ENVIRONMENTAL ASSESSMENT

Managing Damage to Resources and Threats to Human Safety Caused by Birds in the State of Arkansas

Prepared by

United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

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TABLE OF CONTENTS

TABLE OF CONTENTS 2
ACRONYMS 3

CHAPTER 1: PURPOSE AND NEED FOR ACTION
1.1 PURPOSE 4
1.2 NEED FOR ACTION 5
1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT 21
1.4 DECISIONS TO BE MADE 24
1.5 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS . 24
1.6 AUTHORITY OF FEDERAL AND STATE AGENCIES 25
1.7 COMPLIANCE WITH LAWS AND STATUTES 27

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES
2.1 AFFECTED ENVIRONMENT 32
2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES 33
2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE 40

CHAPTER 3: ALTERNATIVES
3.1 DESCRIPTION OF THE ALTERNATIVES 48
3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL 56
3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT 59
3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES 60

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES
4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL 63
4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE 139

CHAPTER 5: LIST OF PREPARERS AND PERSONS CONSULTED
5.1 LIST OF PREPARERS AND REVIEWERS 144
5.2 LIST OF PERSONS CONSULTED 145

LIST OF APPENDICES

APPENDIX A LITERATURE CITED 146

APPENDIX B METHODS AVAILABLE FOR USE OR RECOMMENDATION BY THE ARKANSAS WS PROGRAM 174

APPENDIX C THREATENED AND ENDANGERED SPECIES THAT ARE FEDERALLY LISTED IN THE STATE OF ARKANSAS 186

ACRONYMS

AAD	Arkansas Agriculture Department
AGFC	Arkansas Game and Fish Commission
AI	Avian Influenza
APHIS	Animal and Plant Health Inspection Service
AQDO	Aquaculture Depredation Order
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BO	Biological Opinion
CBC	Christmas Bird Count
CDC	Center for Disease Control
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
ECOFRAM	Ecological Committee on FIFRA Risk Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESC	Enteric Septicemia of Catfish
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Fiscal Year
HP	Highly Pathogenic
INAD	Investigational New Animal Drug
IPN	Infectious Pancreatic Necrosis
MA	Methyl Anthranilate
MOU	Memorandum of Understanding
MBTA	Migratory Bird Treaty Act
NAS	National Audubon Society
NASS	National Agricultural Statistics Service
NCZ	Nicarbazin
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWRC	National Wildlife Research Center
PRDO	Public Resources Depredation Order
ROD	Record of Decision
SOP	Standard Operating Procedure
SVC	Spring Viraemia of Carp
T&E	Threatened and Endangered
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
VHS	Viral Haemorrhagic Septicaemia
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in Arkansas continues to receive requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax auritus*), anhingas (*Anhinga anhinga*), great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), little blue herons (*Egretta caerulea*), tricolored herons (*Eggretta tricolor*), cattle egrets (*Bubulcus ibis*), green herons (*Butorides virescens*), black-crowned night herons (*Nycticorax nycticorax*), yellow-crowed night herons (*Nyctanassa violacea*), black vultures (*Coragyps atratus*), turkey vultures (*Cathartes aura*), Canada geese (*Branta canadensis*), snow geese (*Chen caerulescens*), ring-necked ducks (*Aythya collaris*), lesser scaups (*Aythya affinis*), American coots (*Fulica americana*), ring-billed gulls (*Larus delawarensis*), rock pigeons (*Columba livia*), belted kingfishers (*Ceryle alcyon*), American crows (*Corvus brachyrhynchos*), fish crows (*Corvus ossifragus*), European starlings (*Sturnus vulgaris*), red-winged blackbirds (*Agelaius phoeniceus*), common grackles, (*Quiscalus quiscula*), and brown-headed cowbirds (*Molthrus ater*). Normally, individual wildlife damage management actions conducted by the WS program could be categorically excluded from further analysis pursuant to the National Environmental Policy Act (NEPA), in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003).

The purpose of this Environmental Assessment (EA) is to evaluate activities conducted by WS to manage damage and threats to agricultural resources, property, natural resources, and threats to humans caused by birds. This EA will assist in determining if the proposed management of bird damage could have a significant impact on the environment for both humans and other organisms, analyze alternatives, coordinate efforts with other federal, state, and local agencies, inform the public, and to comply with the NEPA. This EA analyzes the potential effects of bird damage management when requested, as coordinated between WS, the United States Fish and Wildlife Service (USFWS), and the Arkansas Game and Fish Commission (AGFC).

WS is preparing this EA to: 1) facilitate planning, 2) promote interagency coordination, 3) streamline program management, 4) clearly communicate to the public the analysis of individual and cumulative impacts of program activities; and 5) evaluate and determine if there are any potentially significant or cumulative adverse affects from the proposed program. The analyses contained in this EA are based on information derived from WS' Management Information System, published documents (Appendix A), interagency consultations, public involvement, the analyses in the USFWS Final Environmental Impact Statement (FEIS) for the management of double-crested cormorants (USFWS 2003), the analyses in the USFWS FEIS for the management of resident Canada geese (USFWS 2005), the EA previously prepared by WS to address cormorant damage in the State (USDA 2004), and the analyses in WS' programmatic FEIS[2] (USDA 1997) which will be incorporated into this document by reference.

WS previously developed an EA that addressed WS' activities to manage damage associated with double-crested cormorants in the State (USDA 2004). Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed selecting the proposed action alternative. The proposed action

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

[2]WS' has prepared a programmatic FEIS that further addresses WS' activities to manage damage associated with wildlife, including detailed discussion of program activities, risk assessment of methods, and discussion of issues (USDA 1997). Information from WS' programmatic FEIS has been incorporated by reference into this EA. WS' FEIS may be obtained by contacting USDA/APHIS/WS, Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD 20737-1234.

alternative implemented a cormorant damage management program using a variety of methods in an integrated approach to meet the need for action and address the identified issues (USDA 2004). This EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several species of birds in the State.

This EA evaluates the need for action to manage damage associated with birds in the State, the potential issues associated with bird damage management, and the environmental consequences of conducting different alternatives to address the need for action and the identified issues. Issues relating to the reduction of wildlife damage were raised during the scoping process for WS' programmatic FEIS (USDA 1997) and were considered in the preparation of the EA. Issues relating to cormorant damage management (USFWS 2003) and resident Canada goose damage were also considered during the development of this EA. The issues and alternatives associated with bird damage management in Arkansas were initially developed by WS in consultation with the USFWS, the AGFC, and the Arkansas Agriculture Department (AAD). The USFWS has regulatory authority to manage populations of migratory bird species in the State. To assist with the identification of additional issues and alternatives to managing damage associated with birds in Arkansas, the EA will be made available to the public for review and comment prior to a Decision[3].

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and thrive in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between humans and wildlife that lead to requests for assistance to reduce damage to resources and to reduce threats to human safety. WS' programmatic FEIS summarizes the relationship of wildlife values and wildlife damage in this way (USDA 1997):

"*Wildlife has either positive or negative values, depending on varying human perspectives and circumstances...Wildlife is generally 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 are 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*."

Both sociological and biological carrying capacities must be applied to resolve wildlife damage problems. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the habitat may have a biological carrying capacity to support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or has been met. Once the wildlife acceptance capacity is met or exceeded,

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

people begin to implement population or damage management, including lethal methods, to alleviate damage or address threats to human health and safety.

The alleviation of damage or other problems caused by or related to the behavior of wildlife is termed wildlife damage management and is recognized as an integral component of wildlife management (The Wildlife Society 1992). The imminent threat of damage or loss of resources is often sufficient for individual actions to be initiated and the need for damage management is derived from the specific threats to resources. Those species have no intent to do harm. They utilize habitats (*e.g.*, reproduce, walk, forage) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and can be based on many factors (*e.g.*, economic, social, aesthetics). Therefore, how damage is defined is often unique to the individual person and damage occurring to one individual may not be considered damage by another individual. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e.*, has reached an individual threshold). The term "*damage*" is most often defined as economic losses to resources or threats to human safety but could also include a loss in aesthetic value and other situations where the actions of wildlife are no longer tolerable to an individual person.

The need for action to manage damage and threats associated with birds in Arkansas arises from requests for assistance[4] received by WS to reduce and prevent damage associated with birds from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. WS has identified those bird species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance. Table 1.1 lists WS' technical assistance projects involving bird damage or threats of bird damage to those four major resource types in Arkansas from the federal fiscal year[5] (FY) 2006 through FY 2009. Technical assistance is provided by WS to those persons requesting assistance with resolving damage or the threat of damage by providing information and recommendations on bird damage management activities that can be conducted by the requestor without WS' direct involvement in managing or preventing the damage. WS' technical assistance activities are discussed further in Chapter 3 of this EA.

The technical assistance projects conducted by WS are representative of the damage and threats that are caused by birds in Arkansas. As shown in Table 1.1, WS has conducted 967 technical assistance projects in Arkansas that addressed damage and threats associated with those bird species addressed in this assessment from FY 2006 through FY 2009. WS has conducted 253 technical assistance projects involving damage or threats of damage associated with Canada geese in the State. Geese often overgraze lawns and turf and often leave accumulations of droppings where the geese loaf, roost, and feed. The droppings and overgrazing often negatively impact the aesthetics of property and can cause substantial economic damage from the loss of landscaping and turf. Goose feces can pose health risks when accumulations occur in areas where people may contact fecal droppings, such as parks, golf courses, and beaches.

WS also conducted 134 technical assistance projects involving damage and threats associated with double-crested cormorants in the State. Damage and threats of damage associated with cormorants in Arkansas occur primarily from cormorants feeding on fish fry at aquaculture facilities in the State (USDA

[4] WS only conducts bird damage management after receiving a request for assistance. Before initiating bird damage activities, a Memorandum of Understanding, cooperative service agreement, or other comparable document must be signed between WS and the cooperating entity which lists all the methods the property owner or manager will allow to be used on property they own and/or manage.

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

2004). Cormorants are often opportunistic feeders and will often congregate in areas where aquaculture production occurs in the State.

In addition, WS has conducted 145 technical assistance projects involving vultures since FY 2006. Vultures often roost in mixed species flocks in large numbers. Fecal droppings often accumulate under areas where vultures roost and loaf. Concerns are often raised about disease transmission to people that encounter fecal droppings on their property. The odor and aesthetically displeasing presence of fecal droppings at roost sites can also be a concern. Damage can also occur to property from vultures pulling and tearing shingles, trim, and rubber material on buildings and vehicles.

