PREDECISION

ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE MANAGEMENT IN EASTERN OKLAHOMA

Prepared By:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
ANIMAL DAMAGE CONTROL

In Cooperation With:

OKLAHOMA DEPARTMENT OF AGRICULTURE

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

December 1996

This publication, printed by the Oklahoma Department of Libraries as authorized by 65 O.S. 1991, §3-110, is produced by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control Program and the Oklahoma Department of Agriculture. A total of 125 copies have been printed at a cost of $550.00. Twenty-five copies have been deposited with the Oklahoma Department of Libraries, Publication Clearinghouse. 12/96.

TABLE OF CONTENTS

1.0 CHAPTER 1: PURPOSE OF AND NEED FOR ACTION 1-1

1.1 NEED FOR ACTION 1-3
1.1.1 Summary of Proposed Action 1-3
1.1.2 Need for Predator Damage Management for Protection of Livestock 1-4
1.1.3 Need for Predator Damage Management for Protection of Crops, Property, and, Human Health and Safety 1-6
1.2 RELATIONSHIP OF THIS ENVIRONMENTAL ASSESSMENT TO OTHER ENVIRONMENTAL DOCUMENTS 1-7
1.2.1 ADC Programmatic EIS 1-7
1.3 DECISIONS TO BE MADE 1-7
1.4 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS 1-7
1.4.1 Actions Analyzed 1-7
1.4.2 Counties Not Part of the Operational ADC Wildlife Damage Management Program 1-7
1.4.3 American Indian Lands and Tribes 1-7
1.4.4 Other Federal Lands 1-7
1.4.5 Period for Which This EA is Valid 1-7
1.4.6 Site Specificity 1-8
1.5 AUTHORITY AND COMPLIANCE 1-8
1.5.1 Authority of Federal and State Agencies in Wildlife Damage Management 1-8
1.5.2 Compliance with Federal Laws 1-9

2.0 CHAPTER 2: ISSUES 2-1

2.1 ISSUES 2-1
2.2 ISSUES USED TO DEVELOP MITIGATION 2-1
2.2.1 Effects on Nontarget Species Populations, Including T&E Species 2-1
2.2.2 Humaneness of Methods Used by ADC 2-1
2.2.3 The Public's Concern About Use of Chemicals 2-2
2.2.4 American Indian and Cultural Resource Concerns 2-2
2.3 ISSUES NOT CONSIDERED IN DETAIL WITH RATIONALE 2-3
2.3.1 ADC's Impact on Biodiversity 2-3
2.3.2 Livestock Losses Are a Tax "Write Off" 2-3
2.3.3 Livestock Losses Should Be an Accepted Cost of Doing Business 2-3
2.3.4 No Wildlife Damage Management at Taxpayer Expense, Wildlife Damage Management Should Be Fee Based 2-3

3.0 CHAPTER 3: ALTERNATIVES INCLUDING THE PROPOSED ACTION ... 3-1

3.1 ALTERNATIVES ANALYZED IN DETAIL 3-1
3.2 DESCRIPTION OF THE ALTERNATIVES 3-1
3.2.1 ALTERNATIVE 1 - Continue the Current Program (the Proposed Action) 3-1
3.2.2 ALTERNATIVE 2 - No Federal Predator Damage Management 3-6
3.2.3 ALTERNATIVE 3 - Technical Assistance Only 3-6
3.2.4 ALTERNATIVE 4 - Nonlethal Required Before Lethal Control 3-6

3.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE . . . 3-6
3.3.1 Compensation for Predator Damage Losses . . . 3-6
3.3.2 Bounties . . . 3-7
3.3.3 Eradication and Long Term Population Suppression . . . 3-7
3.3.4 The Humane Society of the United States (HSUS) Alternative . . . 3-7
3.3.5 Lithium Chloride as an Aversive Agent . . . 3-8
3.4 MITIGATION AND STANDARD OPERATING PROCEDURES FOR WILDLIFE DAMAGE MANAGEMENT TECHNIQUES . . . 3-8
3.4.1 Mitigation in Standard Operating Procedures (SOPs) . . . 3-8
3.4.2 Additional Mitigation Specific to the Issues . . . 3-9

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES . . . 4-1

4.1 ENVIRONMENTAL CONSEQUENCES . . . 4-1
4.1.1 Cumulative and Unavoidable Impacts . . . 4-1
4.1.2 Non-significant Impacts . . . 4-1
4.1.3 Irreversible and Irretrievable Commitments of Resources . . . 4-1
4.2 ISSUES ANALYZED IN DETAIL . . . 4-1
4.2.1 Effects on Target Predator Populations . . . 4-1
4.2.2 Effects on Nontarget Species Populations, Including T&E Species. . . . 4-9
4.2.3 Effects of Predator Removal on Prey Populations . . . 4-10
4.2.4 Humaneness of Control Techniques . . . 4-13

5.0 CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED . . . 5-1

5.1 List of Preparers . . . 5-1
5.2 List of Persons and Agencies Consulted . . . 5-1

APPENDIX A: LITERATURE CITED . . . A - 1

1.0 CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

Across the United States, wildlife habitat has substantially changed as human populations have expanded and land has been transformed to meet varying human needs. These changes often compete with wildlife and have inherently increased the potential for conflicts between wildlife and people. Some species of wildlife, in particular, have adapted to and thrive in the presence of humans and the changes that have been made. These species are often responsible for the majority of conflicting activities between humans and wildlife. The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Animal Damage Control (ADC) Final Environmental Impact Statement (FEIS) summarizes the relationship in American culture of wildlife values and wildlife damage in this way (USDA 1994):

> *"Wildlife has either positive or negative values, depending on varying human perspectives and circumstances . . . Wildlife generally is regarded as providing economic, recreational and aesthetic benefits . . . , and the mere knowledge that wildlife exists is a positive benefit to many people. However, . . . the activities of some wildlife may result in economic losses to agriculture and damage to property . . . Sensitivity to varying perspectives and values is required to manage the balance between human and wildlife needs. In addressing conflicts, wildlife managers must consider not only the needs of those directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well."*

ADC is charged by law with managing a Program to reduce human and wildlife conflicts. This Environmental Assessment (EA) evaluates a portion of this responsibility. Specifically, this EA addresses the management of mammalian predators, including almost all species in the Order *Carnivora* and the opossum (*Didelphis virginiana*), to resolve conflicts in the Northeast and Southeast Districts (formally the Oklahoma ADC East District which was split July 1, 1996) by ADC. Data for this EA reflects the East District prior to March 31, 1996. The dividing line between the two East Districts is roughly I-40 and between Eastern Oklahoma and the West District, roughly I-35 (Figure 1). For the purposes of this document, Eastern Oklahoma will be referred to as the District.

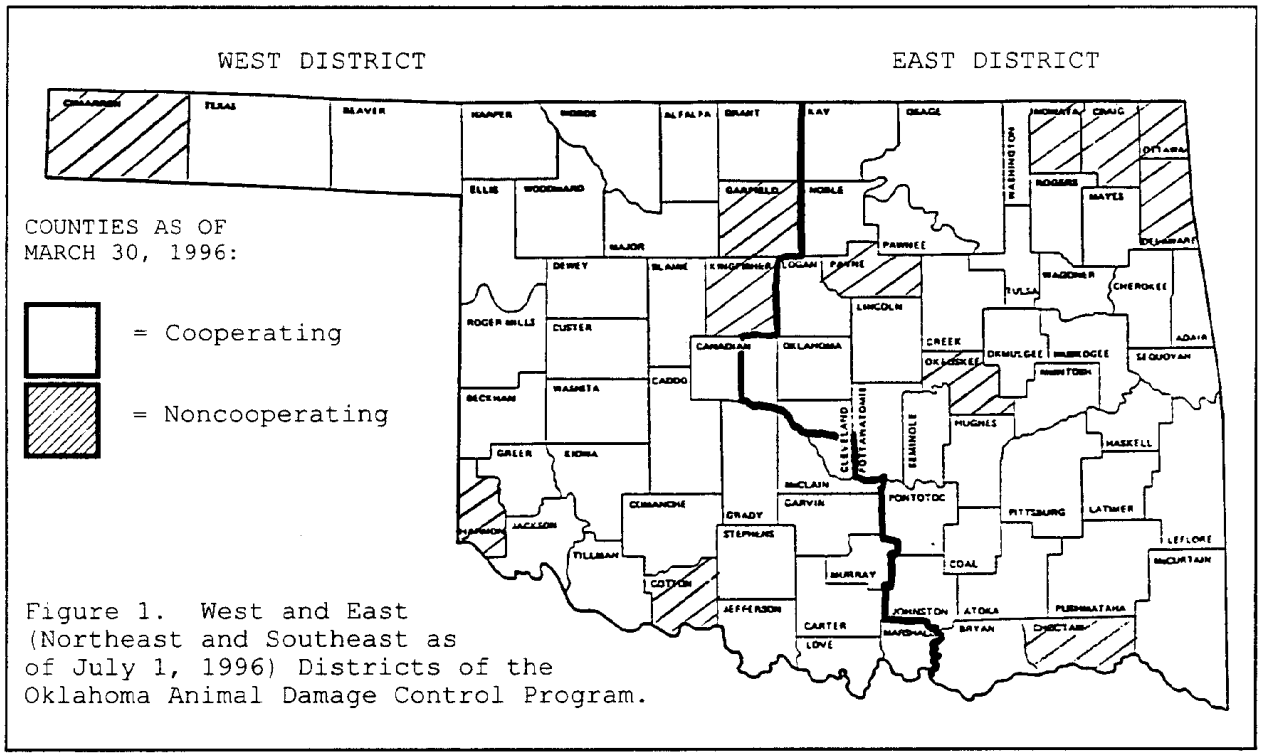

Figure 1. West and East (Northeast and Southeast as of July 1, 1996) Districts of the Oklahoma Animal Damage Control Program.

The District's physiognomic regions include mixed-grass plains in the northwest; post oak-blackjack uplands in the southwest counties of the District; tall grass prairie rolling hills in the north central region; oak-hickory Ozark Plateau in the northeast; and oak-hickory-pine Ouchita Highlands in the southeast. These regions support a wide variety of wildlife typical of the eastern deciduous forests and tall grass prairie.

Mammalian predators in the District include a range of species that prey on livestock and wildlife, damage property and other natural resources, and threaten human health and safety. Those that create the majority of conflicts are coyotes (*Canis latrans*), feral/free roaming dogs (*C. familiaris*), gray fox (*Urocyon cinereoargentus*), bobcats (*Lynx rufus*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), and opossums. Most other predators in the District have historically caused only localized damage on an occasional basis and include feral/free roaming cats (*Felis domesticus*), mink (*Mustela vison*), long-tailed weasels (*M. frenata*),badgers (*Taxidea taxus*), spotted skunks (*Spilogale putorius*), and red fox (*Vulpes vulpes*).

ADC responds to a few requests for assistance involving mountain lions (*Felis concolor*), but none have been verified by ADC in the District. ADC refers complaints received for river otters (*Lutra canadensis*) and black bears (*Ursus americanus*) the only other mammalian predators in the District, to the Oklahoma Department of Wildlife Conservation (ODWC); ODWC can request assistance from ADC to resolve problems with these species, but they will be the lead agency at all times. ADC does respond to requests involving predatory birds and reptiles. All of these species will be considered in other NEPA documentation pursuant to this.

The Oklahoma ADC Program

ADC's mission, developed through a strategic planning process, is to "provide leadership in wildlife damage management for the protection of America's agricultural, industrial and natural resources, and to safeguard public health and safety" (USDA 1989). This is accomplished through:

A) training of wildlife damage management professionals;
B) development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
C) collection, evaluation, and dissemination of management information;
D) cooperative wildlife damage management programs;
E) informing and educating the public on how to reduce wildlife damage; and
F) providing technical advice and a source for limited-use management materials and equipment such as pesticides, cage traps, and pyrotechnics.

ADC's Policy Manual[1] reflects the mission and provides guidance for engaging in wildlife damage control activities. Before wildlife damage management is conducted, *Agreements for Control* or *ADC Annual Work Plans* must be signed by ADC and the land owner/administrator/agency representative. ADC cooperates with land and wildlife management agencies, when appropriate and as requested, to combine efforts to effectively and efficiently resolve wildlife damage problems in compliance with all applicable federal, state, and local laws and Memorandums of Understanding (MOUs) between ADC and other agencies.

ADC is a cooperatively funded, service-oriented Program. Cooperators range from private citizens to other agency personnel. A primary cooperator of the Oklahoma ADC Program by legislation is the Oklahoma State Department of Agriculture (ODA). Their mission and support is primarily focused on the development and protection of Oklahoma agriculture, animal husbandry, forestry, wildlife, and human health and safety. The relationship and responsibilities between ADC and ODA are defined in an MOU.

---

[1]**ADC Policy Manual** - Provides guidance for ADC personnel to conduct wildlife damage management activities through Directives. ADC Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Section.

Purpose

This EA analyzes predator damage management (PDM) for the protection of livestock, crops, property, natural resources, and human health and safety. Normally, according to the APHIS procedures for implementing the National Environmental Policy Act (NEPA), individual wildlife damage management actions are categorically excluded (7 CFR 372.5(c), 60 Fed. Reg. 6,000-6,003, 1995). To evaluate and determine if the proposed program may cause significant impacts to the human environment, we have decided to prepare this EA.

PDM is conducted on private, state, county, and municipal lands, and a few classes of federal lands in the District. The area encompassed by the District covers more than 21.6 million acres which includes about 40½ counties as shown in Figure 1. As of March 1996, ADC had agreements to conduct PDM on about 2.1 million acres in 34 counties (Figure 1) representing about 10% of the total area in the District (MIS[2] 1996). Even though agreements are active, not all properties have PDM conducted on them during a given year. For example, properties totaling 670,000 acres had PDM conducted where target predators were taken in FY 95 (federal fiscal year 1995 = Oct. 1, 1994 - Sept. 30, 1995) representing about 3% of the lands in the District, even though many more properties had active agreements on them.

The majority of property under agreement for PDM is privately owned. As of March 1996, ADC had one agreement for conducting PDM on federal land (Tinker Airforce Base) which was for the purpose of reducing hazards to military aircraft during takeoffs and landings caused by coyotes traversing runways. The District ADC Program does not have current agreements for PDM projects on American Indian Tribes, U.S. Fish and Wildlife Service (FWS), U.S. Army Corps of Engineers, U.S. Forest Service, or other federal lands, but may do so in the future should any of the respective agencies or Tribes request ADC's service.

1.1 NEED FOR ACTION

1.1.1 Summary of Proposed Action

The proposed action is to continue the current ADC PDM activities in the District for the protection of livestock, crops, property, natural resources, and human health and safety. The objective of PDM as conducted in the proposed action is to minimize loss or the risk of loss to the above resource categories from predators by responding to all public requests with technical assistance (advice and/or demonstrations) or direct control. ADC employees will give technical assistance to resource owners on a variety of methods that can be used to resolve problems and where resource owners can handle the problem themselves or cooperative funds are not available. ADC will also assist resource owners through educational programs on damage identification, prevention, and control and providing a source of some supplies such as the loaning of cage traps and propane cannons.

