dry conditions, it is readily soluble in water and likely to be highly mobile in soils. In addition, dissolved nitrate is very mobile, moving quickly through the vadose zone to the underlying water table (Bouwer 1989). However, burning sodium nitrate, as in the use of a gas cartridge as a fumigant in a den, is believed to produce mostly simple organic and inorganic gases, using all of the available sodium nitrate. In addition, the human health drinking water tolerance level for this chemical is 10 mg / L, a relatively large amount, according to EPA Quality Criteria for Water (EPA 1986*a*, EPA 1986*b*). The gas along with other components of the cartridge, are likely to form oxides of nitrogen, carbon, phosphorus, and sulfur. Those products are environmentally non-persistent because they are likely to be metabolized by soil microorganisms or they enter their respective elemental cycles. In rodent cartridges, sodium nitrate is combined with seven additional ingredients: sulfur, charcoal, red phosphorus, mineral oil, sawdust, and two inert ingredients. None of the additional ingredients in this formulation is likely to accumulate in soil, based on their degradation into simpler elements by burning the gas cartridge. Sodium nitrate is not expected to accumulate in soils between applications, nor does it accumulate in the tissues of target animals (EPA 1991). The EPA stated sodium nitrates "*...as currently registered for use as pesticides, do not present any unreasonable adverse effects to humans*" (EPA 1991). The TWSP would only use gas cartridges in dens that show signs of active target animal use to minimize risks to non-target species.

Sodium Cyanide (EPA Reg. No. 56228-15) is used in the M-44 device, a spring-activated ejector device developed specifically to kill coyotes and other canids. The M-44 is a mechanical device that ejects sodium cyanide powder into the mouth of an animal that pulls up on it with its teeth. The M-44 is made of four parts and is set with special pliers. It is selective for canids (members of the dog family) due to their feeding behavior (scavenging) and because the attractants used are relatively canid-specific. When properly used, the M-44 presents little risk to humans and the environment, and provides an additional tool to reduce predator damage. The M-44 device consists of: (1) a capsule holder wrapped with fur, cloth, or wool; (2) a capsule containing 0.97 grams of powdered sodium cyanide; (3) an ejector mechanism; and (4) a 5-7 inch hollow stake. The hollow stake is driven into the ground, the ejector unit is cocked and placed in the stake, and the capsule holder containing the cyanide capsule is screwed onto the ejector unit. A fetid meat or other suitable bait is spread on the capsule holder. A canine attracted by the bait will try to pick up or pull the baited capsule holder. When the M-44 device is pulled, a spring-activated plunger propels sodium cyanide into the animal's mouth. Toxic symptoms may occur when swallowed, inhaled as a dust, or absorbed through the skin. When it encounters carbon dioxide or acids, it forms hydrogen cyanide gas. Hydrogen cyanide gas is highly and quickly toxic by contact, ingestion, or inhalation of vapors at which time it enters the bloodstream. Hydrogen cyanide gas is an asphyxiant that prohibits the use of oxygen which affects cellular activities and functions of all tissues in the body. The body is unable to use oxygenated blood (arterial blood). The body will respond to cyanide poisoning with a variety of symptoms depending on the amount of exposure. The characteristic response is a rapid loss of consciousness and cessation of breathing except with the mildest of exposures. After ingestion of a large dose of sodium cyanide, the target species may become unconscious within a few seconds. Breathing is rapid at first, but soon becomes slow and gasping. Convulsions may follow, but in severe poisoning cases, especially if untreated, coma and death may occur in a few minutes. M-44 users carry an antidote kit that consists of six amyl nitrite pearls while setting out or checking the devices. Personnel must be certified to use the M-44. The EPA label for the M-44 includes 26 use restrictions. Although the M-44 is selective for canids, the TWSP could lethally remove unintentionally some non-targets other than canids on rare occasions.

Sodium Fluoroacetate (EPA Reg. No. 56228-22 and EPA Reg. No. 46779-1), or Compound 1080, is currently used in the LPC to reduce coyote damage. The LPC is registered for use by the TWSP and livestock producer use that have been specially trained and certified under the FIFRA and the TDA. LPC use is restricted to fenced pastures where coyote predation of sheep or goats has occurred. The LPC, attached to the neck of a sheep or goat, dispenses the toxicant when punctured by the bite of an attacking predator and is selective not only for the target species, but also for target individuals. It especially targets coyotes because they characteristically attack sheep and goats by grabbing the throat whereas other wildlife and dogs attack the animal elsewhere on the body (*e.g.*, dogs attack the flanks and cougars the skull). As a result, fewer predators and non-target animals would be killed unintentionally to resolve depredations on pastured sheep and goats.

Secondary poisoning risk is reduced because scavengers tend to feed preferentially in the thoracic cavity and hind portion of the carcass, while Compound 1080 contamination would be primarily to the wool on the sheep's neck. The use of the LPC would pose little likelihood of a dog being poisoned because they usually attack flanks and not the throat, and that secondary hazards are at most minimal. In addition, the LPC would not be used extensively because it can only be used in very limited situations, as specified on the label.