Table 1.1 – Technical assistance projects conducted by WS from FY 2006 through FY 2009

Species	Projects	Species	Projects
American white pelican	28	**Canada goose**	253
Double-crested cormorant	134	**Snow goose**	47
Great blue heron	99	**Lesser scaup**	19
Great Egret	28	**American coot**	1
Little blue heron	1	**Ring-billed gull**	1
Cattle egret	8	**Rock pigeon**	15
Green heron	6	**American crow**	33
Egrets/Herons	10	**European Starling**	5
Egrets/Herons/Cormorants	4	**Red-winged blackbird**	3
Black vulture	93	**Common grackle**	13
Turkey vulture	5	**Blackbirds (mixed)**	114
Vultures (mixed)	47	**TOTAL**	**967**

Vultures can cause injuries and death to newborn lambs and calves during the birth of the animals. Vultures often attack the soft tissue areas of newborns as they are being expunged from the female. During the birthing process, newborns and mothers are vulnerable and often are unable to prevent attacks by large groups of vultures. Vultures often attack the eyes and rectal area of newborns during delivery that results in serious injury to the lamb or calf which often leads to death of the animal.

Table 1.2 lists those bird species and the resource types that those bird species can cause damage to in Arkansas. Many of the bird species can cause damage to or pose threats to a variety of resources. In Arkansas, most requests for assistance received by WS are related to threats associated with damage or threats of damage at aquaculture facilities.

Many of the species addressed in this assessment are gregarious (*i.e.*, form large flocks) species especially during the fall and spring migration periods. Although damage and threats can occur throughout the year, damage is highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can be found during the breeding season where suitable nesting habitat exists, such as herons, cormorants, and gulls. The flocking behavior of many bird species during migration periods can pose increased risks when those species occur near or on airport properties. Aircraft striking multiple birds can increase the damage to the aircraft but also can increase the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines.

Table 1.2 – Bird species that WS in Arkansas routinely receives requests for assistance for and the resource type damaged by those species

Species	Resource				Species	Resource			
	A	N	P	H		A	N	P	H
American white pelican	X	X	X	X	Canada goose	X	X	X	X
Double-crested cormorant	X	X	X	X	Snow goose	X		X	X
Anhinga	X	X	X	X	Ring-necked duck	X		X	X
Great blue heron	X	X	X	X	Lesser scaup	X		X	X
Great Egret	X	X	X	X	American coot	X		X	X
Snowy egret	X	X	X	X	Ring-billed gull	X	X	X	X
Little blue heron	X	X	X	X	Rock pigeon	X		X	X
Tricolored heron	X	X	X	X	Belted kingfisher	X		X	X
Cattle egret	X	X	X	X	American Crow	X		X	X
Green heron	X	X	X	X	Fish Crow	X		X	X
Black-crowned night heron	X	X	X	X	European Starling	X	X	X	X
Yellow-crowed night heron	X	X	X	X	Red-winged blackbird	X		X	X
Black vulture	X		X	X	Common grackle	X		X	X
Turkey vulture	X		X	X	Brown-headed cowbird	X		X	X

[a]A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

As stated previously, the need for action arises from requests received from state, federal, and private entities to provide assistance with resolving damage or threats of damage to four main categories of resources in Arkansas that include agricultural resources, natural resources, property, and human safety. More specific information regarding bird damage to those main categories are discussed in the following subsections of the EA:

Need to Resolve Bird Damage to Agricultural Resources

Agriculture is one of the leading industries in Arkansas with 13.6 million acres devoted to agricultural production (USDA 2009*a*). The total market value of agricultural products sold in the State was over $7.5 billion in 2007 (USDA 2009*a*). The value of grain crops, oilseeds, dry beans, and dry peas production in the State was over $2.2 billion in 2007 (USDA 2009*a*). The cattle and calf inventory for Arkansas was over 1.8 million head during 2007 with a sales value of nearly $626 million (USDA 2009*a*). The value of sales from aquaculture production in the State during 2007 was nearly $119 million which ranked third in the United States (USDA 2009*a*).

As shown in Table 1.2, all of the bird species addressed in this assessment have been identified as causing or posing threats to agricultural resources in Arkansas.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic wildlife. Damage can also result from the death of fish and other aquatic wildlife from injury associated with bird predation as well as the threat of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites. The principal species propagated in Arkansas are catfish, baitfish, and trout (USDA 2009*b*). In 2007, there were 166 commercial catfish operations in Arkansas with over 95 million pounds of catfish sold (USDA 2009*b*). Arkansas leads the United States in bait fish production and ranks second in catfish production. In 1998, the Arkansas aquaculture industry was valued at $162.8 million (B. Collins, USDA/ARS, pers. comm., 2000). There were also five commercial trout producing operations in

the State during 2007 with nearly 1.5 million pounds of trout sold (USDA 2009*b*). Of those birds shown in Table 1.1 associated with damage to agriculture, of primary concern to aquaculture facilities in Arkansas are pelicans, cormorants, herons, egrets, and to a lesser extent lesser scaup, ring-necked ducks, ring-billed gulls, coots, kingfishers, and grackles.

Double-crested cormorants can feed heavily on fish being raised for human consumption, and on fish commercially raised for bait and restocking in Arkansas (USFWS 2003). The frequency of occurrence of cormorants at a given aquaculture facility can be a function of many interacting factors, including: (1) size of the regional and local cormorant population; (2) the number, size, and distribution of aquaculture facilities; (3) the size distribution, density, health, and species composition of fish populations at facilities; (4) the number, size, and distribution of wetlands in the immediate area; (5) the size distribution, density, health, and species composition of free-ranging fish populations in the surrounding landscape; (6) the number, size, and distribution of suitable roosting habitat; and (7) the variety, intensity and distribution of local damage abatement activities. Cormorants are adept at seeking out the most favorable foraging and roosting sites. As a result, cormorants rarely are distributed evenly over a given region, but rather tend to be highly clumped or localized. Damage abatement activities can shift bird activities from one area to another; thereby, not eliminating predation but only reducing damage at one site while increasing damage at another location (Aderman and Hill 1995, Mott et al. 1998, Reinhold and Sloan 1999, Tobin et al. 2002). Thus, it is not uncommon for some aquaculture producers in a region to suffer little or no economic damage from cormorants, while others experience exceptionally high losses.

Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. The magnitude of economic impacts that cormorants have on the aquaculture industry can vary dependent upon many different variables including, the value of the fish stock, number of depredating birds present, and the time of year the predation is taking place.

In addition to cormorants, great blue herons are also known to forage at aquaculture facilities (Parkhurst et al. 1987). During a survey of aquaculture facilities in the northeastern United States, 76% of respondents identified the great blue heron as the bird of highest concern from predation (Glahn et al. 1999*a*). Glahn et al. (1999*a*) found that 80% of the aquaculture facilities surveyed in the northeastern United States perceived birds as posing an economic threat due to predation which coincided with 81% of the facilities surveys having birds present on aquaculture ponds. Great blue herons were found at 90% of the sites surveyed by Glahn et al. (1999*a*). Loss of trout in ponds with herons present ranged from 9.1% to 39.4% in Pennsylvania with an estimated loss in production ranging from $8,000 to nearly $66,000 (Glahn et al. 1999*b*). The stomach contents of great blue herons collected at trout producing facilities in the northeastern United States contained almost exclusively trout (Glahn et al. 1999*b*).

In addition to cormorants and herons, other bird species have also been identified as causing damage or posing threats to aquaculture facilities. In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities, including egrets, herons, gulls, kingfishers, crows, common grackles, and brown-headed cowbirds (Parkhurst et al. 1987).

Predation at aquaculture facilities can occur from American crows (Parkhurst et al. 1987, Parkhuarst et al. 1992). During a survey of ten fisheries in 1985 and 1986, American crows were observed at eight of the facilities in central Pennsylvania (Parkhurst et al. 1992). The mean size of trout captured by crows in one study was 22.5 centimeters with a range of 15.2 to 31.7 centimeters (Parkhurst et al. 1992). Crows consumed a mean of 11,651 trout per year per site from ten trout hatcheries in Pennsylvania in 1985 and 1986 (Parkhurst et al. 1992). Since crows selected for larger fish classes at fish facilities, Parkhurst et al. (1992) determined economic losses from foraging by crows led to a higher mean economic impact at facilities compared to other avian foragers based on the value of larger fish classes.

Although primarily insectivorous during the breeding season and granivorous during migration periods (Peer and Bollinger 1997), common grackles have been identified as feeding on fish (Hamilton 1951, Beeton and Wells 1957, Darden 1974, Zottoli 1976, Whoriskey and Fitzgerald 1985, Parkhurst et al. 1992). During a study of aquaculture facilities in central Pennsylvania, Parkhurst et al. (1992) found grackles feeding on trout fry at nine of the ten facilities observed. The mean length of trout captured by grackles was 7.6 centimeters with a range of 6.0 to 7.9 centimeters. Once fish reached a mean size of 14 centimeters, grackles switch to alternative food sources at the facilities (Parkhurst et al. 1992). Among all predatory bird species observed during the study conducted by Parkhurst et al. (1992), grackles captured and removed the most fish per day per site which was estimated at 145,035 fish captured per year per site.

Also of concern to aquaculture facilities is the transmission of diseases by birds between impoundments and from facility to facility. Given the confinement of aquatic wildlife inside impoundments at aquaculture facilities and the high densities of those organisms in the impoundments, the introduction of a disease can result in substantial economic losses since the entire impoundment is likely to become infected and result in extensive mortality. Although the actual transmission of diseases through transport by birds is difficult to document, birds have been documented as having the capability of spreading diseases through fecal droppings and possibly through other mechanical means such as on feathers, feet, and regurgitation.

Birds have been identified as a possible source of transmission of three fish viruses in Europe: Spring Viraemia of Carp (SVC), Viral Haemorrhagic Septicaemia (VHS), and Infectious Pancreatic Necrosis (IPN) (European Inland Fisheries Advisory Commission 1989). VHS and IPN are known to occur in North America (Price and Nickum 1995). SVC has also been documented to occur in North America (USDA 2003). Peters and Neukirch (1986) found the IPN virus in the fecal droppings of herons when the herons were fed IPN infected trout. Olesen and Vestergard-Jorgensen (1982) found herons could transmit the VHS (Egtved virus) from beak to fish when the beaks of herons were contaminated with the virus. However, Eskildsen and Vestergard-Jorgensen (1973) found the Egtved virus did not pass through the digestive tracks into the fecal droppings of black-headed gulls when artificially inserted into the esophagus of the gulls.