Direct control support will mostly be given with methods that are difficult for the public to implement, especially those that involve lethal control measures, and where cooperative funding is available; resource owners that are given direct control assistance will also be encouraged to use additional management strategies and sound husbandry practices when and where appropriate to help reduce problems.

Under the proposed action, Integrated Wildlife Damage Management (IWDM) will be implemented which encourages the use of all legal techniques and methods, used singly or in combination, to meet the needs of the requestors for resolving conflicts with predators. Most wildlife damage situations require professional expertise, an organized control effort, and the use of up to several of the available control methods to sufficiently resolve them; this will be the task of ADC personnel who are trained professionals

[2]**MIS** - Computer-based Management Information System used by ADC for tracking Program activities. ADC in Oklahoma has had the current MIS system operational since FY 93, and an older version was in place since the early 80s. Throughout the text, MIS will be noted along with the year, ie. 1996, when the data was entered. MIS reports though will not be referenced in the Literature Cited Section since most reports from the MIS are not kept on file. A database is kept that allows queries to be made to retrieve the information needed.

and equipped to handle most damage situations. The resource, species, location and the type of damage, and the available biologically sound, cost-efficient and legal methods will be analyzed by ADC personnel to determine the action taken to correct a conflict with a predator.

The proposed action will allow the use of all legal methods. A wide range of methods are available to resource owners and ADC personnel. These fall into different categories including cultural practices (ie. shed lambing and guard animals), habitat and behavior modification (ie. exclusion, chemical repellents and hazing), and population management (ie. traps, shooting, and toxicants). Population management methods used by ADC personnel will include shooting, calling and shooting, aerial hunting, traps, snares, M-44s, denning, gas cartridges, and dogs; these techniques are primarily used lethally.

PDM will be allowed in the District under the proposed action when and where requested and on public and private lands where signed *Agreements for Control* are in place. All PDM will comply with federal, state, and local laws and current MOUs between ADC and the various management agencies. ADC personnel will communicate with other agency personnel when appropriate and necessary.

1.1.2 Need for Predator Damage Management for Protection of Livestock

Contribution of Livestock to the Economy

Agriculture generates over $3.8 billion in annual sales from farm and ranch commodities in Oklahoma. Of this, livestock production, primarily cattle, hogs, sheep, and poultry, accounts for about 70% of total farm commodity cash receipts (OASS 1995) and is, therefore, considered a primary agricultural industry sector in the State. In 1994, the total cash value from sales of all livestock products was about $2.7 billion in Oklahoma (OASS 1995).

Cattle and sheep production in the District and State contributes substantially to local economies (Table 2). In 1994, an estimated 5,100,000 cattle and calves were in Oklahoma valued at nearly $2 billion and 44% of these were in the District. Sheep and lamb inventories totaled 117,000 (excluding new crop lambs) valued at more than $5.5 million and 33% of these were in the District. Within the District, cattle and sheep are grazed almost exclusively on private lands in fenced, improved (planted) pastures and rangeland.

Table 2. Livestock numbers and their value to the Oklahoma economy in 1994.

1994 OKLAHOMA LIVESTOCK STATISTICS (in thousands)						
CLASS	**Cattle & Calves**	**Sheep & Lambs**	**Swine**	**Chickens**	**Total $ Livestock**	**Total Farm Rcpt.. (gross)**
Total Head - District	2,220	33	Not available	Not available	N/A	N/A
Total Head - State	5,100	117	300	190,670	N/A	N/A
Stock Receipts (Gross $)	1,998,804	5,543	87,217	363,726	2,699,805	3,864,455
% of Total Farm Rcpt..	52%	0.1%	2%	9%	70%	100%

Scope of Livestock Losses

Predators are responsible for the predation (killing, harassment, or injury resulting in monetary losses to the owner) of a wide variety of livestock including cattle, goats, sheep, swine, exotic pen-raised game, other hoofed-stock, and poultry. Cattle and calves are vulnerable to predation, especially at calving (NASS 1992, 1996). Sheep, especially lambs, goats (primarily Angora, Spanish), and poultry are highly susceptible to predation year-round (Henne 1975, Nass 1977, 1980, NASS 1991, Tigner and Larson 1977,

O'Gara et al. 1983). Livestock losses cause economic hardships to their owners and without effective PDM to protect them, predation losses are higher and, hence, the economic impacts greater (Nass 1977, 1980, Howard and Shaw 1978, Howard and Booth 1981, O'Gara et al. 1983).

Of the predators, coyotes inflict high predation rates on livestock. 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 these kills were not fed upon (Nass 1977). Coyotes were also the predominant predator on sheep throughout a Wyoming study and essentially the only predator in winter (Tigner and Larson 1977).

Connolly (1992) determined that only a fraction of the total predation attributable to coyotes is reported to or confirmed by ADC. He also stated that based on scientific studies and recent livestock loss surveys from NASS, ADC only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators. ADC Specialists do not attempt to locate every livestock kill reported by ranchers, but rather make attempts to verify sufficient losses to determine if a problem exists that requires PDM actions. Therefore, ADC reports do not actually reflect the total number of livestock lost.

Although it is impossible to accurately determine the amount of livestock PDM saves from predation, it can be estimated. Scientific studies have revealed that in areas without some level of PDM, losses of adult sheep and lambs to predators can be as high as 8.4% and 29.3% of the total number of head, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983). Conversely, other studies have indicated that sheep and lamb losses are significantly lower where PDM is applied (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978; Howard and Booth 1981). In evaluating cost effectiveness of PDM, the ADC programmatic EIS concluded that benefits, in terms of avoided sheep and lamb losses plus price benefits to consumers, are 2.4 times the cost of providing ADC PDM services for sheep protection in the 16 western states (USDA 1994). That analysis did not address the value of calf protection which is a substantial component of ADC PDM services in the District.

Loss of Livestock to Predators in Oklahoma

NASS (1995) reported that predators killed 1,025 adult sheep valued at $68,000 and 1,425 lambs valued at $51,300 in 1994 in Oklahoma. The most recent data available for statewide cattle and calf losses to predators is for 1991 (NASS 1992); the data indicated predation losses of 1,800 cattle valued at $1.1 million and 7,000 calves valued at $2.4 million in Oklahoma. In the District, losses to predators of all classes of livestock including poultry and commercially raised game amounted to $101,778 as reported to or verified by ADC (MIS 1995).

In the District, coyote predation accounted for more losses than all other predators combined. Of losses reported to or verified by ADC personnel during FY 95, coyote predation accounted for 89% of the value, followed by feral/free-ranging dogs at 4.5% and bobcats at 2.3%. The remainder of reported and verified predation losses were caused by red fox, gray fox, raccoons, opossums, and mink (MIS 1995). Additionally, badgers and striped skunks caused some damage to livestock in the District during FY 93-94 (MIS 1993, 1994).

ADC personnel routinely confirm a portion of the losses that are caused by predators by examining evidence at sites where depredations occur. Confirmed predation and injury losses to livestock in the District during 1995 totaled 8 adult cattle, 169 calves, 25 adult sheep, 27 lambs, 45 adult goats, 50 kid goats, 661 domestic fowl (ducks, geese, turkeys, chickens, and guinea fowl) and 32 domestic pigs in cooperating counties with an estimated total value of $68,000 (MIS 1995). These losses occurred in spite of control efforts by producers, who must tolerate additional costs for these activities (Jahnke et al. 1987), and ADC personnel.

Producers also lose livestock indirectly to predators. For example, an indirect potential loss to cattle producers is disease transmission from striped skunks; cattle were the number two carrier of rabies in Oklahoma preceded only by skunks in 1995 and most of the cases of rabies in cattle were probably transmitted by skunks (N. Eskew pers. comm.). This type of problem is typically minor, but the potential losses can be devastating if a major outbreak occurred.

Commercially raised game animals are also produced in Oklahoma including a variety of deer species, ratites, and others. Predators also take these; for example, in FY 95 coyotes killed 7 fallow deer and 12 other exotic game valued at $4,300 (MIS 1995) in the District.

1.1.3 Need for Predator Damage Management for Protection of Crops, Property, and Human Health and Safety

Predators impact a number of resources in Oklahoma other than livestock. Those resources include:

- Crops - Field crops such as melons (watermelons and cantaloupes), peanuts, sweet corn, field corn and wheat are sometimes damaged by species such as coyotes, feral/free-roaming dogs, badgers, and raccoons. Another type of problem is damage to improved or planted pasture caused by badgers burrowing; landowners complain that the holes and uneven ground left by the burrows hamper the use of planting and mowing equipment and can sometimes result in damage to such equipment. Total losses verified by or reported to ADC as a result of predator damage to crops and pasture in the District during FY 95 were valued at $1,790 (MIS 1995).

- Property - Animals kept as pets are one type of personal property damaged by predators in the District. The total number of pets reported as being killed by predators in the District in FY 95 was 49 at a total reported value of $3,300. ADC personnel verified 6 of these losses. Coyotes were responsible for 65% of the reported and/or verified losses of pets, with bobcats, badgers, feral dogs, and raccoons responsible for the rest. Other types of property that are damaged by predators are landscaping (badgers and raccoons at $250) and structures such as buildings and residential houses (skunks, opossum, raccoons, badgers, and coyotes at $1,500) (MIS 1995). Red and gray fox were not responsible for damage during FY 95, but were during FY 93-94 (MIS 1993, 1994).

- Human Health and Safety - ADC conducts limited PDM actions in the District to reduce human health and safety concerns of the public. Mammalian predators, mostly skunks (69%), were responsible for 85 human health and safety requests in FY 95 (MIS 1995). Airstrike hazards are among these and coyotes traversing runways at airports or airbases were also a cause for concern. Recommendations are generally made to consider exclusion methods (fences) to keep coyotes off of runways. However, when managers of affected aviation facilities determine that the costs of coyote-proof fencing are too great to be practical, then limited coyote removal from areas adjacent to runways is recommended and/or conducted by ADC to reduce hazards. Coyotes taken for this purpose generally total less than 5% of the total coyote take in the District. ADC could also be requested to conduct local population reduction of certain predator species to reduce risk of wildlife disease transmission to humans (e.g. rabies). Other species involved in human health and safety complaints in FY 93-95 were feral cat, gray and red fox, opossum, raccoon, feral dog, and long-tailed weasel (MIS 1994, 1994, 1995).

- Natural Resources - Predators are sometimes responsible for requests for assistance involving natural resources such as threatened and endangered (T&E) species protection. During FY 95 (MIS 1995), no requests were received involving wildlife predation concerns. In FY 93-94, requests were received for predation of deer, bobwhite and other native species by bobcats, weasels, coyotes, and feral dogs (MIS 1994, 1994). Most of these types of requests are handled through technical assistance. However, ADC may be requested to conduct PDM periodically for the protection of natural resources for other agencies; an example of this would be PDM for the protection of the endangered Interior least tern (*Sterna antillarum*) in Oklahoma requested by a wildlife management agency if unacceptable levels of predation to nests have occurred.

1.2 RELATIONSHIP OF THIS ENVIRONMENTAL ASSESSMENT TO OTHER ENVIRONMENTAL DOCUMENTS

1.2.1 ADC Programmatic EIS

ADC has issued a Final EIS on the national APHIS/ADC Program (USDA 1994). Pertinent information available in the FEIS has been incorporated by reference into this EA.

1.3 DECISIONS TO BE MADE

ADC is the lead agency for this EA, and therefore responsible for the scope, content, and decisions made. As cooperating agencies, ODA and ODWC provide input and direction to ADC to assure that Program actions are in accordance with the desires of the State of Oklahoma.

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

- Should PDM, as currently implemented, be continued in the District?
- If not, how should ADC fulfill its legislative responsibilities in the District?
- Does the proposal have significant impacts requiring preparation of an EIS?

1.4 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

1.4.1 Actions Analyzed. This EA evaluates PDM to protect livestock, crops, property, and human health and safety within the District.

1.4.2 Counties Not Part of the Operational ADC Wildlife Damage Management Program. Some counties in the District do not have Cooperative Agreements with ADC (Figure 1). Because the current program's mission is to provide assistance when requested and where funds are available, this EA analyzes impacts not only at the current program level, but at potential program levels should nonparticipating counties decide to enter the program.

1.4.3 American Indian Lands and Tribes. Presently, no Tribes have requested ADC to provide assistance with PDM in the District, but may do so in the future. The methods employed and potential impacts would be the same as for any private land upon which ADC could provide service. However, the Tribe, at that time, would be consulted to determine if PDM activities would impact traditional cultural properties or beliefs. Therefore, this EA would cover such actions, if requested and implemented.

1.4.4 Federal Lands. Currently ADC has not been requested to provide PDM assistance on federal lands in the District including FWS, U.S. Forest Service, Army Corps of Engineers, and others with the exception of coyote control at Tinker Air Force Base. The methods employed and potential impacts would be the same on these lands as they would be on private lands upon which ADC provides service. Therefore, if ADC were requested to conduct PDM on federal lands for the protection of livestock, property, human health and safety, or natural resources such as T&E species provided that PDM impacts to the T&E species have already been considered, this EA would cover such actions implemented.

1.4.5 Period for Which This EA Is Valid. This EA will remain valid until ADC determines that new demands for action or new alternatives have arisen that have different environmental affects and must be analyzed. At that time, this analysis and document will be supplemented pursuant to NEPA. This EA will be reviewed each year to ensure that it is complete and still appropriate for the scope of PDM activities in the District.

1.4.6 Site Specificity. This EA analyzes potential impacts of PDM and addresses ADC 's PDM activities on all lands under Cooperative Agreement and/or Agreements For Control within the District. It also addresses the impacts of PDM on areas where additional agreements with ADC may be written in the reasonably foreseeable future within the District. Because the proposed action is to continue the current Program, and because the current Program's goal and responsibility is to provide service when requested within the constraints of available funding and manpower, it is conceivable that additional PDM efforts could occur. Thus, this EA anticipates potential expansion and analyzes the impacts of such expanded efforts as part of the current Program. This EA emphasizes significant issues as they relate to specific areas whenever possible; however, the issues that pertain to predator damage and resulting management are the same, for the most part, wherever they occur, and are treated as such. The standard ADC Decision Model (Slate et al. 1992) and ADC Directive 2.105 will be the site-specific procedure for determining methods and strategies to use or recommend for individual actions conducted by ADC in the District (See USDA 1994, Chapter 2 and Appendix N for a more complete description of the ADC Decision Model and examples of its application). Decisions made using the model will be in accordance with any mitigation and standard operating procedures described herein and adopted or established as part of the decision.