The LPC consists of two rubber reservoirs, each of which contains about 15cc of a 1% solution of sodium fluoroacetate (Compound 1080) solution. The advantage of the LPC is its selectivity in eliminating only those individual predators that are responsible for attacking sheep and goats. Disadvantages include the limited applicability of this technique, death of collared livestock that are attacked, the logistics of having to collar and monitor the collared livestock, and the management efforts required to protect livestock other than the target flock (Connolly and Longhurst 1978, Burns et al. 1988). From an efficacy standpoint, use of the LPC is best justified in areas with a high frequency of predation (*i.e.*, at least one kill per week) or flocks that are high value, such as registered livestock.

Sodium fluoroacetate has been a subject of wide research in the United States and elsewhere and has been widely used for pest management in many countries. Fluoroacetate acid and related chemicals occur naturally in plants in many parts of the world and are not readily absorbed through intact skin (Atzert 1971). Sodium fluoroacetate is discriminatingly toxic to predators, being many times more lethal to them than most non-target species (Atzert 1971, Connolly and Burns 1990).

Chemical Medication Drugs are being used by the WS program nationally to treat animals that are infected with a disease or other malady, or to prevent the spread of disease (*e.g.*, rabies). WS is involved in disease surveillance, monitoring, and management programs to assist in minimizing the spread of disease and reduce the potential for humans to be infected. This may require that medication be given to wildlife through injections, or via oral or topical applications. Oral treatments, if not administered directly by a tube, are often contained in sachets disguised in baits acceptable by the target animal. Risk assessments on drugs being used in the field are completed prior to their use. WS is using an oral rabies vaccine that is a genetically engineered recombinant vaccinia-rabies glycoprotein (Raboral V-RG®, Merial Inc.) vaccine (USDA 2009). It is currently licensed for use in raccoons in the United States and Canada and approved for use in gray fox and coyotes in Texas. The TWSP has been using this vaccine since 1995. The vaccine has been extensively evaluated in the laboratory for safety in more than 50 vertebrate species with no adverse effects, regardless of inoculation route or dose. WS has used Imrab3®, Merial Inc. in rabies outbreaks. Imrab3® is another vaccine that is registered for use in small predators such as ferrets. Being vaccines, they are expected to have no adverse effects on non-target species and negligible on treated animals.

APPENDIX C
FEDERAL AND STATE LISTED T&E SPECIES IN THE FORT WORTH DISTRICT

SPECIES	Scientific Name	Status	District Locale		PDM
MAMMALS					
Rafinesque's Big Eared Bat	*Corynorhinus rafinesquii*	ST	Fort Worth		0
Louisiana Black Bear	*Ursus amerivanus luteolus*	F/S E	Fort Worth		0
Texas Kangaroo Rat	*Dipodomys elator*	ST	Fort Worth		0
BIRDS					
Bald Eagle	*Haliaeetus leucocephalus*	ST	Fort Worth		0
Golden-cheeked Warbler	*Dendroica chrysoparia*	F/S E	Fort Worth		0
Black-capped Vireo	*Vireo atricapilla*	F/S E	Fort Worth		0
Whooping Crane	*Grus americana*	F/S E	Fort Worth		0
Red-cockaded Woodpecker	*Picoides borealis*	F/S E	Fort Worth		0
REPTILES					
Texas Horned Lizard	*Phrynosoma cornutum*	ST	Fort Worth		0
Scarlet Snake	*Cemophora coccinea*	ST	Fort Worth		0
Timber (Canebrake) Rattlesnake	*Crotalus horridus*	ST	Fort Worth		0
Brazos Water Snake	*Nerodia harteri*	ST	Fort Worth		0
Louisiana Pine Snake	*Pituophis ruthveni*	F/S T	Fort Worth		0
Alligator Snapping Turtle	*Macrochelys temminckii*	ST	Fort Worth		0
NO AMPHIBIANS					
FISH					
Paddlefish	*Polyodon spathula*	ST	Fort Worth		0
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	ST	Fort Worth		0
Bluehead Shiner	*Pteronotropis hubbsi*	ST	Fort Worth		0
Blue Sucker	*Cycleptus elongatus*	ST	Fort Worth		0
Blackside Darter	*Rercina maculata*	ST	Fort Worth		0
PLANTS					
Earth Fruit	*Geocarpon minimum*	F/S T	Fort Worth		0
INSECTS					
American Burying Beetle	*Nicrophorus americanus*	FE	Fort Worth		0
NO MOLLUSKS AND CRUSTACEANS					
NO SPIDERS AND RELATIVES					

STATUS	HABITAT	PDM - Impacts
F *- Federal*	***D*** *- Desert/desert scrub*	*(-) = Negative*
S *- State*	***F*** *- Forests/riparian borders*	*0 = none*
E *- Endangered*	***G*** *- Grassland/meadow*	*(+) = Positive*
T *- Threatened*	***R*** *- Rangeland/sage/high desert*	
P *- Proposed*	***W*** *- Wetlands/marshes*	
C *- Candidate*	***L*** *- Lakes, Rivers*	
X *- Exp. nonessential pop.*	***S*** *- Small rivers/creeks/springs*	
	g *- Gravel/flowing water*	
	m *- mud bottoms/pools*	