Birds are also capable of passing bacterial pathogens through fecal droppings and on their feet (Price and Nickum 1995). The bacterial pathogen for the fish disease Enteric Septicemia of catfish (ESC) has been found within the intestines and rectal areas of great blue herons and double-crested cormorants from aquaculture facilities in Mississippi (Taylor 1992). However, since ESC is considered endemic in the region, Taylor (1992) did not consider birds as a primary vector of the disease. Birds also pose as primary hosts to several cestodes, nematods, trematodes, and other parasites which can infect fish. Birds can also act as intermediate hosts of parasites that can infect fish after completing a portion of their life-cycle in crustaceans or mollusks (Price and Nickum 1995).

Although documentation that birds, primarily herons and cormorants, can pose as vectors of diseases known to infect fish, the rate of transmission is currently unknown and is likely very low. Since fish-eating birds are known to target fish that are diseased and less likely to escape predation at aquaculture facilities (Price and Nickum 1995, Glahn et al. 2002) and given the mobility of birds to move from one impoundment or facility to another, the threat of disease transmission is a concern given the potential economic loss resulting from extensive mortality of fish or other cultivated aquatic wildlife if a disease outbreak occurs.

Damage and Threats to Livestock Operations

Damage to livestock operations can occur from several bird species in Arkansas. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual birds or small groups of birds can cause economic damage to livestock producers, such as a vulture or a group of vultures feeding on newborn cattle, most economic damage occurs from bird species that congregate in large flocks at livestock operations.

In Arkansas, damage to livestock occurs primarily from vultures. Economic damage occurs from vultures feeding on livestock. Vultures are known to prey upon newly born calves and harass adult cattle, especially during the birthing process. The National Agricultural Statistics Service (NASS) reported livestock owners in the United States lost 8,600 head of cattle and calves from vultures in 2006 valued at $3.8 million (NASS 2006). Damage from vultures was primarily reported from black vultures (NASS 2006). Although turkey vultures are known to feed on livestock in mixed species flocks of vultures, livestock damages from vultures is generally restricted to the range of the black vulture. While both turkey vultures and black vultures have been documented harassing expectant cattle, WS in Arkansas has documented calf predation by black vultures. Black vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported black vultures killed pigs by pulling eyes out followed by attacks to the rectal area or directly attacking the rectal area. WS in Arkansas has also documented reports of birthing cows being harassed and distressed by black vultures. During a difficult delivery, vultures will peck at the half-expunged calf which can lead to the death of the animal. Reports of calf depredation occur throughout Arkansas but are not necessarily common. Many livestock producers do not leave birthing cows unattended.

Although damage and disease threats to livestock operations can occur throughout the year, damage is highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can be found during the breeding season where suitable nesting habitat exists, such as pigeons. Of primary concern to livestock feedlots and dairies in Arkansas are starlings, red-winged blackbirds, grackles, cowbirds, pigeons, and to a lesser extent crows and gulls. The flocking behavior of those species either from roosting and/or nesting behavior can lead to economic losses to agricultural producers from the consumption of livestock feed and from the increased risks associated with the transmission of diseases from fecal matter being deposited in feeding areas and in water used by livestock.

Economic damages associated with starlings and blackbirds feeding on livestock rations has been documented in France and Great Britain (Feare 1984), and in the United States (Besser et al. 1968, Dolbeer et al. 1978, Glahn 1983, Glahn and Otis 1986). It is estimated that starlings damage an estimated $800 million worth of agricultural resources per year (Pimentel et al. 2000). Diet rations for cattle contain all of the nutrients and fiber that cattle need, and are so thoroughly mixed that cattle are unable to select any single component over others. Livestock feed and rations are often formulated to ensure proper health of the animal. Higher fiber roughage in livestock feed is often supplemented with corn, barley, and other grains to ensure weight gain and in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs are most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered which can negatively impact the health and production of livestock. The removal of this high energy source by European starlings, is believed to reduce milk yields, weight gains, and is economically critical (Feare

1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, and freezing temperatures and the number of livestock on feed.

The economic significance of feed losses to starlings and blackbirds has been demonstrated by Besser et al. (1968) who concluded that the value of losses in feedlots near Denver, Colorado was $84 per 1,000 birds in 1967. Forbes (1995) reported European starlings consumed up to 50% of their body weight in feed each day. Glahn and Otis (1981) reported losses of 4.8 kg of pelletized feed consumed per 1,000 bird minutes. Glahn (1983) reported that 25.8% of farms in Tennessee experienced starling depredation problems of which 6.3% experienced considerable economic loss. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily brown-headed cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000.

In addition, large concentrations of birds feeding, roosting, and/or loafing at livestock operations increase risks of disease transmission from fecal matter being deposited in areas where livestock feed, water, and are housed. Birds feeding in open troughs on livestock feed leave fecal deposits which can be consumed by feeding livestock, fecal matter can also be deposited in sources of water for livestock which increases the likelihood of disease transmission, and can contaminate other surfaces where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carrying infectious disease which can be excreted in fecal matter. Disease threats associated with birds is not only a risk to individual livestock operations but can be a source of transmission to other livestock operations as birds move from one area to another.

A number of diseases that affect livestock have been associated with rock pigeons, European starlings, and house sparrows (Weber 1979). Although birds are known to be carriers of diseases (vectors) that are transmissible to livestock, the rate that transmission occurs is unknown. Since many sources of disease transmission exist, identifying a specific source can be difficult. Birds are known to be vectors of disease which increases the threat of transmission when large numbers of birds are defecating and contacting surfaces and areas used by livestock. The rate of transmission is likely very low; however, the threat of transmission exists since birds are known vectors of many diseases transmittable to livestock. Rock pigeons and starlings have been identified as carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979). Weber (1979) also reported pigeons and starlings as vectors of several viral, fungal, protozoal, and rickettsial diseases that are known to infect livestock and pets.

Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. Gulls also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and is generally considered an unsightly nuisance and potential health hazard for the feedlot operators and their personnel.

Although birds are known to be carriers of diseases (vectors) that are transmissible to livestock, the rate that transmission occurs is unknown but is likely to be low. Since many sources of disease transmission exist, identifying a specific source can be difficult. Birds are known to be vectors of disease which increases the threat of transmission when large numbers of birds are defecating and contacting surfaces and areas used by livestock. The rate of transmission is likely very low; however, the threat of transmission exists since birds are known vectors of many diseases transmittable to livestock.

Damage to Agricultural Crops

Besser (1985) estimated damage to agricultural crops associated with birds exceeded $100 million annually in the United States. Bird damage to agricultural crops occurs primarily from consumption (loss of the crop and revenue).

Fruit and nut crops can be damaged by European starlings, red-winged blackbirds, grackles, cowbirds, and American crows. Besser (1985) estimated bird damage to grapes, cherries, and blueberries exceed $1 million dollars annually in the United States. In 1972, Mott and Stone (1973) estimated that birds caused $1.6 to $2.1 million in damage to the blueberry industry in the United States, with starlings, robins, and grackles causing the most damage. Red-winged blackbirds, cowbirds, and crows are also known to cause damage to blueberries (Besser 1985). Damage to blueberries typically occurs from birds plucking and consuming the berry (Besser 1985).

Damage to apples occurs from beak punctures which makes the apples unmarketable (Besser 1985). Crows have been documented as causing damage to apples (Mitterling 1965). Damage is infrequently reported in apples since harvest of the crop typically occurs before apples reach a stage when damage is likely with damage being greatest during periods of drought (Mitterling 1965).

Bird damage to sweet corn can also result in economic losses to producers. Damage to sweet corn is often amplified since damage to sweet corn caused by birds makes the ear of corn unmarketable because the damage is unsightly to the consumer (Besser 1985). Large flocks of red-winged blackbird are responsible for most of the damage reported to sweet corn with damage also occurring from grackles (Besser 1985). Damage occurs when birds rip or pull back the husk exposing the ear for consumption. Most bird damage occurs during the development stage known as the milk and dough stage when the kernels are soft and filled with a milky liquid. Birds will puncture the kernel to ingest the contents. Once punctured, the area of the ear damaged often discolors and is susceptible to disease introduction into the ear (Besser 1985). Damage usually begins at the tip of the ear as the husk is ripped and pulled back but can occur anywhere on the ear (Besser 1985).

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985). Damage to sprouting corn occurs primarily from grackles and crows but red-winged blackbirds are also known to cause damage to sprouting corn (Stone and Mott 1973). Damage to sprouting corn is likely localized and highest in areas where grackle breeding colonies exist in close proximately to agricultural fields planted with corn (Stone and Mott 1973, Rogers and Linehan 1977). Rogers and Linehan (1977) found grackles damaged two corn sprouts per minute on average when present at a field planted near a grackle breeding colony.

Most damage associated with Canada geese is associated with the consumption of crops, but also consists of unacceptable accumulations of feces on pastures, trampling of emerging crops, and increased erosion and runoff from fields where the cover crop has been grazed (USFWS 2005). Canada geese graze a variety of crops, including alfalfa, barley, beans, corn, soybeans, wheat, rye, oats, spinach, and peanuts (Atlantic Flyway Council 1999). A single intense grazing event by Canada geese in fall, winter, or spring can reduce the yield of winter wheat by 16-30% (Fledger et al. 1987), and reduce growth of rye plants by more than 40% (Conover 1988). In 2009, agricultural producers in Arkansas planted 430,000 acres of winter wheat in the State with a production value of over $83 million (USDA 2009*a*). However, some studies have shown that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985).

Canada geese can also be a concern to livestock producers. Waterfowl droppings in and around livestock ponds can affect water quality and could be a source of a number of different types of bacteria, creating concerns about potential disease interactions between Canada geese and livestock. The transmission of diseases through drinking water is one of the primary concerns for a safe water supply for livestock.

Need to Resolve Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.2 can be closely associated with human habitation and often exhibit gregarious roosting behavior (roost in large numbers), such as starlings, pigeons, vultures, crows, blackbirds, gulls, and herons. The close association of those bird species with human activity can pose threats to human safety from disease transmission, threaten the safety of air passengers if birds are struck by aircraft, excessive droppings can be aesthetically displeasing, and aggressive behavior, primarily from geese, can pose risks to human safety.

Threat of Disease Transmission

Birds can play an important role in the transmission of zoonotic diseases where humans may come into contact with fecal droppings of those birds. Few studies are available on the occurrence of zoonotic diseases in wild birds and the risks to humans from transmission of those diseases. Study of this issue is complicated by the fact that some disease-causing agents associated with birds may also be contracted from other sources. The risk of disease transmission from birds to humans is likely very low. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. The gregarious behavior of bird species leads to accumulations of fecal droppings that can be considered a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings. WS recognizes and defers to the authority and expertise of local and state health officials in determining what does or does not constitute a threat to public health.