1.5 AUTHORITY AND COMPLIANCE

1.5.1 Authority of Federal and State Agencies in Wildlife Damage Management in Oklahoma[3]

ADC Legislative Authority

The primary statutory authority for the ADC Program is the Animal Damage Control Act of 1931, which provides that:

> *The Secretary of Agriculture is authorized and directed to conduct such investigations, experiments, and tests as he may deem necessary in order to determine, demonstrate, and promulgate the best methods of eradication, suppression, or bringing under control on national forests and other areas of the public domain as well as on State, Territory or privately owned lands of mountain lions, wolves, coyotes, bobcats, prairie dogs, gophers, ground squirrels, jackrabbits, brown tree snakes and other animals injurious to agriculture, horticulture, forestry, animal husbandry, wild game animals, furbearing animals, and birds, and for the protection of stock and other domestic animals through the suppression of rabies and tularemia in predatory or other wild animals; and to conduct campaigns for the destruction or control of such animals. Provided that in carrying out the provisions of this Section, the Secretary of Agriculture may cooperate with States, individuals, and public and private agencies, organizations, and institutions."*

Since 1931, with changes in societal values, ADC policies and programs place greater emphasis on the part of the Act discussing "bringing (damage) under control," rather than "eradication" and "suppression" of wildlife populations. In 1988, Congress strengthened the legislative authority of ADC with the Rural Development, Agriculture, and Related Agencies Appropriations Act (Public Law 100-202, Dec.22, 1987. Stat. 1329-1331 (7 U.S.C. 426c)). This Act states, in part:

> *"That hereafter, the Secretary of Agriculture is authorized, except for urban rodent control, to conduct activities and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions in the control of nuisance mammals and birds and those mammal and bird species that are reservoirs for zoonotic diseases, and to deposit any money collected under any such agreement into the appropriation accounts that incur the costs to be available immediately and to remain available until expended for Animal Damage Control activities."*

---

3 See Chapter 1 of USDA 1994 for a complete discussion of federal laws pertaining to ADC.

Oklahoma Department Wildlife Conservation

ODWC has the responsibility to manage all protected and classified wildlife in Oklahoma, except federally listed T&E species, regardless of the land class on which the animals are found (1995 Oklahoma Revised Statutes (ORS) Title 29, §5-412, 412.1). ODWC is authorized to cooperate with ADC and ODA for controlling predatory animals (ORS Title 29, §3-103,105, §4-135). ODWC also issues permits, including those for aerial hunting per the Fish and Wildlife Act of 1956, as amended, to landowners, lawful tenants, and lessees to take predatory animals (ORS Title 29, §4-135). However, furbearers (badger, bobcat, fox, mink, opossum, raccoon, skunk, and weasel) found destroying livestock can be taken immediately without a permit by the general public (ORS Title 29, §5-405). Coyotes are not protected in Oklahoma and are classified as predatory animals by definition under ORS Title 29, §2-132.

ODWC has the responsibility to respond to damage complaints involving black bear and river otter, but they can request assistance from ADC for livestock depredation complaints involving bear under the MOU between ADC and ODWC as they have in a few instances. ADC responds to a number of complaints that involve "suspected" mountain lions in the District, although, none have been documented by ADC employees; under the MOU with ODWC, ADC has primary responsibility to respond to complaints involving livestock depredations and ODWC is responsible for nuisance complaints.

Oklahoma Department of Agriculture (ODA)

ORS Title 2, Article 12 (1995) discusses ODA's responsibilities regarding predatory animal and rodent control. ORS Title 2, §12-1 authorizes ODA to enter into agreements with ADC "for the purpose of cooperating in the control of coyotes, bobcats, and other predatory animals causing destruction to livestock, poultry, and game". It further states that "pursuant to this section the control and destruction of predatory animals . . . shall be conducted in accordance with an organized and systematic plan of field operations including but not limited to hunting, trapping, or other practical methods for the control of predatory animals. Said operations shall be directly supervised by {ADC}." It also allows ODA to enter into agreements with other entities to conduct PDM. ODA currently has an MOU and Annual Work Plan with ADC. These documents establish a cooperative relationship between ADC and ODA, outline responsibilities, and set forth annual objectives and goals of each agency for resolving wildlife damage management conflicts in Oklahoma.

Oklahoma Statutes - Animal Control Laws

ORS Title 4, §41 authorizes the take of any animal in the Canidae (dogs) and Felidae (cats) families found chasing, injuring, or killing livestock, including exotics, off the premises of the owner. This law also holds the owner of these animals liable for damages sustained from them to livestock and other property. Additional laws can be enacted to control dogs running at large in counties with more than 200,000 people (ORS 4, §43). In Oklahoma, dog control is generally the responsibility of local governmental agencies. Local animal control officials or County sheriffs are responsible for responding to dogs that threaten, damage, or kill livestock. ADC policy allows ADC to assist in feral dog control at the request of local authorities upon approval of the ADC State Director.

1.5.2 Compliance with Federal Laws. Several federal laws authorize, regulate, or otherwise affect ADC wildlife damage management. ADC complies with these laws, and consults and cooperates with other agencies as appropriate.

National Environmental Policy Act (NEPA) ADC prepares analyses of the environmental impacts of Program activities to meet procedural requirements of this law. This EA meets the NEPA requirement for the proposed action in the District.

Endangered Species Act (ESA) It is federal policy, under the ESA, 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.2(c)). ADC conducts Section 7 consultations with the FWS to use the expertise of the FWS 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 shall use the best scientific and commercial data available" (Sec.7(a)(2)). ADC has obtained a Biological Opinion from FWS describing potential effects on T&E species and prescribing reasonable and prudent measures for avoiding jeopardy (USDA 1994, Appendix F). Impacts from the different methods on T&E species in Oklahoma will be considered in this EA.

Migratory Bird Treaty Act The Migratory Bird Treaty Act provides the FWS regulatory authority to protect species of birds that migrate outside the United States. The law prohibits any "take" of these species, except as permitted by the FWS; therefore the FWS issues permits for managing wildlife damage situations. These permits do not have any impacts on mammalian predators, though.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All chemical methods used or recommended by the ADC Program in Oklahoma are registered with and regulated by EPA and ODA, and used by ADC in compliance with labeling procedures and requirements.

National Historic Preservation Act (NHPA) of 1966 as Amended The NHPA and its implementing regulations (CFR 36, 800) requires federal agencies to: 1) determine whether proposed activities constitute "undertakings" that can result in changes in the character or use of historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources; and 3) consult with appropriate American Indian tribes to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings. Activities described under the proposed action do not cause major ground disturbance and are not undertakings defined by NHPA. The Oklahoma Historic Preservation Office has indicated no concerns with PDM actions in the State.

2.0 CHAPTER 2 - ISSUES

Chapter 2 contains a discussion of the issues, including those that will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), and those that were used to develop mitigation measures and standard operating procedures, and the issues that will not be considered in detail with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop mitigation measures. Additional affected environments will be incorporated into the discussion of the environmental impacts in Chapter 4.

2.1 ISSUES

The following issues have been identified as areas of concern requiring consideration in this EA.

- Effects on Target Predator Species Populations
- Effects on Nontarget Species populations, including Threatened and Endangered Species
- Effects of Predator Removal on Prey Populations
- Humaneness of Control Techniques

2.2 ISSUES USED TO DEVELOP MITIGATION

2.2.1 Effects on Nontarget Species Populations, Including T&E Species

A common concern among members of the public and wildlife professionals, including ADC personnel, is the impact of PDM control methods and activities on nontarget species, particularly T&E species. Standard operating procedures of ADC include measures intended to mitigate or reduce the effects of PDM on nontarget species populations and are presented in Chapter 3.

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or mitigation measures. The results of the biological evaluation and a description of mitigation measures established are presented in Chapter 3.

2.2.2 Humaneness of Methods Used by ADC

The issue of humaneness, as it relates to the killing or capturing of wildlife is an important but very complex concept that can be interpreted in a variety of ways. Humaneness is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The issue of humaneness has two aspects in relation to the proposed action:

1. Animal welfare organizations are concerned that some methods used to manage wildlife damage expose animals to unnecessary pain and suffering. Research suggests that with some methods, such as restraint in leghold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements indicated similar changes in foxes that had been chased by dogs for about five minutes as those restrained in traps (USDA 1994). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

2. Humaneness, as perceived by the livestock industry and pet owners, requires that domestic animals be protected from predators because humans have bred the natural defense capabilities out of domestic animals. It has been argued that man has a moral obligation to protect these animals from predators (USDA 1994). Predators frequently do not kill larger prey animals quickly, and will often begin feeding on them while they are still alive and conscious (Wade and Bowns 1982). The suffering apparently endured by livestock damaged in this way is unacceptable to many livestock producers.

Thus, the decision-making process involves tradeoffs between the above two aspects of humaneness. The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology, yet provide sufficient PDM to resolve problems.

ADC has improved the selectivity of management devices through research and development such as pan tension devices for traps and breakaway snares. Research is continuing to bring new findings and products into practical use. Until such time as new findings and products are found to be practical, a certain amount of animal suffering will occur if PDM objectives are to be met in those situations where nonlethal control methods are not practical. Furthermore, if it were possible to quantify suffering, it is possible that the actual net amount of animal suffering would be less under the proposed action (or any other alternative involving the use of lethal methods) than under no action since suffering of livestock preyed upon by predators would be reduced if the action is successful.

ADC personnel in the District are experienced and professional in their use of management methods so that they are as humane as possible under the constraints of current technology. Mitigation measures and standard operating procedures used to maximize humaneness are listed in Chapter 3.

2.2.3 The Public's Concern About Use of Chemicals

The use of toxicants by ADC, which under the alternatives proposed in this EA include sodium cyanide in the M-44 device and carbon monoxide produced from the gas cartridge used for fumigating coyote, skunk, and fox dens, is regulated by EPA under FIFRA, Oklahoma Pesticide Control Laws, and ADC Directives. Based on a thorough Risk Assessment, APHIS concluded that, when ADC Program chemical methods, including those referenced above, are used in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible impacts on the environment (USDA 1994).

2.2.4 American Indian and Cultural Resource Concerns

The National Historic Preservation Act of 1966, as amended, requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and to consult with appropriate American Indian Tribes to determine whether they have concerns for cultural properties in areas of these federal undertakings. The Native American Graves and Repatriation Act of 1990 provides protection of American Indian burials and establishes procedures for notifying Tribes of any new discoveries. Senate Bill 61, signed in 1992, sets similar requirements for burial protection and Tribal notification with respect to American Indian burials discovered on state and private lands.

In most cases, wildlife damage management activities have little potential to cause adverse affects to sensitive historical and cultural resources. In consideration of cultural and archeological interests, though, the ADC Program solicited input from the Oklahoma State Historic Preservation Office (SHPO). Their response to ADC was that wildlife damage management activities would have negligible impacts to historic properties in Oklahoma.

In consideration of American Indian cultural and archeological interests, the ADC Program requested a list of the Tribes in the District from the Bureau of Indian Affairs (BIA). PDM activities will only be conducted at the request of a Tribe and, therefore, the Tribe will have ample opportunity to discuss cultural and archeological concerns with ADC.

2.3 ISSUES NOT CONSIDERED IN DETAIL WITH RATIONALE

2.3.1 ADC's Impact on Biodiversity

No ADC wildlife management program in Oklahoma is conducted to eradicate a wildlife population. ADC operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. Any reduction of a local population or group would be temporary because immigration from adjacent areas or reproduction would soon replace the animals removed. The impacts of the current ADC Program on biodiversity are not significant nationwide, statewide, or in the District (USDA 1994). ADC operates on a relatively small percentage of the land area of the District and ADC take is a small proportion of the total population of any species as analyzed in Chapter 4.

2.3.2 Livestock Losses Are a Tax "Write Off"

There is a belief that livestock producers receive double benefits by having a partially publicly funded program to resolve predation problems and also receive deductions as a business expense on tax returns. The Internal Revenue Service tax code (Internal Revenue Code, Section 1245, 1281) does not allow for livestock losses to be "written off" if the killed livestock was produced on the ranch. About 82% (MIS 1995) of predation occurs to young livestock (lambs, kids, and calves) in the District. Many ewes, nannies, and cows are added to herds as young livestock to replace breeding stock, and if lost to predation they cannot be "written off" since they were not purchased. These factors limit the ability of livestock producers to recover financial losses. Producers do not receive double benefits by having a federal program to manage wildlife damage and federal tax deductions for predation losses.

2.3.3 Livestock Losses Should Be an Accepted Cost of Doing Business -- a Threshold of Loss Should Be Reached Before Providing PDM Services

ADC is aware of concerns that federal wildlife damage management should not be allowed until economic losses become unacceptable. Although some losses of livestock and poultry can be expected and tolerated by livestock producers, ADC has the legal direction to respond to requests for wildlife damage management, and it is Program policy to aid each requester to minimize losses. ADC uses the Decision Model discussed in Chapter 3 to determine an appropriate strategy.

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie NF, et al., the United States District Court of Utah denied plaintiffs' motion for preliminary injunction. In part, the court found that a forest supervisor need only show that damage from predators is threatened to establish a need for wildlife damage management (Civil No. 92-C-0052A January 20, 1993).

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

ADC is aware of concerns that wildlife damage management should not be provided at the expense of the taxpayer or that it should be fee based. ADC was established by Congress as the agency responsible for providing wildlife damage management to the people of the United States. Funding for ADC PDM comes from a variety of sources in addition to federal appropriations. Such nonfederal sources include Oklahoma general appropriations, local government funds (county or city), livestock associations, and livestock producer funds which are all applied toward program operations. Federal, state, and local officials have decided that ADC needs to be conducted and have allocated funds for these activities. Additionally, wildlife damage management is an appropriate sphere of activity for government programs, since wildlife management is a government responsibility. A commonly voiced argument for publicly funded wildlife damage management is that the public should bear the responsibility for damage to private property caused by "publicly-owned" wildlife.

3.0 CHAPTER 3: ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 ALTERNATIVES ANALYZED IN DETAIL

1) Alternative 1 - Continue the Current Federal PDM Program. This is the Proposed Action as described in Chapter 1 and is the "No Action" alternative as defined by the Council on Environmental Quality for ongoing Programs.

2) Alternative 2 - No Federal ADC PDM. This alternative consists of no federal PDM.

3) Alternative 3 - Technical Assistance Only. Under this alternative, ADC would not conduct any direct operational PDM activities in the District. If requested, affected producers would be provided with technical assistance information only.

4) Alternative 4 - Nonlethal Required Before Lethal Control. This alternative would not allow any lethal control by ADC until nonlethal methods have been tried and found to be inadequate in each depredation situation.

3.2 DESCRIPTION OF THE ALTERNATIVES

3.2.1 ALTERNATIVE 1 - Continue the Current Program (the Proposed Action)

A complete description of the proposed action was presented in Chapter 1. The discussion that follows contains further information intended to foster understanding of ADC's rationale for constructing the proposed action.

Integrated Wildlife Damage Management (IWDM)

During more than 70 years of resolving wildlife damage problems, ADC has considered, developed, and used numerous methods of managing damage problems (USDA 1994, P. 2-15). The efforts have involved research and development of new methods and the implementation of effective strategies to resolve wildlife damage.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and control of damage caused by wildlife based on local problem analyses and the informed judgement of trained personnel. The ADC Program applies IWDM, commonly known as Integrated Pest Management (IPM) (ADC Directive 2.105), to reduce damage through the ADC Decision Model (Slate et. al. 1992) described in the FEIS (USDA 1994).

The philosophy behind IWDM is to implement effective management techniques in a cost effective manner while minimizing the potentially harmful effects on humans, target and nontarget species, and the environment. IWDM draws from the largest possible array of options to create a combination of techniques appropriate for the specific circumstances. IWDM may incorporate cultural practices (i.e. animal husbandry), habitat modification, animal behavior (i.e. scaring), local population reduction, or any combination of these, depending on the characteristics of the specific damage problems. In selecting management techniques for specific damage situations consideration is given to the:

- Species responsible;
- Magnitude of the damage;
- Geographic extent of damage;
- Duration and frequency of the damage;
- Prevention of future damage (lethal and nonlethal techniques); and
- Environmental concerns such as T&E species in the same area.