Birds can play an important role in the transmission of zoonotic diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Public health officials and residents near areas where fecal droppings accumulate express concerns for human health related to the potential for disease transmission. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum* which causes the disease histoplasmosis in humans (Weeks and Stickley 1984). The disturbance of soil or fecal droppings under bird roosts where fecal droppings have accumulated can cause *H. capsulatum* to become airborne. Once airborne, the fungus could be inhaled by people in the area. Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by humans, livestock, and pets that can be associated with accumulations of bird droppings. Pigeons are most commonly associated with the spread of Ornithosis to humans. Ornithosis is a virus that is spread through infected bird droppings when viral particles become airborne after infected bird droppings are disturbed. In most cases in which human health concerns are a major reason for requesting assistance, no actual cases of bird transmission of disease to humans have been proven to occur. Thus, it is the risk of disease transmission that is the primary reason for requesting assistance.

Waterfowl may impact human health through the distribution and incubation of various pathogens and through nutrient loading. For instance, a foraging Canada goose defecates between 5.2 and 8.8 times per hour (Bedard and Gauthier 1986). Kear (1963) recorded a maximum fecal deposition rate for Canada geese of 0.39 pounds per day (dry weight). Public swimming beaches, private ponds, and lakes can be affected by goose droppings. There are several pathogens involving waterfowl which may be contracted by humans; however, the risk of infection is believed to be low (Centers for Disease Control and Prevention (CDC) 1998). The primary route of infection is through incidental contact with contaminated material. Direct contact with fecal matter is not a likely route of transmission of waterfowl zoonoses unless ingested directly. Although intentional contact with feces is not likely, transmission can occur when people unknowingly contact and ingest contaminated material. Therefore, the risk to human health

from waterfowl zoonoses is low and a direct link of transmission from waterfowl to humans is difficult to determine, especially given that many pathogens occur naturally in the environment or can be attributed to contamination from other sources. However, the presence of disease causing organisms in waterfowl feces increases the risks of exposure and transmission of zoonoses wherever people may encounter large accumulations of feces from waterfowl. Flemming et al. (2001) reviewed the impacts of Canada geese on water quality by addressing pathogens and nutrient loading and identified a number of hazards that geese are associated with. The USFWS has documented threats to public health from geese and has authorized the take of geese to reduce this threat in the resident Canada goose FEIS (USFWS 2005).

Cryptosporidiosis is a disease caused by the parasite *Cryptosporidium parvum* and was not known to cause disease in humans until as late as 1976 (CDC 1998). A person can be infected by drinking contaminated water or from contact with the fecal material of infected animals (CDC 1998). Exposure can occur from swimming in lakes, ponds, streams, and pools, and from swallowing water while swimming (Colley 1996). *Cryptosporidium* can cause gastrointestinal disorders (Virginia Department of Health 1995) and produce life threatening infections, especially in people with compromised or suppressed immune systems (Roffe 1987, Graczyk et al. 1998). Cryptosporidiosis is recognized as a disease with implications for human health (Smith et al. 1997). Canada geese in Maryland were shown with molecular techniques to disseminate infectious *Cryptosporidium parvum* oocysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) found that *Cryptosporidium* was the most common infectious organism found in 77.8% of goose fecal samples from sites comprised primarily of parks and golf courses, indicating that occupational exposure to this pathogen is very plausible although the risk to humans is relatively low.

Giardiasis (*Giardia lambia*) is an illness caused by a microscopic parasite that has become recognized as one of the most common causes of waterborne disease in humans in the United States during the last 15 years (CDC 1999). Giardiasis is contracted by swallowing contaminated water or from placing contaminated surfaces into the mouth. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 1999). Canada geese in Maryland were shown with molecular techniques to disseminate infectious *Giardia* spp. cysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) also found *Giardia* spp. in goose feces at numerous urban sites.

Salmonella (*Salmonella* spp.) may be contracted by humans by handling materials soiled with bird feces (Stroud and Friend 1987). Salmonella causes gastrointestinal illness, including diarrhea.

Chlamydia psittaci, which can be present in diarrhetic feces of infected waterfowl, can be transmitted if it becomes airborne (Locke 1987). Severe cases of Chlamydiosis have occurred among wildlife biologists and others handling snow geese, ducks, and other birds (Wobeser and Brand 1982). Chlamydiosis can be fatal to humans if not treated with antibiotics. Waterfowl, herons, and rock pigeons are the most commonly infected wild birds in North America (Locke 1987).

Campylobacteriosis is an infectious disease caused by bacteria of the genus *Campylobacter*. In persons with compromised immune systems, *Campylobacter* occasionally spreads to the bloodstream and causes a serious life-threatening infection, but normally causes diarrhea and is one of the most common diarrhea illnesses in the United States (CDC 2007). Canada geese have been found to be a carrier of *Campylobacter* and can spread the bacteria in their feces (Kassa et al. 2001).

Escherichia coli (*E. coli*) are fecal coliform bacteria associated with fecal material of warm blooded animals. There are over 200 specific serological types of *E. coli* with the majority of serological types being harmless (Sterritt and Lester 1988). Probably the best known serological type of *E. coli* is *E. coli* O157:H7, which is usually associated with cattle (Gallien and Hartung 1994). Recent research has demonstrated that Canada geese can disseminate *E. coli* into the environment which can elevate fecal

coliform densities in the water column (Hussong et al. 1979, Alderisio and DeLuca 1999, Cole et al. 2005). Many communities monitor water quality at swimming beaches and lakes, but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, the beaches are temporarily closed which can adversely affect the enjoyment of those areas by the public, even though they may not have been able to determine the serological type of the *E. coli*. Unfortunately, linking the elevated bacterial counts to the frequency of waterfowl use and attributing the elevated levels to human health threats has been problematic until recently. Advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific animal species and link those animal sources of coliform bacteria to fecal contamination (Simmons et al. 1995, Jamieson 1998). Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998, Alderisio and DeLuca 1999). Also, fecal coliform bacteria counts coincided with the number of Canada geese and gulls roosting at the reservoir. Cole et al. (2005) found that geese may serve as a vector of antimicrobial resistance genes, indicating that they not only harbor and spread zoonotic diseases like *E. coli* but may spread strains that are resistant to current control measures.

Roscoe (1999) conducted a survey to estimate the prevalence of pathogenic bacteria and protozoa in resident Canada geese in New Jersey and found no *Salmonella* spp., *Shigella* spp., or *Yersinia* spp. isolated from any of the 500 Canada goose samples. However, Roscoe (1999) did report finding *Cryptosporidium* spp. in 49 (10%) of the 500 geese, and *Giardia* sp. in 75 (15%) of the geese. Additionally, the United States Geological Survey (USGS) conducted field studies in New Jersey, Virginia, and Massachusetts to determine the presence of organisms that could cause disease in humans exposed to feces of Canada geese at sites with a history of high public use and daily use by geese (USGS 2000). *Salmonella* spp., *Listeria* spp., *Chlamydia* spp., and *Giardia* spp. were isolated from goose feces from those sites in New Jersey (USGS 2000).

While transmission of diseases or parasites from birds to humans has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blandespoor and Reimink 1991, Graczyk et al. 1997, Saltoun et al. 2000). In worst case scenarios, infections may even be life threatening for immunocompromised and immunosuppressed people (Roffe 1987, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting a disease from feces is believed to be small. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Canada geese and several of the birds species addressed in this EA are closely associated with human habitation and they often exhibit gregarious roosting and nesting behavior. This gregarious behavior leads to accumulations of fecal droppings that can be considered a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings.

Financial costs related to human health threats involving birds may include testing of water for *coliform* bacteria, cleaning and sanitizing beaches regularly of feces, contacting and obtaining assistance from public health officials, and implementing non-lethal and lethal methods of wildlife damage management.

Research has shown that gulls carry various species of bacteria such as *Bacillus* sp., *Clostridium* sp., *Campylobacter* spp., *Escherichia coli*, *Listeria* spp., and *Salmonella* spp. (MacDonald and Brown 1974, Fenlon 1981, Butterfield et al. 1983, Monaghan et al. 1985, Norton 1986, Vauk-Hentzelt et al. 1987, Quessey and Messier 1992). Transmission of bacteria from gulls to humans is difficult to document;

however, Reilley et al. (1981) and Monaghan et al. (1985) both suggested that gulls were the source of contamination for cases of human salmonellosis. Gulls threaten the safety of municipal drinking water sources by potentially causing dangerously high levels of coliform bacteria from their fecal matter. The United States Environmental Protection Agency (EPA) monitors the safety of public drinking water supplies. Contamination of public water supplies by gull feces has been stated as the most plausible source for disease transmission (*e.g.*, Jones et al. 1978, Hatch 1996). Gull feces has also been implicated in accelerated nutrient loading of aquatic systems (Portnoy 1990), which could have serious implications for municipal drinking water sources.

Public health concerns often arise when gulls feed and loaf near fast food restaurants, and picnic facilities; deposit waste from landfills in urban areas and drinking water reservoirs; and contaminate industrial facility ventilation systems with feathers, nesting debris, and droppings. Gulls feeding on vegetable crops and livestock feed can potentially aid in the transmission of salmonella.

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by humans toward many species of wildlife, especially around urban areas, has led to a decline in the fear wildlife have toward humans. When wildlife species begin to habituate to the presence of humans and human activity, a loss of apprehension occurs that can lead those species to exhibit threatening behavior toward humans. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward humans, or abnormal behavior. Although birds attacking humans occurs rarely, aggressive behavior by birds does occur, especially during nest building and the rearing of eggs and chicks. Canada geese aggressively defend their nests, nesting areas, and young, and may attack or threaten pets, children, and adults (Smith et al. 1999). This is a threat because resident Canada geese often nest in high densities at areas used by humans for recreational purposes such as parks, beaches, and sports fields (VerCauteren and Marks 2004). Additionally, slipping hazards can be created by the buildup of feces from waterfowl on docks, walkways, and other areas of foot traffic.