The cost of IWDM may be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

The IWDM Strategies That ADC Employs

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

- **Direct Control Assistance** (activities conducted or supervised by ADC personnel). Direct control assistance is implemented when the problem cannot effectively be resolved through technical assistance and when Cooperative Agreements provide for ADC direct control assistance. The initial investigation defines the nature and history of the problem, extent of damage, and the species responsible for the damage. Professional skills of ADC personnel are often required to effectively resolve problems, especially if restricted-use pesticides are proposed, or the problem is complex requiring the direct supervision of a wildlife professional. ADC considers the biology and behavior of the damaging species and other factors using the ADC Decision Model (Slate et al. 1992). The recommended strategy (ies) may include any combination of preventive and corrective actions that could be implemented by the requestor, ADC, or other agency, as appropriate. Two strategies are used by ADC.

  1. **Preventive Damage Management.** Preventive damage management is applying wildlife damage management strategies before damage occurs, based on historical damage problems. As requested and appropriate, ADC personnel provide information, conduct demonstrations and/or take action to prevent these historical problems from recurring. For example, in areas where substantial lamb depredation has occurred on lambing grounds, ADC may provide information about guard dogs, fences or other husbandry techniques, or be requested to conduct operational PDM prior to lambing. Preventive damage management can take place on private and county lands without special authorization. For activities on federal lands, historical loss areas are delineated to identify areas where preventive PDM may occur. Maps are available for public review at the appropriate federal office. In addition, when conducting PDM on federal lands, ADC must receive a request from the resource owner or individual that is experiencing the damage. Management areas and restrictions on techniques within areas and within certain time periods are designated and reviewed during annual meetings between the appropriate agencies.

  2. **Corrective Damage Management.** Corrective damage management is applying PDM to stop or reduce current losses. As requested and appropriate, ADC personnel provide information and conduct demonstrations or, with the appropriate signed agreement, take action to prevent additional losses from recurring. For example, in areas where lamb depredations are occurring, ADC may provide information about guard dogs, fences or husbandry techniques, and conduct operational PDM to stop the losses.

Predator Damage Management Methods Available for Use

Most PDM methods have strengths and weaknesses in each specific predator damage situation. ADC personnel can determine for each PDM activity what method or combination of methods are most appropriate and effective using the ADC Decision Model. A number of methods are available for consideration in this process. ADC conducts direct control operations with any of the following methods on a property only where signed *Agreements For Control On Private Property* are in place, or on county or other local government lands *Agreements For Control On Nonprivate Property* and includes the intended target animals and methods to be used.

Nonlethal Methods

Livestock producer and other resource owner practices consist primarily of nonlethal preventive methods such as animal husbandry, and habitat and animal behavior modifications. Livestock husbandry and other management techniques are implemented by the livestock producer. Producers are encouraged to use these methods, based on the level of risk, need, and professional judgement on their effectiveness and practicality (USDA 1992).

1. **Animal Husbandry.** This pertains to the level of care and attention given to livestock. These practices vary between the different classes of livestock, their age and size. Animal husbandry practices include, but are not limited to, techniques such as guard dogs, herders, shed lambing, and carcass removal. These techniques are often only useful in specific situations and have drawbacks. For example, guarding animals are most effective for small acreage farm flocks of sheep, but have not been proven to be effective for cattle and calf protection. In addition, guard dogs have been known to chase other wildlife besides predators; some kill deer fawns regularly and others have influenced wild turkey distribution (Timm and Schmidt 1989). Thus, although considered a nonlethal control measure, guard dogs can have lethal or otherwise detrimental impacts on nontarget wildlife. Close confinement of cattle during calving is sometimes practical for small operations but, as a rule, not for large rangeland operations. Carcass removal usually is not feasible on extensive pasture and range operations, but usually imperative for small acreage (Wade 1982).

2. **Habitat Modifications.** These are methods that alter habitat to attract or repel certain wildlife species, or to separate livestock from predators. Habitat modifications are encouraged when and where practical, and based on the type and extent of the livestock operation. For example, clearing brushy or wooded areas in or adjacent to lambing or calving pastures may be appropriate to reduce available cover for predators; this type of habitat modification, though, is typically not allowed on National Forest or other public lands.

3. **Animal Behavior Modifications.** This refers to tactics that alter the behavior of wildlife to reduce predation or other damages. Animal behavior modification may use scare tactics or fencing to deter or repel animals that cause loss or damage to livestock or property. Some devices in this category are predator-proof fences, electronic guards, propane exploders, and pyrotechnics. These techniques are generally only practical in small acreage situations. Scaring devices are typically only effective for a short period of time for predators as they often become accustomed and learn to ignore them. Predator-proof fencing is effective when it is monitored, but typically cost-prohibitive for many producers, especially for large operations. Fencing adequate to stop predator movements can also restrict movements of game animals and other wildlife (Wade 1982). In large rangeland pasture situations, predators may

be enclosed with livestock by construction of predator proof fencing; this means depredations would likely occur anyway requiring the implementation of predator removal methods to resolve depredation problems. Scaring devices such as propane exploders are often not practical under large rangeland pasture situations and they can alter the behavior of other wildlife besides the target predators.

Lethal Methods

1. **Traps.** Leg-hold and cage traps, and neck and foot snares are used by ADC for preventive and corrective damage management. Leghold traps are set in limited numbers in selected locations where tracks and other signs indicate coyotes or other predators have been and will return. Scent lures are used to attract predators to sets; when predators visit a set to investigate the scent, it generally steps on the trap pan which triggers the trap springs to close the jaws of the trap on it's leg. Traps are secured either by a chain and stake driven into the ground or by a chain and "drag" which hangs up in brush soon after the captured animal leaves the trap site. Animals are held until ADC specialists return to check their traps. Target predators are typically euthanized by shooting.

   Traps and snares can be used lethally and nonlethally, but are primarily used as lethal methods. Nontarget animals captured can often be released. However, targets are usually not relocated, especially with species that are numerous such as coyotes and striped skunks. Translocation of wild mammals is discouraged by ADC policy (ADC Directive 2.501) because of stress to the relocated animal and poor survival rates due to intraspecific strife with established resident animals of the same species, and because of difficulties in adapting to new locations or habitats. Relocation of captured problem mammals is also opposed by the American Veterinary Medical Association, the National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists because of the risk of disease transmission among wild mammals.

2. **Firearms.** Shooting with rifles or shotguns is used to manage predator damage problems and human health hazards when lethal methods are determined to be appropriate and firearms can be used safely and legally. Ground shooting is selective for target species and may be used in conjunction with spotlights, decoy dogs and predator calls. The animals are killed as quickly and humanely as possible.

3. **Dogs.** Hunting dogs are used to trail and capture certain problem predators such as bobcats and raccoons. Dogs are also trained and used for coyote damage management to alleviate livestock depredations (Rowley and Rowley 1987, Coolahan 1990). Trained dogs are used primarily to locate coyotes and dens, to pursue coyotes during aerial hunting and operations, or to decoy problem coyotes into shooting range.

4. **Denning.** Denning is the practice of locating coyote or red fox dens and destroying the pups by fumigation of the den with the gas cartridge or by excavation of the den and euthanasia of the pups (see the gas cartridge under chemical methods). Denning is only useful during the spring and early summer for a few months following the birth of pups. This technique is not used often in the District because of the difficulty in locating dens in the habitats of eastern Oklahoma; only 2 dens were taken in FY 95 (MIS 1995).

5. **Aerial Hunting.** Aerial hunting consists of visually sighting target animals and shooting them from aircraft. The shooting of coyotes from fixed-winged aircraft or helicopters is used on lands where it has been authorized and determined to be appropriate. This is a highly selective method of take.

Chemical Management Methods

All chemicals used by ADC are registered under FIFRA and administered by EPA and ODA. ADC personnel that use chemical methods are certified as pesticide applicators by ODA and are required to adhere to all certification requirements set forth in FIFRA and the Oklahoma State pesticide control laws and regulations. Trainees or personnel under direct supervision (supervisor within a phone call or reach of a radio) can use chemicals under Oklahoma Laws without certification (ORS 2, §3-81). No chemicals are used on federal or private lands without authorization from the land management agency or property owner/manager.

ADC would currently use two chemical methods under the proposed action.

1. **Sodium Cyanide in the M-44 Device.** The M-44 cyanide ejector is a selective device for use in reducing wild canid (coyote, red fox, gray fox and feral dog) predation of livestock (EPA Reg. No. 56228-15), and also for protecting endangered species and public health in certain instances (Thomas 1986, Connolly 1988). The M-44 operating mechanism is a spring-loaded plunger. When a target canid pulls up on the device, the plunger is released and bursts or "pops" through a plastic capsule containing one gram of powdered sodium cyanide, propelling the powder into the animal's mouth. No explosive components are part of the M-44, a common misconception among some persons unfamiliar with the device. M-44s are used for corrective and preventive management, where losses have historically been documented, on state, county and private lands, and on federal lands, where authorized. ADC personnel comply with the EPA label and 26 use restrictions (see USDA 1994, Appendix Q).

   Sodium cyanide is odorless when completely dry, emits an odor when dampened, is strongly alkaline, and decomposes rapidly in the environment. Sodium cyanide is freely soluble in water and is a fast acting, nonspecific toxicant, inhibiting cellular respiration. Low concentrations of cyanide are detectable and frequently found in normal human blood (Feldstein and Klendshoj 1954).

   Sodium cyanide is used for many purposes in the United States, including agricultural, pharmaceutical, and mining applications, and for industrial dyes. In 1989, about 215 million pounds of sodium cyanide were used in North America, and the ADC Program nationwide used only about 0.0001% of this (Knudson 1990). In FY 95 (MIS 1995), about 2.6 pounds of sodium cyanide were used in the District.

2. **Gas Cartridge.** The gas cartridge is a registered fumigant (EPA Reg. No. 56228-2) comprised of 35% charcoal and 65% sodium nitrate. When ignited, the cartridge burns in the den of an animal and produces large amounts of carbon monoxide, a colorless, tasteless gas, which kills animals in the den. This technique is most often used in dens where livestock killing can be attributed to food procurement for young (Till and Knowlton 1983, Till 1992) or to euthanize pups where the parent coyotes have been removed in direct control operations. Effective den hunting generally requires good tracking conditions and is not a major method of take for predators in the District.

A quantitative risk assessment evaluating potential impacts of ADC's use of chemical methods concluded that no adverse effects are expected from the above (USDA 1994, Appendix P).

3.2.2 ALTERNATIVE 2 - No Federal Predator Damage Management

This alternative would consist of no federal involvement in PDM in the District -- neither direct operational management nor technical assistance would be provided from ADC. Information on future developments in nonlethal and lethal management techniques that culminate from ADC's research branch would not be available to producers or resource owners. It would be left up to the resource owner to conduct PDM under this option. It is probable that many PDM methods would be used unsafely and improperly such as the illegal use of pesticides simply out of frustration by resource owners over the inability to reduce damage losses to a tolerable level.

3.2.3 ALTERNATIVE 3 - Technical Assistance Only

This alternative would not allow ADC to conduct operational PDM in the District. ADC would only provide technical assistance and make recommendations when requested. However, producers, state agency personnel, or others could conduct PDM activities including the use of traps, snares, shooting, and any nonlethal methods they deem effective.

Methods and control devices could be applied by persons with little or no training and experience. This in turn could require more effort and cost to achieve the same level of problem resolution, and could cause harm to the environment, including a higher take of nontarget animals.

3.2.4 ALTERNATIVE 4 - Nonlethal Required Before Lethal Control

This alternative would not allow the use of lethal methods by ADC as described under the proposed action until nonlethal methods had been attempted to relieve damage related to predators and found to be ineffective or inadequate. Producers would still have the option of implementing nonlethal control measures and ADC would continue to recommend them where appropriate, but no preventive lethal control would be allowed.

3.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

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

3.3.1 Compensation for Predator Damage Losses

The Compensation alternative would require the establishment of a system to reimburse resource owners for predation or other losses. This alternative was eliminated from further analysis because no federal or state laws currently exist to authorize such action. Under such an alternative, ADC would not provide any direct control or technical assistance. Aside from lack of legal authority, analysis of this alternative in the FEIS indicates that the concept has many drawbacks (USDA 1994).

- It would require larger expenditures of money and manpower to investigate and validate all losses, and determine and administer appropriate compensation.
- It would be difficult, if not impossible, to assess and confirm losses in a timely manner for all requests, and, therefore, many losses could not be verified and uncompensated. Additionally, compensation would most likely be below full market value.
- Compensation would give little incentive to livestock and other resource owners to limit predation and/or damages with PDM strategies such as improved animal husbandry practices and fencing.
- Not all ranchers would rely completely on a compensation program and PDM activities including lethal control would likely continue as permitted by state law.

3.3.2 Bounties

Payment of funds for killing predators (bounties) suspected of causing economic losses is not supported by Oklahoma State agencies such as ODWC and ODA. ADC concurs with these agencies because of the following.

- Bounties are generally not effective in controlling damage, especially over a wide area such as the District.
- Circumstances surrounding the take of animals are typically arbitrary and completely unregulated.
- No process exists to prohibit taking of animals from outside the damage management area for compensation purposes.
- ADC does not have the authority to establish a bounty program.

3.3.3 Eradication and Long Term Population Suppression

An eradication alternative would direct all ADC Program efforts toward total long term elimination of coyotes and perhaps other predator species in entire cooperating counties or larger defined areas in the District.

In Oklahoma, the eradication of predator species is not a desired goal of state agencies, although coyotes may be taken year-round with no restriction and furbearers can be taken when they are found destroying livestock or poultry. Some landowners would prefer that some species of predators be eradicated. However, eradication as a general objective for PDM will not be considered by ADC in detail because:

- ADC opposes eradication of any native wildlife species;
- ODWC, ODA, and OCC oppose eradication of any native Oklahoma wildlife species;
- The eradication of a native species or local population would be extremely difficult, if not impossible to accomplish, and cost-prohibitive in most situations; and
- Eradication is not acceptable to most members of the public.

Suppression would direct ADC Program efforts toward managed reduction of certain problem populations or groups. In localized areas where damage can be attributed to predation by specific groups, ODWC has the authority to increase hunting seasons and hunter tag quotas; ODA has the authority to control predators such as coyotes in the interest of agriculture and human health and safety. When a large number of requests for wildlife damage management are generated from a localized area, ADC would consider suppression of the local population or groups of the offending species, if appropriate.

It is not realistic, practical, or allowable under present ADC policy to consider large-scale population suppression as the basis of the ADC Program. Typically, ADC activities in the District would be conducted on a very small portion of the area inhabited by problem species.

3.3.4 The Humane Society of the United States (HSUS) Alternative

HSUS has proposed an alternative that requires: 1) "permittees evidence sustained and ongoing use of nonlethal/husbandry techniques aimed at preventing or reducing predation prior to receiving the services of the ADC Program"; 2) "employees of the ADC Program use or recommend as a priority the use of appropriate nonlethal techniques in response to a confirmed damage situation"; 3) "lethal techniques are

limited to calling and shooting and ground shooting, and used as a last resort when use of husbandry and/or nonlethal controls have failed to keep livestock losses below an acceptable level"; and 4) "establish higher levels of acceptable loss levels on public lands than for private lands".