Threat of Aircraft Striking Wildlife at Airports and Military Bases

In addition to threats of zoonotic diseases, birds also pose a threat to human safety from being struck by aircraft. Birds struck by aircraft, especially when ingested into engines, can lead to structural damage to the aircraft and can cause catastrophic engine failure. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995). In several instances, wildlife-aircraft collisions in the United States have resulted in human fatalities. In 1995, an Air Force E-3B AWACS aircraft collided with a flock of Canada geese at Elmendorf Air Force Base, Alaska, killing all 24 passengers and crew. In addition, a $190 million plane was lost (Dolbeer 1997). The risk that birds pose to aircraft is well documented with the worst case reported in Boston in 1960 when 62 people were killed in the crash of an airliner which collided with a flock of European starlings (Terres 1980). From 1990 through 2008, a total of 323 birds have been reported as struck by aircraft in Arkansas (Dolbeer et al. 2009).

Target bird species when in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on or near an airport, present a safety threat to aviation. Vultures can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered to be the most hazardous bird for an aircraft to strike based on the frequency of

strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000).

From 1990 through 2008, 89,727 wildlife strikes have been reported to the Federal Aviation Administration (FAA). Birds were involved with nearly 97% of those reported strikes to civil aircraft in the United States (Dolbeer et al. 2009). This number is likely to be much greater since an estimated 80% of civil bird strikes go unreported (Cleary et al. 2005, Wright and Dolbeer 2005). In Arkansas, over 95% of the reported aircraft strikes with wildlife have involved birds (Dolbeer et al. 2009). Generally, bird collisions occur when aircraft are near the ground during take-off and approach to the runway. From 1990 through 2008, approximately 60% of reported bird strikes to civil aviation in the United States occurred when the aircraft was at an altitude of 100 feet above ground level or less. Additionally, 72% occurred less than 500 feet above ground level and approximately 92% occurred under 3,000 feet above ground level (Dolbeer et al. 2009).

From 1990 through 2008, waterfowl (geese and ducks) were involved in 8% of all bird-aircraft strikes to civil aviation reported to the FAA for which the bird species or group were reported (Dolbeer et al. 2009). Waterfowl were involved in the greatest number of damaging strikes (31%) in which the bird species was identified when compared to all other bird groups (Dolbeer et al. 2009). Nationally, the resident Canada goose population probably represents the single most serious bird threat to aircraft safety (Alge 1999, Suebert and Dolbeer 2004, Dolbeer and Seubert 2006). Resident Canada geese are of particular concern to aviation because of their large size (typically 8-15 lbs which exceeds the 4-lb bird certification standard for engines and airframes); flocking behavior (which increases the likelihood of multiple bird strikes); attraction to airports for grazing; and year-around presence in urban environments near airports (Seubert and Dolbeer 2004). From 1990 through 2008, there were 1,181 reported strikes involving Canada geese in the United States, resulting in over $50 million in damage and associated costs to civil aircraft (Dolbeer et al. 2009). The threat that Canada geese pose to aircraft safety was dramatically demonstrated in January 2009 when United States Airways Flight 1549 made an emergency landing in the Hudson River after ingesting multiple Canada geese into both engines shortly after takeoff from New York's LaGuardia Airport (Dolbeer et al. 2009, Wright 2010). Though the aircraft was destroyed after sinking in the river, all 150 passengers and 5 crew members survived (Wright 2010). In addition to civil aviation, the United States Air Force (USAF) reports that Canada geese have caused nearly $93 million in damage and have been involved in 139 strikes since the beginning of their recording period through 2007, averaging nearly $670,000 in damages per strike (USAF 2009).

Birds being struck by aircraft can cause substantial damage to aircraft. Bird strikes can cause catastrophic failure of aircraft systems (*e.g.*, ingesting birds into engines) which can cause the plane to become uncontrollable leading to crashes. Since 1988, more than 229 people worldwide have died in aircraft that have crashed after striking wildlife (Dolbeer and Wright 2008). A recent example occurred in Oklahoma where an aircraft struck American white pelicans causing the plane to crash killing all five people aboard (Dove et al. 2009).

Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.2, all the bird species addressed in this assessment are known to cause damage to property in Arkansas. Property damage can occur in a variety of ways and can result in costly repairs and clean-up.

Bird damage to property occurs through direct damage to structures, through roosting behavior, and through their nesting behavior. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. Aircraft striking birds can also cause substantial damage requiring

costly repairs and aircraft downtime. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows which can scratch paint and siding.

Gulls are one of the bird groups most frequently struck by aircraft in the United States. Of the total known birds struck in the United States from 1990 through 2008, over 19% involved gulls where identification of the species occurred. When struck, 28% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight (Dolbeer et al. 2009). Nearly 1,200 aircraft strikes have occurred in the United States since 1990 that involved Canada geese with nearly $51 million in damages to aircraft reported from those strikes (Dolbeer et al. 2009). Aircraft strikes involving herons, bitterns, and egrets have resulted in over $10 million in damages to aircraft (Dolbeer et al. 2009). In total, aircraft striking birds has resulted in over $308 million in reported damages to civil aircraft since 1990 in the United States (Dolbeer et al. 2009).

Starlings and blackbirds, when in large flocks or flight lines entering or exiting a winter roost at or near airports, present a safety threat to aviation. Starlings and blackbirds are a particularly dangerous bird to aircraft during take-offs and landings because of their high body density and tendency to travel in large flocks of hundreds to thousands of birds (Seamans et al. 1995).

Damage to property associated with large concentrations of roosting birds occurs primarily from accumulations of droppings and feather debris. Many of the bird species addressed in this assessment are gregarious (form large flocks). Although damage and threats can occur throughout the year, damage is highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. Birds that routinely roost and loaf in the same areas often leave large accumulations of droppings and feather debris which is aesthetically displeasing and can cause damage to property. The reoccurring presence of fecal dropping under bird roosts can lead to constant cleaning costs for property owners.

Gull attraction to landfills as a food source has been well documented (Mudge and Ferns 1982, Patton 1988, Belant et al. 1995, Gabrey 1997, Belant et al. 1998). Large numbers of gulls are attracted to and use landfills as feeding and loafing areas throughout North America. In the northeastern United States, landfills often serve as foraging and loafing areas for gulls throughout the year, while attracting larger populations of gulls during migration periods (Bruleigh et al. 1998). Landfills have even been suggested as contributing to the increase in gull populations (Verbeek 1977, Patton 1988, Belant and Dolbeer 1993). Gulls that visit landfills may loaf and nest on nearby rooftops, causing health concerns and structural damage to buildings and equipment. Bird conflicts associated with landfills include accumulation of feces on equipment and buildings, distraction of heavy machinery operators, and the potential for birds to transmit disease to workers on the site. The tendency for gulls to carry waste off site results in accumulation of feces and deposition of garbage on surrounding industrial and residential areas which creates a nuisance, as well as generates the potential for birds to transmit disease to neighboring residents.

Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Corrosion damage to metal structures and painted finishes, including those on automobiles, can occur because of the uric acid found in bird droppings. Electrical utility companies frequently have problems with birds and bird droppings causing power outages by shorting out transformers and substations. This has resulted in outage time for power companies and consumers. Damage can also occur from droppings entering into food items or contaminating surfaces used to prepare food items at manufacturing facilities and can introduce undesirable components into the materials used in manufacturing processes.

The nesting behavior of some bird species can also cause damage to property. Nesting material can be aesthetically displeasing and fecal droppings often accumulate near nests which can also be aesthetically displeasing. The egret and heron species addressed in this assessment are colonial nesters meaning they

nest together in large numbers. Many of the egret and heron species addressed in this assessment can nest in Arkansas.

Need for Bird Damage Occurring to Natural Resources

Birds can also negatively impact natural resources through habitat degradation, competition with other wildlife, and through direct depredation on natural resources. Habitat degradation occurs when large concentrations of birds in a localized area negatively impacts characteristics of the surrounding habitat that can adversely affect other wildlife species and can be aesthetically displeasing. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites. Direct depredation occurs when predatory bird species feed on other wildlife species which can negatively influence those species' populations, especially when depredation occurs on threatened and endangered (T&E) species.

Habitat degradation in Arkansas occurs primarily in areas where colonial waterbirds nest or where the gregarious roosting behavior of birds occurs. The degradation of habitat occurs from the continuous accumulation of fecal droppings that occurs under nesting colonies of birds or under areas where birds consistently roost. Over time, the accumulation of fecal droppings under areas where colonial waterbirds nest, such as cormorants and herons, can lead to the loss of vegetation due to the ammonium nitrogen found in the fecal droppings of birds. A study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

Ammonium toxicity from fecal droppings of cormorants may be an important factor contributing to the declining presence of vegetation on some islands in the Great Lakes (Hebert et al. 2005). The combined activities of stripping leaves and branches for nesting material, the weight of nests of many colonial waterbirds breaking branches, and the accumulation of feces under areas where roosting and nesting occurs can lead to the death of surrounding vegetation with three to 10 years of areas being occupied by colonial waterbirds (Lewis 1929, Lemmon et al. 1994, Weseloh and Ewins 1994, Bédard et al. 1995, Weseloh and Collier 1995, Weseloh et al. 1995, Korfanty et al. 1999, Hebert et al. 2005). Establishment of cormorant colonies on islands in the Great Lakes has threatened the unique vegetative characteristic of many of those islands (Hebert et al. 2005). In some cases, the establishment of colonial waterbird nesting colonies on islands has led to the complete denuding of vegetation from the island. The removal of vegetation can lead to an increase in erosion of the island and can be aesthetically displeasing to recreational users.

Lewis (1929) considered the killing of trees by nesting cormorants to be very local and limited, with most trees having no commercial timber value. However, tree damage may be perceived as a problem if those trees are rare species or aesthetically valued (Bédard et al. 1999, Hatch and Weseloh 1999). In addition to habitat degradation, nesting colonial waterbirds can adversely affect other wildlife species. Cormorants are known to displace other colonial nesting bird species such as black-crowned night herons, egrets, great blue herons, gulls, common terns, and Caspian tern through habitat degradation and nest site competition (USFWS 2003). Cuthbert et al. (2002) examined potential impacts of cormorants on great blue herons and black-crowned night herons in the Great Lakes and found that cormorants have not negatively influenced breeding distribution or productivity of either species at a regional scale, but did contribute to declines in heron presence and increases in site abandonment in certain site specific circumstances.