The components of the proposed HSUS alternative have been analyzed in the alternatives contained in this EA and through court rulings. The HSUS alternative would not allow for a full range of IWDM techniques to resolve wildlife damage. In addition, ADC is charged by law to protect American agriculture, despite the cost of control. Further, in the case Southern Utah Wilderness Society et al. v. Hugh Thompson et al. U.S. Forest Service (Civil No. 92-C-0052A 1993), the court clearly stated that, "The agency need not show that a certain level of damage is occurring before it implements an ADC Program . . . Hence, to establish need for an ADC, the forest supervisors need only show that damage from predators is threatened." Thus, judicial precedence was set and found that it is not necessary to establish a criterion, such as percentage of loss of a herd to justify the need for ADC action. Preventive and corrective control actions are therefore justified by a reasonable determination that damage by predators is threatened. The alternatives selected for detailed analysis in this EA encompass a reasonable range as required by NEPA and include some of the suggestions in the HSUS proposal, and it is believed that inclusion of this alternative would not contribute new information or options for consideration and analysis that are not already being considered and available in IWDM as used by ADC.

3.3.5 Lithium Chloride as an Aversive Agent

Lithium chloride has been tested as a taste aversion agent to condition coyotes to avoid livestock, especially sheep. Despite extensive research, the efficacy of this technique remains unproven (Conover et al. 1977; Sterner and Shumake 1978; Burns 1980, 1983; Horn 1983; Johnson 1984; Burns and Connolly 1980, 1985). In addition, lithium chloride is currently unregistered by EPA or ODA, and therefore cannot be used or recommended for this purpose.

3.4 MITIGATION AND STANDARD OPERATING PROCEDURES FOR WILDLIFE DAMAGE MANAGEMENT TECHNIQUES

3.4.1 Mitigation in Standard Operating Procedures (SOPs)

Mitigation measures are any features of an action that serve to prevent, reduce, or compensate for impacts that otherwise might result from that action. The current ADC Program, nationwide and in Oklahoma, uses many such mitigation measures and these are discussed in detail in Chapter 5 of the FEIS (USDA 1994). Some key mitigating measures pertinent to the proposed action and alternatives that are incorporated into ADC's Standard Operating Procedures include the following.

- The ADC Decision Model, which is designed to identify effective wildlife damage management strategies and their impacts, is consistently used.
- Traps and snares are not set within 30 feet of exposed carcasses to prevent the capture of scavenging birds. The exception to this is for the capture of cougar and black bear because the weight of these target animals allows foot snare tension adjustments to exclude the capture of smaller nontarget animals such as scavenging birds.
- Leghold trap underpan tension devices and foot snare trigger tension devices are used throughout the Program to reduce the capture of nontarget wildlife that weigh less than the target species.
- Nontarget animals captured in leghold traps or foot snares are released unless it is determined by ADC Specialists that they will not survive.
- Conspicuous, bilingual warning signs alerting people to the presence of traps, snares and M-44s are placed at major access points when they are set in the field.

- Reasonable and prudent alternatives and measures are established through consultation with FWS and implemented to avoid adverse impacts to T&E species.

- EPA-approved label directions are followed for all pesticide use.

- All District ADC Specialists who use restricted chemicals are trained and certified by ADC personnel or others who are experts in the safe and effective use of these materials or are supervised by such persons according to ODA's definition (ORS 2, §3-81).

- The M-44 sodium cyanide devices are used following EPA label requirements (see FEIS Appendix Q for label and use restrictions).

Some additional mitigating factors specific to the current program include the following.

- Management actions are directed toward localized populations or groups of target predator species and/or individual offending members of those species. Generalized population suppression across the District will not be conducted.

- Although hazards to the public from PDM devices and activities are low according to a formal risk assessment (USDA 1994, Appendix P), hazards to the public and their pets are even further reduced by the fact that PDM activities are primarily conducted on private or other properties where public access is highly restricted or denied.

3.4.2 Additional Mitigation Specific to the Issues

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

3.4.2.1 Effect on Target Predator Species Populations

- PDM activities to resolve coyote and other predator damage problems are directed at taking action against individual problem animals, or local populations or groups, and not by attempting to eradicate populations in the entire area or region.

- ADC kill is monitored by considering "Total Harvest" and estimated population numbers of key species. These data are used to assess cumulative effects so as to maintain the magnitude of harvest below the level that would impact the viability of populations of native species (See Chapter 4).

3.4.2.2 Effects on Nontarget Species Populations Including T&E Species

- ADC personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with little impact to nontarget animals.

- Leghold trap and foot snare underpan tension devices are used to reduce hazards to nontarget wildlife that weigh less than the target species.

- Nontarget animals captured in leghold traps or foot snares are released unless it is determined by ADC Specialists that they will not survive.

- ADC has consulted with the FWS about the potential impacts of all current PDM methods on T&E species, and abides by the reasonable and prudent alternatives and measures established as a result of that consultation. For the full context of the Biological Opinion, see the ADC FEIS, Appendix F (USDA 1994). The primary T&E species of concern covered

by the formal consultation that occurs in Oklahoma is the bald eagle. Those alternatives and measures and their terms and conditions as related to the proposed action and alternatives described in this EA are as follows.

- ADC personnel will contact either the local ODWC office or the appropriate FWS regional or field office to determine nest and roost locations for bald eagles.
- The appropriate FWS office shall be notified within five days of the finding of any dead or injured bald eagle. Cause of death, injury, or illness, if known, would be provided to those offices.
- If a bald eagle is incidentally taken from the Southwest population, use of the control method will be halted immediately, and ADC will reinitiate consultation.
- Leghold traps (except those used to trap mountain lions) shall be placed a minimum of 30 feet from above ground bait sets.
- When bald eagles are in the immediate vicinity of a proposed wildlife damage management program, ADC personnel will conduct daily checks for carcasses or trapped individuals.

- Potential impacts on other T&E species in the District have been assessed and no adverse impacts are likely to occur from ADC actions. In an informal consultation with FWS, they have concurred that ADC activities are not likely to adversely affect T&E species in the District.

3.4.2.3 Impact of Predator Removal on Prey Populations

- District activities are directed at taking action against individual problem animals, or local populations or groups to resolve problems associated with them. It is generally accepted that predators do not influence prey numbers substantially, rather the reversal tends to be true, in that the cyclic nature of most prey species may affect predator numbers (Clark 1972, Wagner and Stoddart 1972). This is especially true of highly fecund species such as rodents and rabbits, but less so for species such as deer. However, the impact of predator removal in the District has been assessed and will not likely impact prey species except in potentially very local areas.

- ADC currently has agreements for PDM on less than 15% of the land area of the District and generally conducts PDM activities on less than 5% of the land area in any one year, and therefore, will not impact prey species on 85 - 95% of the land in the District.

3.4.2.4 Humaneness of Methods Used by ADC

- ADC personnel attempt to kill captured target animals that are slated for lethal removal as quickly and humanely as possible. In most field situations, a shot to the brain with a small caliber firearm is performed which causes rapid unconciousness followed by cessation of heart function and respiration. This is in concert with the American Veterinary Medical Association's definition of euthanasia. In some situations, accepted chemcial immobilization and euthanasia methods are used.

- Research continues with the goal of improving the selectivity and humaneness of management devices.

- ADC specialists use underpan tension devices which are designed to exclude nontarget animals that weigh less than the target species.

- ADC specialists use trap lures and set traps in locations that are conducive to capturing the target animal, but minimize potential impact to nontarget species.

4.0 CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides the information needed for making informed decisions in selecting the appropriate alternative for meeting the purpose of the proposed action. This chapter analyzes the environmental consequences of each alternative in relation to the issues identified for detailed analysis in Chapter 2.

4.1 ENVIRONMENTAL CONSEQUENCES

This section analyzes the environmental consequences of each alternative in comparison with the proposed action to determine if the real or potential impacts are greater, lesser or the same.

4.1.1 Cumulative and Unavoidable Impacts. Cumulative and unavoidable impacts will be discussed in relationship to each of the potentially affected species analyzed in this chapter.

4.1.2 Non-significant Impacts. The following resource values within the District are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, floodplains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber and range. These resources will not be analyzed further.

4.1.3 Irreversible and Irretrievable Commitments of Resources. No irreversible or irretrievable commitments of resources are expected, other than minor uses of fuels for motor vehicles and other similar materials. These will not be discussed further.

4.2 ISSUES ANALYZED IN DETAIL

4.2.1 Effects on Target Predator Populations

4.2.1.1 Alternative 1. - Continue the Current Federal ADC PDM Program (The Proposed Action as described in Chapter 1)

Coyote Population Information and Impact Analysis

As mentioned, coyotes are the major damage-causing predator in the District and caused more than $96,000 in reported and/or verified damage to livestock, crops, and pets in FY 95. Coyote damage management is therefore the major focus of ADC PDM efforts in the District.

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 biologists and rangeland managers as having a unique resilience to change because they have a strong ability to adapt to adverse conditions and persevere.

Determinations of absolute densities for coyote populations are frequently limited to educated guesses (Knowlton 1972). Coyotes are highly mobile animals with home ranges (territories) that vary by sex and age of the animal and season of the year (Pyrah 1984, Althoff 1978, Todd and Keith 1976). The literature on coyote spatial organization is confusing (Windberg and Knowlton 1988, Messier and Barrette 1982). Coyote population densities will vary depending on the time of year, food abundance, and habitat. Coyote densities have ranged from a low of 0.39/mi^2 during the time when populations are low (just prior to the annual period of pup birth) to a high of 3.55/mi^2 when populations are high (just after the period of pup birth) (Pyrah 1984, Knowlton 1972). Coyote home

ranges may vary from 2.0 mi^2 to 21.3 mi^2 (Andelt and Gipson 1979, Gese et al.1988[4]). Ozoga and Harger (1966), Edwards (1975), and Danner (1976) however, observed a wide overlap between coyote home range and did not consider coyotes territorial.

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 coyotes densities in mid-late winter and the availability of dead livestock (Roy and Dorrance 1985).

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.

Many authors have estimated coyote populations throughout the west and elsewhere (Pyrah 1984, Camenzind 1978, Knowlton 1972, Clark 1972, USDI 1979). Coyote population estimates for Oklahoma are not available from state agencies. However, an estimate suitable for purposes of analysis can be made using information on coyote biology and population dynamics and tempering the "reasonableness" of the estimate by considering field observations of ADC personnel. These types of estimates of carnivore populations are based on a knowledge of the species, experience, and intuition and may be as accurate as those based on more scientific methods (Fritzell 1987).

Knowlton (1972) estimated coyote densities west wide to be an average of 0.5 to 1.0 per square mile over a large portion of the coyote's range. The opinions of ADC Specialists that work in the District, in concurrence with ODWC (R. Hatcher pers comm.), generally agree that coyote numbers in the District are relatively high. Although not substantiated by scientific field studies, Knowlton's average of 0.5 to 1.0 per square mile can be considered reasonable for the area and is very likely lower than true average densities across the District. Thus, Knowlton's "average" for the western U.S. is assumed to be conservative for the area in question, but is used herein for analysis.

Table 1. Cumulative Coyote Kill in the District (Eastern Oklahoma) by the ADC Program for FY 95.

	Using Low Coyote Population Estimate	Using High Coyote Population Estimate
Est. Population	10,000	20,000
ADC Kill	1,907	1,907
Other Take (Kill) [1]	419	419
Total Kill	2,326	2,326
ADC Kill - % of Population	19%	10%
Other Kill - % of Population	4%	2%
Total Kill - % of Population	23%	12%

[1]Harvest data available only for statewide; "other take" for the District is assumed to be one half of the statewide total.

The District is 33,750 square miles (21.6 million acres) in size. Farmland comprises 61% of the District (20,666 square miles) (calculated from county

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

data contained in OASS 1995) and is assumed to be a conservative (i.e. lower than actual) estimate of suitable habitat for coyotes and other carnivores. A conservative estimate of the coyote population for the District, based on what we believe to be a conservative assumption of 0.5 to 1.0 per square mile, is (in rounded figures) 10,000 to 21,000 at any one time.

Private coyote take may legally occur at any time since there is no closed season or bag limit. However, it is reasonable to assume that much of the private take of coyotes occurs in the winter period when furs are prime. Sport hunter and trapper harvest for the 1994-95 fur harvest season was 419 (ODWC 1995). The ADC coyote kill in the District for FY 95 was 1,907 (MIS 1995). These data indicate the total number of coyotes taken (killed) in the District was about 2,300 during 1994-95. Based on our range of estimates of the coyote population in the District (10,000 to 20,000), the cumulative take was between 12 and 23% of the population (Table 1).

Connolly and Longhurst (1975) determined that, "if 75% of the coyotes are killed each year, the population would be exterminated in slightly over 50 years." The authors further say that their "model suggests that coyotes through compensatory reproduction can withstand an annual control level of 70%." To further demonstrate the coyote's recruitment (reproduction and immigration) ability, if 75% control occurred for 20 years, coyote populations would regain precontrol densities by the end of the fifth year after control was terminated. Furthermore, immigration, not considered in the Connolly/Longhurst model can 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, 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 century efforts to exterminate it. Based on this information, ADC's impact on the coyote population in the District, even with possible under-reporting of "Other Harvest", will not affect the general coyote population in the District because the "Total Take" of coyotes in the area is no more than 23% of the estimated population. Evaluating the data using standards established in USDA (1994) to determine the magnitude to which total harvest impacts the species, a cumulative harvest of less than 75% of the *allowable harvest level* of 70% of the population of coyotes results in a determination of "low magnitude." Thus, a "low magnitude" impact rating is achieved if no more than 52.5% of the population is taken per year. Based on the above analysis, the expected cumulative harvest rate of 12 to 23% of the coyote population in the District is well within the "low magnitude" criteria. The analysis further suggests annual coyote take could *conservatively* be increased by a factor of 2 to 4 before the low magnitude rating is exceeded or a factor of 3 to 6 before the 70% allowable harvest level would be reached. Additional supporting evidence that cumulative take is below a sustainable harvest level in the state as a whole is offered by furbearer population trend indices that indicate slight increases in coyote numbers from 1994 to 1995 (ODWC 1995). Therefore, it is reasonable to conclude that cumulative impacts on coyote populations in general within the District are not substantial and would remain so even if the Program's lethal coyote damage management efforts were increased several fold.

In all likelihood, the population impacts shown by this analysis are less than the actual impacts. This is because ADC conducts PDM on less than 5% of the land area of the District in any one year (in FY 95 the actual area of properties where target coyotes were taken was 666,000 acres or 3% of the land area in the District). Thus, populations on more than 95% of the area of the District are not impacted by ADC. Also, our assumed population densities of 0.5 -1.0 coyotes per square mile are probably low because ADC *removed* an average of 1.8 coyotes per square mile from properties where coyotes were taken in FY 95. Therefore, either densities were higher in the area than our assumed range or immigration from surrounding areas following removal of local coyotes is responsible for the high take on properties worked. In any event, the high take on properties for which ADC assistance has been requested suggests that depredation problems are more likely to occur in areas of higher coyote density within the District.

Bobcat Population Information and Impact Analysis

The confirmed and reported damage caused by bobcats in the District during FY 95 was to domestic fowl including ducks, geese, turkeys, chickens, game chickens, guinea fowl, and pea fowl, and domestic pets. Total value of these losses was about $2,400. Efforts to resolve bobcat depredation problems are a relatively minor part of the District Program.

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). Bobcat population densities appear to range between 0.1 and 7/mi^2 according to published estimates. They may live up to 14 years, but annual mortality is as high as 47% (Rolley 1985).

There are no current population estimates for bobcats in Oklahoma and the range of published densities is too broad to be useful in arriving at an estimate. Population trend indices shown by ODWC (1995) indicate bobcat populations in the District increased in most habitat zones within the state between 1994 and 1995. Sex ratios of harvested bobcats in the state were consistently skewed toward males from the 1989-90 through 1994-95 fur harvest seasons which is symptomatic of a dense bobcat population according to ODWC (1995). ADC kill in the District during FY 95 was low totaling 19 animals. Private trapper and hunter harvest totaled about 900 (determined from figures in ODWC (1995) that showed harvest by ecological region within the state). This number may be higher than the actual take in the District because the ecological regions to which it pertains encompass a larger area than the District. In any event, ADC kill was only about 1-2% of total take in the area of the District which means ADC kill is a minor component of overall bobcat mortality. USDA (1994) reported an allowable harvest level for bobcat populations of 20%. Because available trend information suggests the bobcat population increased at the level of private and ADC take that occurred, it can be concluded that the numbers killed were well below this level. ODWC concurs with this finding (R. Hatcher, pers. comm. 1996).

USDA (1994) reported a bobcat population estimate for Oklahoma to be 25,000 in 1988. If the bobcat population can be considered dense as indicated by ODWC's sex ratio data, then a density of 1 per square mile of suitable habitat should be a highly conservative estimate, considering that the highest published estimates are around 7 per square mile. Since the District contains about 20,666 square miles of suitable habitat, it follows that a conservative estimate of the bobcat population is about 20,000. Under this apparently conservative assumption, cumulative take would be less than 5% of the population which is well below the allowable harvest level. It is anticipated that ADC bobcat take in the District would continue to be a low percentage of total take, even if Program PDM activities were doubled or tripled. Thus, bobcat population impacts of the current Program should be low and would remain low in the reasonably foreseeable future even in the event that Program activities were expanded considerably.

Raccoon Population Information and Impact Analysis

The raccoon is a member of the family *Procyonidae* which includes ringtails and coatis (*Nasua narica*) in North America. Raccoons are one of the most omnivorous of animals, 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). Raccoon damage problems, including human health and safety concerns, were reported on 80 occasions in FY 95 (MIS 1995) in the District. They accounted for about $2,500 worth of reported and verified damage to various resources and property such as domestic fowl and livestock feed.

Sanderson (1987) stated that absolute population densities of raccoons are difficult if not impossible to determine because of the difficulty in knowing what percentage of the population has been counted or estimated, and the additional difficulty of knowing how large an area the raccoons are using. Twichell and Dill (1949) reported one of the highest densities, with 100 raccoons removed from a winter tree den area on 101 acres of a waterfowl refuge in Missouri during winter. 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, and Rivest and Bergeron 1981).

Raccoon population indices in all ecological regions of the state suggested an increase in general populations between 1994 and 1995, and indicated higher numbers than for bobcats or coyotes (ODWC 1995). Therefore, it is reasonable to assume an average density for the District that is at least equal to the lower end of published ranges shown above, or about 9 per square mile. With 20,666 square miles of suitable habitat, the total population in the District would be more than 180,000. To be even more conservative, this analysis assumes the population is actually ½ that number or 90,000 and excludes urban habitat where raccoons can be prevalent.

The allowable harvest level for raccoons found in USDA (1994) was established at 49% of the total population. ADC kill was 111 raccoons in the District in FY 95 and private harvest was about 7500. The ADC take is therefore a very minor part of total raccoon mortality. The cumulative take of 7,600 was only about 8% of the population or one-sixth of the allowable harvest level. Therefore, even under very conservative assumptions, ADC take is insignificant to the population in the District and cumulative take is minor. It is anticipated that ADC raccoon take in the District would continue to be a low percentage of total take, even if ADC PDM activities were doubled or tripled. Thus, raccoon population impacts of the current program should be low and would remain low in the reasonably foreseeable future even in the event that program activities were expanded considerably.

Striped Skunk Population Information and Impact Analysis

The striped skunk is the most common member of the *Mustelidae* family. Striped skunks have increased their geographical range in North America with the clearing of forests. They are not associated with any well-defined land type that can be classified as skunk habitat (Rosatte 1987), but are capable of living in a variety of environments including agricultural lands and urban areas. Skunks primarily cause odor problems around homes, transmit diseases such as rabies to humans and domestic animals, and sometimes prey on poultry. Skunks are primarily targeted to reduce these types of problems and control actions for this purpose are a minor part of District activities.

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 1987). Home ranges reported in the literature averaged between 0.85 to 1.9 mi^2 for striped skunks in rural areas (Houseknecht 1971, Storm 1972, Bjorge et al. 1981, Rosaette 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).

There are no population estimates or trend information available for striped skunks in the state. Therefore, the lowest reported density estimates from the literature will be used to estimate skunk populations. Using this information, the estimated population in the District is conservatively estimated to be about 15,000 striped skunks.

ADC killed 11 striped skunks as target animals in the District in FY 95. An additional 17 were killed as nontargets, bringing the total ADC kill to 28. Private harvest was 59 (ODWC 1995) for the State, and probably half, 30, came from the District. Thus, cumulative take was 58. An allowable harvest level has not been determined for striped skunks (USDA 1994). However, cumulative take is only 0.4% of the conservatively estimated population which is believed to be of low impact. It is anticipated that ADC striped skunk take in the District would continue to be a low percentage of total take, even if Program PDM activities were doubled or tripled. Thus, striped skunk population impacts of the current program should be low and would remain low in the reasonably foreseeable future even in the event that program activities were expanded considerably.

Opossum Population Information and Impact Analysis

The ADC FEIS cited studies showing opossum density is highly variable depending upon habitat and ranges from 10 to 634 per square mile (USDA 1994); the FEIS determined that no allowable harvest estimates are available for opossums. In evaluating ADC opossum kill for FY 88, USDA (1994) concluded that a take of 193 opossums in Oklahoma was of low magnitude and private harvest of 7,643 was of moderate magnitude in impact on opossum populations. ADC take in the District during FY 95 was 30. Private harvest was 2,262 in the state and assumed to be about half that total for the District or 1,100. Therefore, cumulative take was probably less than 1,200 animals. Assuming opossum density is at the low end of the range shown in the FEIS, the opossum population in the District is about 200,000. Therefore, cumulative take is less than 1% of the estimated population and the impact is believed to be low.

Gray Fox Population Information and Impact Analysis

Gray fox are common throughout the state and trend indices suggest populations increased from 1994 to 1995 (ODWC 1995). Private harvest was 170 in the District (ODWC 1995) and ADC's take was 8 which is less than a 5% cumulative take. Published estimates of gray fox density range between 3.1 and 5.4/mi^2 (Trapp 1978). Therefore, with 20,666 square miles of suitable habitat in the District, a conservative estimate of gray fox abundance would be about 60,000. An allowable harvest level for gray fox is 25% of the total population or 15,000 per year. The cumulative take of 178 in the District was only 1% of that level which is clearly insignificant to gray fox populations.

Feral Dog Information and Impact Analysis

Feral dogs are not uncommon in Oklahoma. Their predation of livestock and poultry is somewhat common and widespread throughout the District. They were responsible for killing 17 livestock, 16 poultry, and 2 pets and harassing livestock on 3 occasions in the District in FY 95 (MIS 1995) where ADC became involved. They also prey on native wildlife such as deer, turkey, and quail. Primary responsibility for dog control rests with state and local authorities. ADC responds to requests from these entities as well as health departments. District ADC personnel are authorized to control feral dogs to protect livestock, poultry, and human health and safety.

Take of feral and/or free-ranging dogs by the program is considered to be of no significant impact on the human environment since dogs are not an indigenous component of ecosystems in the District. The kill of dogs by ADC is minor in comparison to the number killed by animal control and humane organizations in the country each year.

Red Fox Population Information and Impact Analysis

The red fox is uncommon statewide, but trend indices suggest populations increased from 1994 to 1995 (ODWC 1995). It is most common in the northeast part of the state. ADC has occasionally taken red fox in the District, but did not between FY 93 and FY 95 (MIS 1993-1995). Their population tends to be scattered because of competition with coyotes for food. Red fox cannot be taken throughout Oklahoma, and therefore, no data are available in the fur harvest report. However, red fox can be taken for livestock depredations at any time (ORS 29 §5-405 Part D).

Published estimates of red fox densities have been as high as 50/mi^2 (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986) where there was an abundant food supply; in Ontario, population densities were estimated at 2.6/mi^2 (Voigt 1987). Others reported densities of fox dens at 1 per 3 mi^2 (Sargeant 1972). If we assumed that red fox were found at the low density, about 2/mi^2 in pockets covering 5% of the suitable habitat in the District (1,033 mi^2), this would amount to 2,066 red fox in the District. An allowable harvest for red fox is 70% (USDA 1989) of the total population or 1,446 per year. Therefore, ADC's take could increase significantly before a noticeable impact on the population was realized. ODWC concurs with this conclusion (R. Hatcher, pers. comm. 1996).

Badger Population Information and Impact Analysis

Badgers are uncommon to common in the western ¾ of the state. ADC occasionally takes badgers as target species in the District, most often for the protection of rangeland and pasture damage. Badgers are sometimes captured as nontarget species incidental to PDM activities. Little is known about densities other than a few intensely studied populations. Lindzey (1971) estimated that the Curlew Valley on the Utah-Idaho border supported 1/mi^2 and Messick and Hornocker (1981) found 13/mi^2 in southwestern Idaho. For purposes of this analysis, we will conservatively estimate the badger density at 0.25/mi^2 in 35% of the District's suitable habitat or about 1,800 badgers.

Badger populations can safely sustain an annual harvest rate of 30-40% annually (Boddicker 1980) or about 500 of the 1800 conservatively estimated. ODWC reported 32 badger were taken statewide in 1994/95 (ODWC 1995) while ADC removed 2 in the District in FY 95 (MIS 1995). If we assumed that half of the badgers taken by fur harvesters came from the District plus ADC's take, 18, roughly 4% of the estimated harvest potential was taken. Because this is substantially less than allowable harvest, and badger populations appear at least stable based on fur harvest records from 1989-1995 (ODWC 1995), cumulative impacts are low in magnitude. ODWC concurs with this conclusion (R. Hatcher, pers. comm. 1996).

Other Target Predator Species Impacts

Other target species taken occasionally by ADC for PDM in the District are mink, long-tailed weasels, spotted skunks, and feral cats. ADC receives periodic complaints involving these species in the District and, occasionally, conducts operational control to take offending animals. Mink and feral cats are fairly common throughout most of the District, long-tailed weasels are uncommon except for the far northeastern part of the District, and spotted skunks are considered uncommon throughout the District. During FY 93-95, none of these species were taken as targets in direct control operations for PDM in the District and only 3 feral cats and 2 mink were taken as nontargets incidental to ADC activities (MIS 1993-1995). The PDM methods used by ADC, for the most part, exclude these species unless equipment specific to capturing them is used because of their size and weight.

Fur harvesters took 47 mink in the 1994/95 season (ODWC 1995) and roughly half of these, 24, probably came from the District. ADC took 1 in FY 95 (MIS 1995), totaling 25 animals taken in the District. No information was available for long-tailed weasel take, but ADC did not take any in FY 95 (MIS 1995). Even with minimal take, these populations are highly unlikely to be cumulatively impacted by ADC PDM efforts. ODWC concurs with this finding, even if take were to increase somewhat (R. Hatcher, pers. comm. 1996).

A species of special concern in Oklahoma is the plains spotted skunk. The status of this species is currently unknown, but it has declined for a number of years. It is currently thought to be at relatively low levels throughout the state, but is probably most common in the District. The last one taken by ADC for PDM in the State was in FY 1992, but it was relocated. The last spotted skunk killed in Oklahoma by ADC was in FY 88. None have been taken as nontarget during this time. The fur harvest season was closed in 1994-95, but 2 were taken in the 5 previous fur seasons (ODWC 1995). ODWC (R. Hatcher, pers. comm. 1996) would be concerned if ADC began taking relatively large numbers of these, but is not concerned at the current rate of take, especially when it involves damage such as the removal of a spotted skunk from a residence.

ADC periodically takes feral cats in PDM activities. The take of feral cats by the program is considered to be of no significant impact on the human environment since cats are not an indigenous component of ecosystems in the District. The kill of cats by ADC is minor in comparison to the number killed by animal control and humane organizations in the country each year.

4.2.1.2 Alternative 2 - No Federal ADC PDM

Under this alternative, ADC would have no impact on target predator species populations in the District. However, ODA would probably still provide some level of direct control assistance with predator damage problems but without federal supervision. Also, private efforts to reduce or prevent depredations might increase which could result in impacts on target species populations. Impacts on target species under this alternative could be the same, less, or more than those of the proposed action depending on the level of effort expended by ODA and by private persons. For the same reasons shown in the population impacts analysis in section 4.2.1.1 it is highly unlikely that predator populations would be impacted significantly by implementation of this alternative. However, it is hypothetically possible that frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could lead to unknown impacts on carnivore populations in general in the area.

4.2.1.3 Alternative 3 - Technical Assistance Only

Under this alternative, ADC would have no impact on target predator species populations directly. ODA would probably provide some level of direct control assistance with predator damage problems but without federal supervision, and private efforts to reduce or prevent depredations could increase which would result in impacts on those populations. For the same reasons shown in the population impacts analysis in section 4.2.1.1, it is highly unlikely that coyote populations or other predators would be impacted significantly by implementation of this alternative. Impacts and hypothetical risks of illegal chemical toxicant use under this alternative would probably be about the same as those under Alternative 2.

4.2.1.4 Alternative 4 - Nonlethal Required Before Lethal Control

Under this alternative, ADC take of target predator species would probably be less than that of the proposed action because lethal actions by ADC would be restricted to situations where nonlethal controls had been tried, in most cases by the requestor, but also by ADC, without success. No

preventive lethal control actions would be taken by ADC. For many individual damage situations, this alternative would be similar to the current program because many producers have tried one or more nonlethal methods such as predator resistant fencing without success or have considered them and found them to be impractical in their particular situations prior to requesting ADC's assistance. Without ADC conducting preventive control activities, it is likely that private efforts at preventive control would increase, leading to potentially similar cumulative impacts as those of the proposed action. For the same reasons shown in the population impacts analysis in section 4.2.1.1, it is highly unlikely that District-wide coyote populations or most other predators would be impacted significantly by implementation of this alternative. Impacts and hypothetical risks of illegal chemical toxicant use under this alternative would probably be the same as those under Alternatives 2 and 3.