Cormorants can have a negative impact on vegetation that provides nesting habitat for other birds (Jarvie et al. 1999, Shieldcastle and Martin 1999) and wildlife, including State and federally-listed T&E species (Korfanty et al. 1999). For example, Cuthbert et al. (2002) found that cormorants have a negative effect on normal plant growth and survival on a localized level in the Great Lakes region. Wires and Cuthbert

(2001) identified vegetation die off as an important threat to 66% of the colonial waterbird sites designated as conservation sites of priority in the Great Lakes of the United States. Of the 29 priority conservation sites reporting vegetation die off as a threat, Wires and Cuthbert (2001) reported cormorants were present at 23 of those sites. Based on survey information provided by Wires et al. (2001), biologists in the Great Lakes region reported cormorants as having an impact to herbaceous layers and trees where nesting occurred. Damage to trees was mainly caused by fecal deposits, and resulted in tree die off at breeding colonies and roost sites. Impacts to the herbaceous layer of vegetation were also reported due to fecal deposition, and often this layer was reduced or eliminated from the colony site. In addition, survey respondents reported that the impacts to avian species from cormorants primarily from habitat degradation and from competition for nest sites (Wires et al. 2001). Although loss of vegetation can have an adverse impact on many species, some colonial waterbirds such as pelicans and terns prefer sparsely vegetated substrates.

Crows are considered omnivorous, consuming a variety of invertebrates, amphibians, reptiles, mammals, and small birds, including birds' eggs, nestlings, and fledglings as well as grain crops, seeds, fruits, carrion, and discarded human food (Verbeek and Caffrey 2002). With crows, the primary concern to natural resources occurs from predation on T&E species. Crows have been documented feeding on piping plover (*Charadrius melodus*) eggs and nestlings. Piping plovers are currently considered a threatened species by the USFWS. Although WS has not been requested previously to conduct bird damage management activities to reduce predation on T&E species, WS could be requested to provide assistance in the future.

Brood parasitism by brown-headed cowbirds has also become a concern for many wildlife professionals where those birds are plentiful. Inter-specific nest competition has been well documented in brown-headed cowbirds, which are known to parasitize the nests of at least 220 avian species (Lowther 1993).

Interspecific nest competition has been well documented in European starlings. European starlings compete aggressively for nesting sites and have been found to take over nesting cavities of native birds. Miller (1975) and Barnes (1991) reported European starlings were responsible for a severe depletion of the eastern bluebird (*Sialis sialis*) population due to nest competition. Nest competition by European starlings has also been known to adversely impact American kestrels (*Falco sparverius)* (Von Jarchow 1943, Nickell 1967, Wilmer 1987), red-bellied woodpeckers (*Centurus carolinus*), gila woodpeckers (*Centurus uropygialis*) (Kerpez and Smith 1990, Ingold 1994), northern flickers (*Colaptes auratus*), purple martins (*Progne subis*) (Allen and Nice 1952), and wood ducks (*Aix sponsa*) (Shake 1967, McGilvery and Uhler 1971, Grabill 1977, Heusmann et al. 1977). Weitzel (1988) reported nine native species of birds in Nevada had been displaced by starling nest competition, and Mason et al. (1972) reported European starlings evicting bats from nest holes.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA evaluates the need for bird damage management to reduce threats to human safety and to resolve damage to property, natural resources, and agricultural resources on federal, state, tribal, municipal, and private land within the State of Arkansas wherever such management is requested by a cooperator. This EA discusses the issues associated with conducting bird damage management in the State to meet the need for action and evaluates different alternatives to meet that need while addressing those issues.

The methods available for use or recommendation under each of the alternatives evaluated are provided in Appendix B. The alternatives and Appendix B also discuss how methods would be employed to manage damage and threats associated with birds in the State. Therefore, the actions evaluated in this EA are the

use of those methods available under the alternatives and the employment of those methods by WS to manage or prevent damage and threats associated with birds from occurring when permitted by the USFWS.

The Migratory Bird Treaty Act (MBTA) makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 U.S.C 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13.

The MBTA does allow for the lethal take of those bird species listed in 50 CFR 10.13 when depredation occurs through the issuance of depredation permits or the establishment of depredation orders. Under authorities in the MBTA, the USFWS is the federal agency responsible for the issuance of depredation permits or the establishment of depredation orders for the take of those protected bird species when damage or threats of damage are occurring. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21. The USFWS has jurisdiction over the management of migratory birds and has specialized expertise in identifying and quantifying potential adverse affects to the human environment from bird damage management activities. Under the proposed action alternative, WS' take of birds would only occur when permitted by the USFWS through the issuance of a depredation permit or pursuant to depredation orders, when applicable. WS would not be directly involved with bird damage management activities under the technical assistance alternative nor the no involvement by WS alternative; therefore, no take would occur under those alternatives.

Federal, State, County, City, and Private Lands

Under two of the alternatives, WS could continue to provide bird damage management activities on federal, state, county, municipal, and private land in Arkansas when a request is received for such services by the appropriate property owner or manager. In those cases where a federal agency requests WS' assistance with managing damage caused by birds, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA would cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, actions taken on federal lands have been analyzed in the scope of this EA.

Native American Lands and Tribes

Currently, WS does not have a Memorandum of Understanding (MOU) or signed cooperative service agreements with any Native American tribe in Arkansas. If WS enters into an agreement with a tribe for bird damage management, this EA would be reviewed and supplemented, if appropriate, to insure compliance with the NEPA.

Period for which this EA is Valid

If the analyses in this EA indicates an Environmental Impact Statement (EIS) is not warranted, this EA would remain valid until WS, in consultation with the USFWS and the AGFC, determines that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and supplemented pursuant to the NEPA. Review of the EA would be conducted each year to ensure that activities conducted under the selected alternative occur within the parameters evaluated in the EA. If the alternative analyzing no involvement in bird damage activities by WS is selected, no annual analyses would occur based on the lack of involvement by WS. Annual monitoring of activities ensures the EA remains appropriate to the scope of bird damage management activities conducted by WS in Arkansas.

Site Specificity

As mentioned previously, WS would only conduct damage management activities when requested by the appropriate property owner or manager. In addition, WS' activities that could involve the take of birds under the alternatives would only occur when permitted by the USFWS, when required, and only at levels permitted.

This EA analyzes the potential impacts of bird damage management based on previous activities conducted on private and public lands in Arkansas where WS and the appropriate entities have entered into a MOU, cooperative service agreement, or other comparable document. The EA also addresses the impacts of bird damage management on areas where additional agreements may be signed in the future. Because the proposed action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional bird damage management efforts could occur. Thus, this EA anticipates the potential expansion and analyzes the impacts of such efforts as part of the alternatives.

Many of the bird species addressed in this EA can be found statewide and throughout the year in the State; therefore, damage or threats of damage can occur wherever those birds occur. Planning for the management of bird damage must be viewed as being conceptually similar to other federal or agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Although some of the sites where bird damage would occur can be predicted, all specific locations or times where such damage would occur in any given year cannot be predicted. The threshold triggering an entity to request assistance from WS to manage damage associated with birds is often unique to the individual; therefore, predicting where and when such a request for assistance would be received by WS is difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever bird damage and the resulting management actions occurs and are treated as such.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in Arkansas. The standard WS Decision Model (Slate et al. 1992, USDA 1997) would be the site-specific procedure for individual actions conducted by WS in the State (see Chapter 3 for a description of the Decision Model and its application). Additional information on the Decision Model is available in WS' programmatic FEIS (USDA 1997). Decisions made using the model would be in accordance with WS' directives and Standard Operating Procedures (SOPs) described in this EA as well as relevant laws and regulations.

The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Arkansas. In this way, WS believes it meets the intent of the NEPA with regard to site-specific analysis and that this is the only practical way for WS to comply with the NEPA and still be able to accomplish its mission.

Summary of Public Involvement

Issues related to bird damage management as conducted by WS in Arkansas were initially developed by WS in consultation with the USFWS and the AGFC. Issues were defined and preliminary alternatives were identified through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS' NEPA implementing regulations, this document is being noticed to the public through legal notices published in local print media, through direct mailings to parties that have requested to be notified or have been identified to have an interest in the reduction of

threats and damage associated with birds in the State, and by posting the EA on the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml.

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS would clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. New issues or alternatives raised after publication of public notices would be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a final Decision or publication of a notice of intent to prepare an EIS.

1.4 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Management of migratory birds is the responsibility of the USFWS. The AGFC is responsible for managing wildlife in the State of Arkansas, including birds. The AGFC establishes and enforces regulated hunting seasons in the State, including the establishment of seasons that allow the take of Canada geese, snow geese, ring-necked ducks, lesser scaup, American coots, American crows, and fish crows. For migratory birds, the AGFC can establish hunting seasons for those species under frameworks determined by the USFWS. WS' activities to reduce and/or prevent bird damage in the State would be coordinated with the USFWS and the AGFC which ensure WS' actions are incorporated into population objectives established by those agencies for bird populations in the State.

Based on the scope of this EA, the decisions to be made are: 1) should WS conduct bird damage management to alleviate damage to agriculture, property, natural resources, and threats to human safety, 2) should WS conduct disease surveillance and monitoring in the bird population when requested by the AGFC, the USFWS, and other agencies, 3) should WS implement an integrated wildlife damage management strategy, including technical assistance and direct operational assistance, to meet the need for bird damage management in Arkansas, 4) if not, should WS attempt to implement one of the alternatives to an integrated damage management strategy as described in the EA, and 5) would the proposed action alternative result in adverse impacts to the environment requiring the preparation of an EIS.

1.5 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Programmatic Final Environmental Impact Statement: WS has developed a programmatic FEIS that addresses the need for wildlife damage management in the United States (USDA 1997). The FEIS contains detailed discussions of potential impacts to the human environment from wildlife damage management methods used by WS. Pertinent information available in the FEIS has been incorporated by reference into this EA.

***WS' Double-crested Cormorant Damage Management Environmental Assessment*:** As was stated previously, WS previously developed an EA that addressed WS' activities to manage damage associated with double-crested cormorants in the State (USDA 2004). Based on the analyses in that EA, a Decision and Finding of No Significant Impact was signed selecting the proposed action alternative. The proposed action alternative implemented a cormorant damage management program using a variety of methods in an integrated approach (USDA 2004). Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to address cormorant damage management activities in the State. This EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Since activities conducted under the

previous EA will be re-evaluated under this EA to address the new need for action and the associated affected environment, the previous EA that addresses cormorant damage will be superseded by this analysis and the outcome of the Decision issued based on the analyses in this EA. However, information in the need for action in the previous EA relative to cormorants continues to be appropriate to the need for action associated with this EA (USDA 2004).

Double-crested Cormorant Management in the United States Final Environmental Impact Statement: The USFWS has prepared a FEIS on the management of double-crested cormorants (USFWS 2003). WS was a formal cooperating agency in the preparation of the FEIS and has adopted the FEIS to support WS' program decisions for its involvement in the management of cormorant damage. WS completed a Record of Decision (ROD) on November 18, 2003 (68 FR 68020). Pertinent and current information available in the FEIS have been incorporated by reference into the EA and this document.