4.2.2 Effects on Nontarget Species Populations, Including T&E Species.

4.2.2.1 Alternative 1 - Continue the Current Federal ADC PDM Program

Nontarget species taken in the District in FY 95 were recorded as Target - Unintentional (i.e., they were listed on the agreement as target species but were taken unintentionally during efforts to take other target species) or Nontarget (i.e., they were not listed as target species on the agreement and were taken unintentionally during efforts to take target species). With this type of data recording, some species were targets in some situations and nontargets in others.

Nontarget animals killed by ADC during PDM activities in the District in FY 95 included 2 badgers, 7 bobcats, 40 feral/free-ranging dogs, 20 opossum, 55 raccoons, 17 striped skunks, 1 armadillo (*Dasypus novemcinctus*), 3 white-tailed deer (*Odocoileus virginanus*), 4 gray fox, and 1 wild turkey (*Meleagris gallopavo*). During the 2 years prior to this, feral house cats, cottontails (*Sylvilagus* spp.), jackrabbits (*Lepus californicus*), turkey vultures (*Cathartes aura*), and American crows (*Corvus brachyrhynchos*) were also taken accidentally in PDM activities. No more than just a few of these species were taken and impacts to these species would be considered light. Thus far, impacts to nontarget species have been minimal.

Mitigation measures to avoid T&E impacts were described in Chapter 3 (section 3.4.2.2). Those measures should assure that the proposed action would not impact T&E species. Those mitigation measures have also insured that nontarget take in the District remains at relatively low levels.

Nontarget take was included in the population impacts analysis under 4.2.1.1 for badgers, bobcats, feral cats and dogs, gray fox, opossums, raccoons, and striped skunks; it has been concluded that cumulative impacts to these populations, including the take of nontargets, was not significant. No analysis on armadillo, white-tailed deer, and wild turkey population impacts is presented because these species are common and abundant in Oklahoma and nontarget take by ADC PDM is low enough to be intuitively insignificant to populations. The same is true for the additional species (turkey vultures, crows, cottontails, and jackrabbits) taken in the previous two fiscal years.

4.2.2.2 Alternative 2 - No Federal ADC PDM

Alternative 1 would not allow any ADC wildlife damage management in the District. There would be no impact on nontarget or T&E species by ADC activities from this alternative. However, private efforts to reduce or prevent depredations could increase which could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than the proposed action. ODA would probably still provide some level of direct control assistance with predator damage problems but without federal supervision and would continue to take nontargets but probably in lesser numbers proportionate to the decreased direct control efforts.

Private individuals may trap coyotes year round and would not be restricted to mitigation measures such as ADC's self imposed restrictions of setting traps no closer than 30 feet to livestock carcasses to avoid capturing scavenging birds or using pan tension devices to exclude smaller animals. Hazards to raptors, including bald eagles, and other nontargets could therefore be greater under this alternative. It is hypothetically possible that frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could impact local nontarget species populations, including T&E species.

4.2.2.3 Alternative 3 - Technical Assistance Only

Alternative 3 would not allow any ADC direct operational PDM in the area. There would be no impact on nontarget or T&E species by ADC activities from this alternative. Technical assistance or self-help information would be provided at the request of livestock producers and others. ODA would probably still provide some level of direct control assistance with predator damage problems but without federal supervision and would continue to take nontargets but probably in lesser numbers proportionate to the decreased direct control. Although technical support might lead to more selective use of control methods by private parties than that which could occur under Alternative 2, private efforts to reduce or prevent depredations could result in less experienced persons implementing control methods leading to greater take of nontarget wildlife. Private individuals may trap coyotes year round and would not be restricted to mitigation measures such as ADC's self imposed restrictions of setting traps no closer than 30 feet to livestock carcasses to avoid capturing scavenging birds or using pan tension devices to exclude smaller animals. Hazards to raptors, including bald eagles, could therefore be greater under this alternative. However, it is hypothetically possible that, similar to Alternative 2, frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could lead to unknown impacts on local nontarget species populations, including T&E species.

4.2.2.4 Alternative 4 - Nonlethal Required Before Lethal Control

Under this alternative, ADC take of nontarget animals would probably be less than that of the proposed action because no preventive lethal control actions would be taken by ADC. Mitigation measures to avoid T&E impacts were described in Chapter 3. Those measures should assure that adverse impacts are not likely to occur to T&E species by implementing Alternative 4.

If cooperators were not satisfied by corrective control operations by ADC, private efforts to reduce or prevent depredations could increase. This could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than the proposed action. Private individuals may trap coyotes year round and would not be restricted to mitigation measures such as ADC's self imposed restrictions of setting traps no closer than 30 feet to livestock carcasses to avoid capturing scavenging birds or using pan tension devices to exclude smaller animals. Hazards to raptors, including bald eagles, could therefore be greater under this alternative. Private individuals are not allowed to use M-44 devices. However, it is hypothetically possible that, similar to Alternative 2, frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could lead to unknown impacts on local nontarget species populations, including T&E species.

4.2.3 Effects of Predator Removal on Prey Populations

4.2.3.1 Alternative 1 - Continue the Current Federal ADC PDM Program

ADC takes several species of predators in the District as discussed in 4.2.2.1, but has the greatest impact on the coyote population (about 90% of the total predators removed through PDM). Since coyotes have had the greatest impact on them, much of the following information is given for their affects on prey species.

The relationship between predators and rodent and rabbit populations has been summarized in USDI (1979). Rabbit and rodent populations normally fluctuate substantially in several-year cycles. Two hypotheses attempt to explain these cyclic fluctuations: 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 1983); and 2) populations are regulated by environmental factors such as food and predation (Pitelka 1957, Fuller 1969).

Keith (1974) concluded that: 1) during cyclic declines in prey populations, predation has a depressive effect and as a result, the prey populations may decline further and be held 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 concluded that coyote populations seemed to respond to an abundance of jackrabbits. When a broad range of prey species is available, coyotes 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).

The impact analysis on rodents and lagomorphs (rabbits and hares) showed that predators generally prolong the low points in rodent population cycles and spread the duration of the peaks. Predators generally do not "control" rodent populations (Keith 1974, Clark 1972, Wagner and Stoddart 1972). It is more likely that prey abundance controls predator populations. USDI (1979, p. 128) concluded that "ADC Program activities have no adverse impacts to populations of rodents and lagomorphs." USDA (1994) did not specifically deal with this issue.

Henke (1995) reviewed literature concerning coyote-prey interactions and concluded that short term (≤6 months) coyote removal efforts typically do not result in increases in small mammal prey species populations. However, longer term intensive coyote removal (9 months or longer) can in some circumstances result in changes in rodent and rabbit species composition which may lead to changes in plant species composition and forage abundance. Most PDM actions in the District are not year round but occur for short periods after damage occurs (corrective control situations) or for short periods (< 6 months) at the time of year when benefits are most likely such as the 2 -3 month period immediately preceding calving in the spring. This factor, combined with the fact that ADC conducts PDM on less than 5% of the land area of the District, and kills a low percentage (10-20% at most) of the District's population of coyotes, means ecosystem impacts should be low in magnitude. Also, take of other carnivores that prey on rodents and rabbits such as gray fox is too low to indicate any potential for a significant effect. Evidence also exists to suggest other carnivores such as gray and red fox increase in number when coyote populations are reduced (Robinson 1961, Nunley 1977). Therefore, even if coyote numbers were reduced significantly, other species that prey on rodents and rabbits would probably increase in number to mitigate the reduction in coyote predation on those prey species.

Other prey species of coyotes include white-tailed and mule deer, and pronghorn antelope. Under certain conditions, predators, primarily coyotes, have been documented as having a significant adverse impact on deer and pronghorn antelope populations and this predation is not necessarily limited to sick or inferior animals (Pimlott 1970, Bartush 1978, USDI 1978, 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. These cases showed that coyote

predation had a significant influence on some populations of white-tailed deer (*Odocoileus virginianus*), black-tailed deer (*Odocoileus hemionus columbianus*), pronghorn antelope and bighorn sheep (*Ovis canadensis*). Hamlin et al. (1984) observed that a minimum of 90% summer mortality of fawns was a result of coyote predation. Other authors observed that coyotes were responsible for the majority of fawn mortality during the first few weeks of life (Knowlton 1964, White 1967).

Teer et al. (1991) concluded from work conducted at the Welder Wildlife Refuge, Texas that coyotes take a large portion of the fawns each year during the first few weeks of life. Another Texas study (Beasom 1974) found that predators were responsible for 74% and 61% of the fawn mortality for two consecutive years. Garner (1976), Garner et al. (1976), and Bartush (1978) found annual losses of deer fawns in Oklahoma to be about 88%, with coyotes responsible for about 88% to 97% of the mortality.

Reductions of local coyote and other predator populations have been shown to result in increasing fawn survival of white-tailed deer (Guthery and Beasom 1977, Stout 1982, Knowlton and Stoddart 1992) and pronghorn antelope (Arrington and Edwards 1951, Smith et al. 1986). Reductions of coyotes has also been suggested to benefit small predator populations such as the swift fox (USDI 1995).

Based on the above information, it is clear that local short term predator population reductions can enhance deer populations. This could either be a beneficial or detrimental effect depending upon whether local deer populations were at or below the capacity of the habitat to support them. Since ADC only conducts PDM on less than 5 % of the land area of the District in any one year, it is unlikely that effects on deer populations would be significant, except in isolated instances. The impacts are unlikely to be significant in major portions of the District.

4.2.3.2 Alternative 2 - No Federal ADC PDM and Alternative 3 - Technical Assistance Only

Since Alternatives 2 and 3 would result in no ADC operational programs, the potential effects would be similar and will be analyzed together. Under Alternatives 2 and 3, the impacts on prey populations from predator removal would likely be somewhat less than those of the proposed action because no federal PDM activities would occur. However, the difference is not likely to be substantial because of the following factors.

1. Private efforts to reduce coyote populations could still occur and would probably increase without ADC operational activities.

2. ODA PDM actions could still occur without federal involvement but would likely be to a lesser extent than under a cooperative program with federal involvement. Eliminating federal involvement would probably only reduce the percentage of land area worked from 3% to 1-2% which is not a major change in terms of potential impacts on prey populations.

3. Anticipated effects on coyote populations and other carnivore populations are expected to be minimal as identified by the analysis in section 4.2.1.

4.2.3.3 Alternative 4 - Nonlethal Required Before Lethal Control

Impacts of implementing Alternative 4 on prey species populations would not likely differ much from those of the proposed action for the same reasons identified in section 4.2.3.1.

4.2.4 Humaneness of Control Techniques

4.2.4.1 Alternative 1 - Continue the Current Federal ADC PDM Program

Under this alternative, methods viewed by some persons as inhumane would be employed. Despite standard operating procedures designed to maximize humaneness as described in sections 3.4.2.4 and 2.2.3, the perceived stress and trauma associated with being held in leghold traps or snares until the ADC specialist arrives at the trap or snare site to dispatch the animal, or, as in the case of an unharmed nontarget, to release it, is unacceptable to some persons. Other PDM methods used to take target animals including shooting and the M-44 result in a relatively humane death because the animals die instantly or within seconds to a few minutes.

On the other hand, if PDM under the current program was selected, fewer livestock animals would suffer from injuries caused by depredations. Thus, a balance of sorts between the two aspects of humaneness might be achieved under the proposed action.

4.2.4.2 Alternative 2 - No Federal ADC PDM

Under this alternative, methods viewed by some persons as inhumane would not be employed by ADC but would likely be employed by private individuals, with the exception of the M-44 device. Use of leghold traps and shooting by private individuals would probably increase. This could result in less experienced persons implementing use of traps and snares without modifications such as underpan tension devices which exclude smaller nontarget animals. Greater take and suffering of nontarget wildlife could result. It is hypothetically possible that frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which might result in increased animal suffering.

More livestock could be expected to suffer from injuries caused by depredations than under the proposed action.

4.2.4.3 Alternative 3 - Technical Assistance Only.

Impacts regarding the issue of humaneness under this alternative would likely be similar to those under Alternative 2.

4.2.4.4 Alternative 4 - Nonlethal Required Before Lethal Control

The amount of suffering by target and nontarget wildlife under this alternative would likely be less than under the proposed action since preventive control activity by ADC would not be allowed. However, use of leghold traps and shooting by private individuals would probably increase if depredation was not satisfactorily reduced. This could result in less experienced persons implementing use of traps and snares without modifications such as underpan tension devices which exclude smaller nontarget animals. Greater take and suffering of nontarget wildlife could result. The hypothetical risk of frustration leading to illegal pesticide use and its associated animal suffering is probably less than under alternatives 2 and 3 but more than under the proposed action.

Suffering of livestock because of injuries caused by depredation would likely increase under this alternative because PDM actions by ADC could not be implemented until the onset of depredation.

5.0 CHAPTER 5 - LIST OF PREPARERS AND PERSONS CONSULTED

5.1 List of Preparers

Thomas C. Hall, Supervisory Wildlife Biologist/Asst. State Director, Oklahoma, USDA-APHIS-ADC

George Graves, Supervisory Wildlife Biologist/State Director, Oklahoma, USDA-APHIS-ADC

Gary A. Littauer, Wildlife Biologist/Environmental Coordinator, USDA-APHIS-ADC

5.2 List of Persons and Agencies Consulted

U.S. Fish and Wildlife Service

Oklahoma Department of Agriculture
- Dennis Howard, Commissioner
- Dr. N. Eugene Eskew, Staff Veterinarian, Animal Industry
- Kevin Holley, Agric. Res. Sect. Sup., Plant Industry & Consumer Services

Oklahoma Department of Wildlife Conservation
- Richard Hatcher, Chief, Game Division
- Julie Hoaglund, Furbearer Biologist, Game Division
- Michael Shaw, Supervisor, Wildlife Research

Oklahoma Historical Society, State Historic Preservation Office

APPENDIX A

LITERATURE CITED

Allen, S. H., J. O. Hastings, and S. C. Kohn. 1987. Composition and stability of coyote families and territories in North Dakota. Prairie Nat. 19:107-114.

Althoff, D. P. 1978. Social and spatial relationships of coyote families and neighboring coyotes. M.S. Thesis, Univ. Nebraska, Lincoln. 80pp.

Andelt, W. F. and P. S. Gipson. 1979. Home range, activity, and daily movements of coyotes. J. Wildl. Manage. 43:944-951.

Arrington, O. N. and A. E. Edwards. 1951. Predator control as a factor in antelope management. Trans. N. Am. Wildl. Conf. 16:179-193.

Bartush, W. S. 1978. Mortality of white-tailed deer fawns in the Wichita Mountains, Comanche County, Oklahoma, Part II. M.S. Thesis. Oklahoma State Univ., Stillwater, OK. 161pp.

Beasom, S. L. 1974. Relationships between predator removal and white-tailed deer net productivity. J. Wildl. Manage. 38:854-859.

Bekoff, M. and M. C. Wells. 1982. Behavioral ecology of coyotes: social organization, rearing patterns, space use, and resource defense. Z. Tierpsychol. 60:281-305.

Bjorge, R. R., J.R. Gunson, and W.M. Samuel. 1981. Population characteristics and movements of striped skunks (*Mephitis mephitis*) in central Alberta. Can Field. Nat. 95:149-155.

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

Burns, R. J. 1980. Evaluation of conditioned predation aversion for controlling coyote predation. J. Wildl. Manage. 44:938-942.

_____ and G.E. Connolly. 1980. Lithium chloride aversion did not influence prey killing in coyotes. Proc. Vertebr. Pest Conf. 9:200-204.