Extended Management of Double-crested Cormorants under 50 CFR 21.47 and 21.48 Final Environmental Assessment: The FEIS developed by the USFWS in cooperation with WS established a Public Resource Depredation Order (PRDO; 50 CFR 21.48) and made changes to the 1998 Aquaculture Depredation Order (AQDO; 50 CFR 21.47). To allow for an adaptive evaluation of activities conducted under the PRDO and the AQDO established by the FEIS, those Orders would have expired on April 30, 2009 (USFWS 2003). The EA determined that a five-year extension of the expiration date of the PRDO and the AQDO would not threaten cormorant populations and activities conducted under those Orders would not have a significant impact on the human environment (74 FR 15394-15398; USFWS 2009).

Resident Canada Goose Management Final Environmental Impact Statement: The USFWS has issued a FEIS addressing the need for and potential environmental impacts associated with resident goose damage management activities titled "*Resident Canada Goose Management*" (USFWS 2005). The FEIS also contains detailed analyses of the issues and methods used to manage Canada goose damage. A ROD and Final Rule were published by the USFWS on August 10, 2006 (71 FR 45964- 45993). On June 27, 2007, WS, as a cooperating agency, issued a ROD and adopted the USFWS FEIS (72 FR 35217).

Light Goose Management Final Environmental Impact Statement: The USFWS has also prepared a FEIS to address the management of snow geese and Ross's geese (USFWS 2007). The preferred alternative in the FEIS modified existing regulations to allow additional hunting methods to harvest snow geese and Ross's geese within the current migratory bird hunting season frameworks. The preferred alternative also created a conservation order for the management of overabundant snow goose populations (50 CFR 21.60).

1.6 AUTHORITY OF FEDERAL AND STATE AGENCIES

The authorities of WS and other agencies as those authorities relate to conducting wildlife damage management activities are discussed by agency below:

WS' Legislative Authority

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

United States Fish and Wildlife Service Authority

The USFWS mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Responsibilities are shared with other federal, State, tribal, and local entities; however, the USFWS has specific responsibilities for the protection of T&E species under the Endangered Species Act (ESA), migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources. The USFWS also manages lands under the National Wildlife Refuge System.

The USFWS is responsible for managing and regulating take of bird species that are listed as migratory under the MBTA and those that are listed as threatened or endangered under the ESA. The take of migratory birds is prohibited by the Act. However, the USFWS can issue depredation permits for the take of migratory birds when certain criteria are met pursuant to the MBTA. Depredation permits are issued to take migratory birds to alleviate damage and threats of damage. Under the permitting application process, the USFWS requires applicants to describe, prior non-lethal damage management, techniques that have been used. In addition, the USFWS can establish depredation orders that allow for the take of those migratory birds addressed in the orders when those bird species are causing or about to cause damage without the need for a depredation permit.

The USFWS authority for migratory bird management is based on the MBTA of 1918 (as amended), which implements treaties with the United States, Great Britain (for Canada), the United Mexican States, Japan, and the Soviet Union. Section 3 of this Act authorized the Secretary of Agriculture:

"From time to time, having due regard to the zones of temperature and distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the convention to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same, in accordance with such determinations, which regulations shall become effective when approved by the President."

The authority of the Secretary of Agriculture, with respect to the MBTA, was transferred to the Secretary of the Interior in 1939 pursuant to Reorganization Plan No. II. Section 4(f), 4 FR 2731, 53 Stat. 1433.

United States Environmental Protection Agency

The EPA is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) which regulates the registration and use of pesticides, including avicides available for use to lethally take birds.

Arkansas Game and Fish Commission

Amendment 35 to the Arkansas Constitution states that "*the control, management, restoration, conservation, and regulation of birds, fish, game, and wildlife resources of the State, including hatcheries, sanctuaries, refuges, reservations, and all property now owned or used for said purposes and the acquisition and establishment of same, the administration of the laws now and/or hereafter pertaining thereto, shall be vested in a commission known as the Arkansas State Game & Fish Commission ….*" Although many AGFC mandates occur throughout the Arkansas State Code, the primary purpose of the AGFC is the conservation of fish and wildlife resources in Arkansas.

AGFC currently has an MOU with WS that establishes a cooperative relationship between WS and AGFC. Responsibilities include planning, coordinating, and implementing policies to address wildlife damage management and facilitating exchange of information.

Arkansas Department of Agriculture

In Arkansas, pesticide use and regulation occurs within the Pesticide Division of the Arkansas State Plant Board. The mission of the Pesticide Division is to "*...insure the proper labeling, distribution, storage, transportation, use, application, and disposal of pesticides with the State of Arkansas through fair and equitable implementation and enforcement of applicable State and federal laws*".

1.7 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes authorize, regulate, or otherwise affect WS' activities. WS complies with those laws and statutes and consults with other agencies as appropriate. Additional laws and regulations pertaining to wildlife damage management activities are addressed in WS' programmatic FEIS (USDA 1997). WS would comply with all applicable federal, State, and local laws and regulations in accordance with WS Directive 2.210. Those laws and regulations relevant to bird damage management activities in the State are addressed below:

National Environmental Policy Act

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

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

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-711; 40 Stat. 755), as amended

The MBTA provides the USFWS regulatory authority to protect families of migratory birds. A complete list of bird species afforded protection under the MBTA can be found at 50 CFR 10.13. The law prohibits any "*take*" of migratory bird species by any entities, except as permitted by the USFWS. Under permitting guidelines in the Act, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the Act (see 50 CFR 21). All actions conducted in this EA would be in compliance with the regulations of the MBTA, as amended.

In addition to the issuance of depredation permits for the take of migratory birds, the Act allows for the establishment of depredation orders that allow migratory birds to be taken without a depredation permit when certain criteria are met.

Due to an increasing resident Canada goose population and an increase in damage complaints received, the USFWS developed an EIS that analyzed issues and alternatives associated with managing resident goose populations (USFWS 2005). Based on the analyses in the FEIS, several depredation orders were established to address resident goose populations which allow for the take of geese (see 50 CFR 21.49, 50 CFR 21.50, 50 CFR 21.51, 50 CFR 21.52, and 50 CFR 21.61). In addition, the USFWS has established a depredation order for double-crested cormorants (see 50 CFR 21.47 and 50 CFR 21.48) and blackbirds (see 50 CFR 21.43). A conservation order was also established for light geese (snow geese) to allow for additional harvesting opportunities to manage populations (see 50 CFR 21.60).

Depredation Order for Double-Crested Cormorants at Aquaculture Facilities (50 CFR 21.47)

The AQDO was established to reduce cormorant depredation of aquacultural stock at private fish farms and state and federal fish hatcheries. Under the AQDO, cormorants can be lethally taken at commercial freshwater aquaculture facilities and state and federal fish hatcheries in 13 States, including Arkansas. The Order authorizes landowners, operators, and tenants, or their employees/agents, that are actually engaged in the production of aquacultural commodities to lethally take cormorants causing or about to cause damage at those facilities without the need for a depredation permit. Those activities can only occur during daylight hours and only within the boundaries of the aquaculture facility. The AQDO also authorizes WS to take cormorants at roost sites near aquaculture facilities at any time from October through April without the need for a depredation permit with appropriate landowner permissions.

Depredation Order for Double-crested Cormorants to Protect Public Resources (50 CFR 21.48)

The purpose of the PRDO is to reduce the actual occurrence, and/or minimize the risk, of adverse impacts of cormorants to public resources. Public resources, as defined by the PRDO, are natural resources managed and conserved by public agencies. Public resources include fish (free-swimming fish and stocked fish at federal, State, and tribal hatcheries that are intended for release in public waters), wildlife, plants, and their habitats. The Order authorizes WS, state fish and wildlife agencies, and federally-recognized Tribes to conduct damage management activities involving cormorants without the need for a depredation permit from the USFWS in 24 states, including Arkansas. It authorizes the take of cormorants on "*all lands and freshwaters*" including public and private lands. However, landowner/manager permission must be obtained before cormorant damage management activities may be conducted at any site.

Depredation Orders for Resident Canada Geese

As discussed previously, the USFWS developed an EIS to evaluate alternatives to address the increasing resident goose population across the United States and to reduce associated damage (USFWS 2005). In addition, several depredation orders were established to manage damage associated with Canada geese without a depredation permit from the USFWS when certain criteria are occurring. Under 50 CFR 21.49, resident Canada geese can be lethally taken at airports and military airfields without the need for a depredation permit by airport authorities or their agents when those geese are causing damage or posing a threat of damage to aircraft. A Canada goose nest and egg depredation order has also been established that allows the nests and eggs of those geese causing or posing a threat to people, property, agricultural crops, and other interests to be destroyed without the need for a depredation permit once the participant has registered with the USFWS (see 50 CFR 21.50). A similar depredation order was established to manage damage to agricultural resources associated with Canada geese. Under 50 CFR 21.51, Canada

geese can be lethally taken without a permit from the USFWS in those states designated, including Arkansas, when geese are causing damage to agricultural resources. Resident Canada geese can be addressed using lethal and non-lethal methods by State agencies, Tribes, and the District of Columbia when those geese pose a direct threat to human health under 50 CFR 21.52. Under the depredation orders for Canada geese, no individual federal depredation permit is required to take geese once the criteria of those orders have been met.

Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43)

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to lethal take blackbirds when those species are found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance. Those bird species that can be lethally taken under the blackbird depredation order that are addressed in the assessment include American crows, fish crows, red-winged blackbirds, common grackles, and brown-headed cowbirds.

Conservation Order for Light Geese

The USFWS recently finalized rules allowing the use of expanded hunting methods and implementation of a conservation order to increase light goose (*i.e*., snow geese and Ross's geese) harvest. The final rule authorizes the use of new hunting methods, such as electronic calls and unplugged shotguns, to harvest light geese during normal hunting season frameworks. Those regulations are allowed during a light-goose-only hunting season when all other waterfowl and crane hunting seasons, excluding falconry, are closed. Further, the rule authorizes States to implement a conservation order to allow the harvest of light geese outside of traditional hunting seasons. In addition, the conservation order allows shooting hours to continue until one-half hour after sunset and removes the daily bag limit for light geese.