_____. 1983. Coyote predation aversion with lithium chloride: management implications and comments. Wildl. Soc. Bull. 11:128-133.

_____ and _____. 1985. A comment on "Coyote control and taste aversion". Appetite 6:276-281.

Camenzind, F. J. 1978. Behavioral ecology of coyotes on the National Elk Refuge, Jackson, Wyoming. Pp 267-294 *in* M. Bekoff, ed. Coyotes: Biology, behavior and management. Academic Press, New York.

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

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

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

_____. 1978. Predators and Predator Control. Pp 369-394 *in* Schmidt J.L. and D.L. Gilbert, eds. Big Game of North America: Ecology and Management. Wildl. Management Institute.

_____. 1988. M-44 sodium cyanide ejectors in the Animal Damage Control Program, 1976-1986. Proc. Vertebr. Pest Conf. 13:220-225.

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

Conover, M. R., J. G. Francik, and D. E. Miller. 1977. An experimental evaluation of aversive conditioning for controlling coyote predation. J. Wildl. Manage. 41:775-779.

Coolahan, C. 1990. The use of dogs and calls to take coyotes around dens and resting areas. Proc. Vertebr. Pest Conf. 14:260-262.

Crowe, D.M. 1975. A model for exploited bobcat populations in Wyoming. J. Wildl. Manage. 39:408-415.

Danner, D. A. 1976. Coyote home range, social organization, and scent post visitation. M.S. Thesis, University of Arizona, Tucson. 86 pp.

_____ and N. S. Smith. 1980. Coyote home range, movements, and relative abundance near cattle feedyard. J. Wildl. Manage. 44:484-487.

Edwards, L. L. 1975. Home range of coyotes in southern Idaho. M.S. Thesis, Idaho State Univ., Moscow. 36 pp.

Feldstein, M. and N. C. Klendshoj. 1954. The determination of cyanide in biological fluids by microdiffusion analysis. J. Lab. Clin. Med. 44:166-170.

Ferris, D. H. and R. D. Andrews. 1967. Parameters of a natural focus of *Leptospira pomona* in skunks and opossums. Bull. Wildl. Dis. Assoc. 3:2-10.

Fritzell, E.K. 1987. Gray Fox and Island Gray Fox. Pp. 408-420 *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock. Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150pp.

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

Garner, G. W. 1976. Mortality of white-tailed deer fawns in the Wichita Mountains, Comanche County, Oklahoma. PhD. Thesis. Oklahoma State Univ., Stillwater. 113 pp.

_____, J. A. Morrison, and J. C. Lewis. 1976. Mortality of white-tailed deer fawns in the Wichita Mountains, Oklahoma. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agen. 13:493-506.

Gese, E. M., O. J. Rongstad, and W. R. Mytton. 1988. Home range and habitat use of coyotes in southeastern Colorado. J. Wildl. Manage. 52:640-646.

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

Hamlin, K. L., S. J. Riley, D. Pyrah, A. R. Dood, and R. J. Mackie. 1984. Relationships among mule deer fawn mortality, coyotes, and alternate prey species during summer. J. Wildl Manage. 48:489-499.

Harris, S. 1977. Distribution, habitat utilization and age structure of a suburban fox (*Vulpes vulpes*) population. Mammal Rev. 7:25-39.

_____ and J. M. V. Rayner. 1986. Urban fox (*Vulpes vulpes*) population estimates and habitat requirements in several British cities. J. Anim. Ecol. 55:575-591.

Henne, D. R. 1975. Domestic sheep mortality on a western Montana ranch. Pp. 133-149 *in* R. L. Phillips and C. Jonkel eds. Proc. 1975 Predator Sym. Montana For. Conserv. Exp. Stn., School For., Univ. Mont. Missoula.

Henke, S. E. 1995. Affects of coyote control on their prey: a review. *In* (Proc.) Coyotes in the Southwest: a compendium of our knowledge. Dec. 1995. Tex. Agric. Ext. Serv., Tex. A&M Univ., San Angelo. pp. 35-40.

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

Horn, S. W. 1983. An evaluation of predatory suppression in coyotes using lithium chloride-induced illness. J. Wildl. Manage. 47:999-1009.

Houseknecht, C. R. 1971. Movements, activity patterns and denning habits of striped skunks (*Mephitis mephitis*) and exposure potential for disease. PhD. Thesis, Univ. Minnesota, Minneapolis. 46pp.

Howard, V. W., Jr. and R. E. Shaw. 1978. Preliminary assessment of predator damage to the sheep industry in southeastern New Mexico. Agric. Exp. Stn., New Mexico State Univ., Las Cruces, Res. Rpt. 356.

_____ and T. W. Booth. 1981. Domestic sheep mortality in southeastern New Mexico. Agric. Exp. Stn., New Mexico State Univ., Las Cruces. Bull 683.

Jahnke, L.J., C. Phillips, S.H. Anderson, and L.L. McDonald. 1987. A methodology for identifying sources of indirect costs of predation control: A study of Wyoming sheep producers. Vertebr. Pest. Cont. Manage. Mat. 5, ASTM STP 974. pp 159-169.

Johnson, E. L. 1984. Applications to use sodium fluoroacetate (Compound 1080) to control predators; final decision. Fed. Reg. 49(27):4830-4836.

Jones, H. W., Jr. 1939. Winter studies of skunks in Pennsylvania. J. Mammal. 20: 254-256.

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

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

_____. 1972. Preliminary interpretation of coyote population mechanics with some management implications. J. Wildl. Manage. 36:369-382.

_____ and L.C. Stoddart. 1992. Some observations from two coyote-prey studies. Pp 101-121 *in* A.H. Boer, ed., Ecology and Management of the Eastern Coyote. Univer. of New Brunswick, Fredericton, New Brunswick, Canada.

Knudson, T. 1990. Birds fall prey to a King Midas technology. High Country News. June 4, pp. 7.

Koehler, G. 1987. The Bobcat. *In* Silvestro, R.L. ed. Audubon Wildlife Report, The National Audubon Society, New York, N.Y. pp.399-409.

Lindzey, F. G. 1971. Ecology of badgers in Curlew Valley, Utah and Idaho with emphasis on movement and activity patterns. MS Thesis, Utah State Univ., Logan, Utah 50pp.

Lynch, G. M. 1972. Effect of strychnine control on nest predators of dabbling ducks. J. Wildl. Manage. 36:436-440.

MacDonald, D. W. and M. T. Newdick. 1982. The distribution and ecology of foxes. *Vulpes vulpes* (L.) in urban areas. *In* R. Bornkamm, J. A. Lee, and M. R. D. Seaward eds. Urban Ecology. Blackwell Sci. Publ., Oxford, UK. pp.123-135.

Messier, F. and C. Barrette. 1982. The social system of the coyote *(Canis latrans)* in a forested habitat. Can. J. Zool. 60:1743-1753.

Messick, J.P. and M.G. Hornocker. 1981. Ecology of the badger in southwestern Idaho. Wildl. Monograph No. 76, 53pp.

Munoz, J.R. 1977. Cause of Sheep Mortality at the Cook Ranch, Florence, Montana. 1975-1976. M.S. Thesis. University of Montana, Missoula. 55pp.

Myers, J. and C.J. Krebs. 1983. Genetic, behavioral, and reproductive attributes of dispersing field voles *Microtus pennsylvanicus* and *Microtus ochrogaster*. Ecol. Monogr. 41:53-78.

Nass, R.D. 1977. Mortality associated with range sheep operations in Idaho. J. Range Manage. 30: 253-258

_____. 1980. Efficacy of predator damage control programs. Proc. Vertebrate Pest Conf. 9:205-208.

NASS (National Agricultural Statistics Service). 1991. Sheep and goat predation loss. USDA, NASS, Wash., DC. 12pp.

_____. 1992. Cattle and calves death loss. USDA, NASS, Wash., DC. 23pp.

_____. 1995. Sheep and goat predator loss. USDA, NASS, Wash., DC. 16pp.

_____. 1996. Cattle predator loss. USDA, NASS, Wash., DC. 23pp.

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

Nunley, G. L. 1977. The effects of coyote control operations on nontarget species in New Mexico. Great Plains Wildl. Damage Workshop 3:88-110.

O'Gara, B. W., K. C. Brawley, J. R. Munoz, and D. R. Henne. 1983. Predation on domestic sheep on a western Montana ranch. Wildl. Soc. Bull. 11:253-264.

OASS (Oklahoma Agricultural Statistics Service). 1994. Oklahoma Agricultural Statistics 1994. USDA/ODA, OASS, 2800 N. Lincoln Blvd., Okla. City, OK 73105. 105pp.

ODWC (Oklahoma Department of Wildlife Conservation). 1995. Furbearer population and harvest distribution and trends. Upland Game Inventories Performance Report. ODWC 24pp.

Ozoga, J. J. and E. M. Harger. 1966. Winter activities and feeding habits of northern Michigan coyotes. J. Wildl. Manage. 30:809-818.

Pimlott, D. H. 1970. Predation and productivity of game populations in North America. Trans. Int. Congr. Game Biol. 9:63-73.

Pitelka, F.A. 1957. Some characteristics of microtine cycles in the Arctic. Oregon State College, Biol. Colloquium Proc. 18:73-88.

Pyrah, D. 1984. Social distribution and population estimates of coyotes in north-central Montana. J. Wildl. Manage. 48:679-690.

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

Robinson, W. B. 1961. Population changes of carnivores in some coyote-controlled areas. J. Mamm. 42:510-515.

Rolley, R.E. 1985. Dynamics of a harvested bobcat population in Oklahoma. J. Wildl. Manage.49:283-292.

Rosatte, R. C. and J. R. Gunson. 1984. Dispersal and home range of striped skunks, *Mephitis mephitis*, in an area of population reduction in southern Alberta. Can. Field Nat. 98:315-319.

_____. 1987. Striped, spotted, hooded and hog-nosed skunks. Pp. 599-613 *in* M. Novak, J. A. Baker, M. E. Obbard and B. Malloch (eds.) Wild Furbearer Management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150pp.

Rowley, G. J. and D. Rowley. 1987. Decoying coyotes with dogs. Proc. Great Plains Wildl. Damage Cont. Work. 8:179-181.

Roy, L. D. and M. J. Dorrance. 1985. Coyote movements, habitat use, and vulnerability in central Alberta. J. Wildl. Manage. 49:307-313.

Sanderson, G.C. 1987. Raccoon. Pp 486-499 *in* M. Novak, J.A. Baker, M.E. Obbard, B. Mallock. Wild Furbearer management and Conservation in North America. Ministry of Natural Resources, Ontario, Canada. 1150pp.

Sargeant, A. B. 1972. Red fox spatial characteristics in relation to waterfowl predation. J. Wildl. Manage. 36:225-236.

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

Smith, R. H., D. J. Neff, and N. G. Woolsey. 1986. Pronghorn response to coyote control - A benefit:cost analysis. Wildl. Soc. Bull. 14:226-231.

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

Sterner, R. T. and S. A. Shumake. 1978. Bait-induced prey aversion in predators: some methodological issues. Behav. Bio. 22:565-566.

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

Storm, G. L. 1972. Daytime retreats and movements of skunks on farmlands in Illinois. J. Wildl. Manage. 36:31-45.

_____ and M. W. Tzilkowski. 1982. Furbearer population dynamics: a local and regional management perspective. Pp. 69-90 *in* G. C. Anderson, ed. Midwest Furbearer Management. Proc. Sym. 43rd Midwest Fish and Wildl. Conf., Wichita, KS.

Stout, G. G. 1982. Effects of coyote reduction on white-tailed deer productivity on Fort Sill, Oklahoma. Wildl. Soc. Bull. 10:329-332.

Teer, J.G., D. L. Drawe, T. L. Blankenship, W. F. Andelt, R. S. Cook, J. Kie, F. F. Knowlton, and M. White. 1991. Deer and coyotes: The Welder Experiments. Trans. N.A. Wildl. Nat. Res. Conf. 56:550-560.

Thomas, L. 1986. Statement of fact and proposed findings and conclusions on behalf of the United States Fish and Wildlife Service before the USEPA Administrator. FIFRA Docket No. 559. pp4-5.

Tigner, J. R. and G. E. Larson. 1977. Sheep losses on selected ranches in southern Wyoming. J. Range Manage. 30:244-252.

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

_____. 1992. Behavioral effects of removal of coyote pups from dens. Proc. Vertebr. Pest Conf. 15:396-399.

Timm, R. M. and R. H. Schmidt. 1986. Management problems encountered with livestock guarding dogs on the University of California, Hopland Field Station. Proc. Great Plains Wildl. Damage Control Workshop 9:54-58.

Todd, A. W. and L. B. Keith. 1976. Responses of coyotes to winter reductions in agricultural carrion. Alberta Recreation, Parks Wildl., Wildl. Tech. Bull. 5. 32 pp.

Trapp, G.R. 1978. Comparative behavior ecology of the ringtail and gray fox in southwestern Utah. Carnivore, Vol. 1, No.2, pp. 3-32.

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

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

USDA. 1989. USDA, Animal and Plant Health Inspection Service, Animal Damage Control Strategic Plan. USDA, APHIS, ADC, Operational Support Staff, 6505 Belcrest RD, Room 820 Federal Bldg, Hyattsville, MD 20782.

_____. 1992. A producers guide preventing predation to livestock. USDA, APHIS, ADC, Wash., D.C. Agric. Information Bull. No. 650. 14pp.

_____. 1994. Final Environmental Impact Statement. USDA, APHIS, ADC, Operational Support Staff, 6505 Belcrest RD, Room 820 Federal Bldg, Hyattsville, MD 20782.

USDI (U.S. Department of the Interior), Fish and Wildlife Serv. 1978. Predator damage in the West: a study of coyote management alternatives. Wash., D.C. 168pp.

_____ _____. 1979. Mammalian predator damage management for livestock protection in the Western United States. Final Environ. Impact Statement. Wash., D.C. 789 pp.

_____. 1995. Twelve-month administrative finding on petition to list the swift fox. Memorandum from Dir. Region 6 to Director dated April 14, 1995. 61pp.

Verts, B. J. 1967. The biology of the striped skunk. Univ. Illinois Press, Urbana. 218 pp.

Voigt, D. R. 1987. "Red Fox". Pp. 378-392 *in* Novak, M., Baker, J. A., Obbard, M. E. and Mallock, B. (Eds.) Wild Furbearer Management and Conservation in North America. Ontario Ministry of Natural Resources, Toronto, Ontario, Canada. 1150 p.

Wade, D.A. 1982. Impacts, incidence and control of predation on livestock in the United States, with particular reference to predation by coyotes. Council for Agricultural Science and Technology (CAST) Spec. Publ. No. 10. 250 Memorial Union, Ames, IA 50011. 20 pp.

_____ and J.E. Bowns. 1982. Procedures for evaluating predation on livestock and wildlife. TexasAgri. Ext. Serv. and TX Agric. Exp. Sat. Texas A&M Univ. in coop. with USDI-FWS (Fish and Wildl. Serv.) Pub. B-1429. 42 pp.

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

White, M. 1967. Population ecology of some white-tailed deer in south Texas. PhD. Thesis. Purdue University, Lafayette. pp72-86. 215 pp.

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

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