Endangered Species Act

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

WS obtained a Biological Opinion (BO) on programmatic activities from the USFWS in 1992 describing potential effects on T&E species, and prescribing reasonable and prudent measures for avoiding jeopardy (see Appendix F in USDA 1997). Evaluation of the alternatives in regards to the ESA will occur in Chapter 4 of this EA.

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

The NHPA and its implementing regulations (36 CFR 800) require federal agencies to initiate the section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106. None of the bird damage management methods described in this EA that might be used operationally by WS causes major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to

introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

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

Environmental Justice - Executive Order 12898

Executive Order 12898, titled "*Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*" promotes the fair treatment of people of all races, income levels and cultures with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Environmental justice is a priority within APHIS and WS. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies and activities on minorities and persons or populations of low income. APHIS implements Executive Order 12898 principally through its compliance with the NEPA. All WS' activities are evaluated for their impact on the human environment and compliance with Executive Order 12898. WS personnel use only legal, effective, and environmentally safe wildlife damage management methods, tools, and approaches. It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minorities and persons or populations of low income.

Protection of Children - Executive Order 13045

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children, WS has considered the impacts that this proposal might have on children. The proposed bird damage management program would occur by using only legally available and approved methods where it is highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing this proposed action.

Responsibilities of Federal Agencies to Protect Migratory Birds - Executive Order 13186

Executive Order 13186 requires each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations, is directed to develop and implement, a MOU with the USFWS that shall promote the conservation of migratory bird populations. WS has developed a draft MOU with the USFWS as required by this Executive Order and is currently waiting for USFWS approval. WS would abide by the MOU once it is finalized and signed by both parties.

Invasive Species (Executive Order 13112)

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

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal projects would discontinue work until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All chemical methods integrated into the WS' program in Arkansas, including the use of or recommendation of repellents are registered with and regulated by the EPA and the AAD, and used or recommended by WS in compliance with labeling procedures and requirements.

Investigational New Animal Drug (INAD)

The United States Food and Drug Administration (FDA) can grant permission to use investigational new animal drugs (see 21 CFR 511). The sedative drug alpha-chloralose is registered with the FDA to capture waterfowl, coots, and pigeons. The use of alpha-chloralose by WS was authorized by the FDA through approval under the INAD which allows use of the drug as a non-lethal form of live-capture. Alpha-chloralose as a method for resolving waterfowl and pigeon damage and threats to human safety are discussed in Appendix B of this EA.

Occupational Safety and Health Act of 1970

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

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that 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. Additional descriptions of affected environments will be incorporated into the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Bird damage or threats of damage can occur statewide in Arkansas where ever birds occur. However, bird damage management would only be conducted by WS when requested by a landowner or manager and only on properties where a cooperative service agreement or other comparable document has been signed between WS and a cooperating entity. Most species of birds addressed in this EA can be found throughout the year across the State where suitable habitat exists for foraging, loafing, roosting, and breeding. Bird species are capable of utilizing a variety of habitats in the State. Since birds can be found throughout the State, requests for assistance to manage damage or threats of damage could occur in areas occupied by those bird species.

Upon receiving a request for assistance, bird damage management activities could be conducted on federal, state, tribal, municipal, and private properties in Arkansas. The areas of the proposed action could include areas in and around commercial, industrial, public, and private buildings, facilities and properties and at other sites where birds may roost, loaf, feed, nest, or otherwise occur. Examples of areas where bird damage management activities could be conducted are, but are not necessarily limited to: agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, aquaculture facilities, fish hatcheries, grain mills, grain handling areas, railroad yards, waste handling facilities, industrial sites, natural areas, government properties and facilities, private properties, corporate properties, schools, hospitals, parks, woodlots, recreation areas, communally-owned homeowner/property owner association properties, wildlife refuges, wildlife management areas, military bases, and airports.

Environmental Status Quo

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

Wildlife species, such as most native species, are protected under state or federal law. For some bird species, take during the hunting season is regulated pursuant to the MBTA by the USFWS through the issuance of frameworks, that includes the allowable length of hunting seasons, methods of take, and allowed take which are implemented by the State wildlife agency. Pursuant to the MBTA, the USFWS can issue depredation permits to those entities experiencing damage associated with birds, when deemed appropriate. In addition, Canada geese, double-crested cormorants, American crows, fish crows, red-winged blackbirds, common grackles, and brown-headed cowbirds can be taken under depredation orders without the need for a depredation permit when conditions outlined in those Orders exist. Rock pigeons and European starlings are afforded no protection under the MBTA and can be addressed at any time without the need for a depredation permit.

When a non-federal entity (*e.g.*, agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other non-federal entity) with the appropriate permits or acting under depredation orders takes a bird damage management action, the action is not subject to compliance with the NEPA due to the lack of federal involvement[6] in the action. Under such circumstances, the environmental baseline or status quo must be viewed as an environment that includes those resources as

[6]If a federal permit is required to conduct damage management activities, the issuing federal agency would be responsible for compliance with the NEPA for issuing the permit.

they are managed or impacted by non-federal entities in the absence of the federal action being proposed. Therefore, in those situations in which a non-federal entity has decided that a management action directed towards birds will occur and even the particular methods that will be used, WS' involvement in the action would not affect the environmental status quo if the requestor would have conducted the action in the absence of WS' involvement since take can occur either during hunting season, under depredation orders, through the issuance of depredation permits, or without the need for a permit. Especially given that most methods for resolving damage are available to both WS and to other entities. WS' decision-making ability is restricted to one of two alternatives - either taking the action using the specific methods as decided upon by the non-federal entity or taking no action at which point the non-federal entity would take the action anyway either during the hunting season, under depredation orders, through the issuance of a depredation permit, or without the need for a permit. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

Therefore, based on the discussion above, in those situations where a non-federal entity conducts activities under the regulated harvest season, under depredation orders, under depredation permits, or without the need for a permit and has already made the decision to remove or otherwise manage birds to stop damage with or without WS' assistance, WS' participation in carrying out the action would not affect the environmental status quo.

In some situations, however, certain aspects of the human environment may actually benefit more from WS' involvement then from a decision not to assist. For example, if a cooperator believes WS has greater expertise to selectively remove birds than a non-WS entity; WS' management activities may have less of an impact on target and non-target species than if the non-federal entity conducted the action alone. The concern arises from those persons experiencing damage having no prior experience with managing damage or threats associated with birds. The lack of experience in bird behavior and damage management methods could lead to the continuation of damage which could threaten human safety or could lead to the use of inappropriate methods in an attempt to resolve damage. WS' personnel are trained in the use of methods which increases the likelihood that damage management methods are employed appropriately with regards to effectiveness, humaneness, minimizing non-target take, and reducing threats to human safety from those methods. WS' mission is to provide leadership in resolving and preventing damage to resources and to reduce threats to human safety caused by wildlife, including birds in Arkansas. Thus, in those situations, WS' involvement may actually have a beneficial effect on the human environment when compared to the environmental status quo in the absence of such involvement.

2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns of the public and/or professional community raised regarding potential adverse affects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. Issues relating to the reduction of wildlife damage were raised during the scoping process for WS' programmatic FEIS (USDA 1997) and were considered in the preparation of this EA. Those issues are fully evaluated within WS' FEIS which analyzed specific data relevant to WS' programmatic activities at the time of preparation. Issues related to managing damage associated with resident Canada geese and double-crested cormorants which were addressed in the USFWS FEIS on the management of resident Canada geese (USFWS 2005) and the USFWS FEIS on the management of cormorants (USFWS 2003) were also considered in the preparation of this EA. Issues related to managing damage associated with birds in Arkansas were developed by WS in consultation with the USFWS and the AGFC. The EA will also be made available to the public for review and comment to identify additional issues.

The issues as those issues relate to the possible implementation of the alternatives, including the proposed action, are discussed in detail in Chapter 4. The issues analyzed in detail in the EA are the following:

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

A common issue when addressing damage caused by wildlife are the potential impacts of management actions on the populations of target species. Methods used to resolve damage or threats to human safety can involve altering the behavior of target species and may require the use of lethal methods when appropriate. Under the proposed action, WS would incorporate non-lethal and lethal methods described in Appendix B in an integrated approach in which all or a combination of methods may be employed to resolve a request for assistance. WS would recommend both non-lethal and lethal methods, as governed by federal, state, and local laws and regulations.

Non-lethal methods can disperse or otherwise make an area unattractive to target species causing damage which reduces the presence of those species at the site and potentially the immediate area around the site where non-lethal methods are employed. Lethal methods would be employed to remove a bird or those birds responsible for causing damage or posing threats to human safety. The use of lethal methods would therefore result in local population reductions in the area where damage or threats were occurring. The number of target species removed from the population using lethal methods under this alternative would be dependent on the number of requests for assistance received, the number of individuals involved with the associated damage or threat, and the efficacy of methods employed.

Target bird species specifically addressed in this EA include the American white pelican, double-crested cormorant, anhinga, great blue heron, great egret, snowy egret, little blue heron, tricolored heron, cattle egret, green heron, black-crowned night heron, yellow-crowed night heron, black vulture, turkey vulture, Canada goose, snow goose, ring-necked duck, lesser scaup, American coot, ring-billed gull, rock pigeon, belted kingfisher, American crow, fish crow, European starling, red-winged blackbirds, common grackle, and brown-headed cowbird.

The analysis for magnitude of impact on populations from the use of lethal methods generally follows the process described in WS' programmatic FEIS (USDA 1997). Magnitude is described in WS' programmatic FEIS as "*...a measure of the number of animals killed in relation to their abundance*." Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest data when available. Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage. WS' take is monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse impacts to the viability of native species populations (USDA 1997). All lethal take of birds by WS would occur at the requests of a cooperator seeking assistance.

WS' proposed action alternative discussed in chapter 3 of this EA incorporates an adaptive approach to resolve damage and reduce threats to human safety by targeting a bird or groups of birds using non-lethal and lethal methods after applying the WS' Decision Model (Slate et al. 1992, USDA 1997) to identify possible techniques. Lethal methods may be used to reinforce non-lethal methods to reduce damage to a level that is more acceptable to the requester. The effects on target bird populations in Arkansas from implementation of the identified alternatives, including the proposed action, are analyzed in Chapter 4.

Information on bird populations and trends are often derived from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population

database, published literature, and harvest data. Further information on those sources of information is provided below.

Breeding Bird Survey

Bird populations can be monitored by using trend data derived from data collected during the BBS. Under established guidelines, observers count birds at established survey points for a set duration along a pre-determined route. Surveys were started in 1966 and are conducted in June which is generally considered as the period of time when those birds present at a location are likely breeding in the immediate area. The BBS is conducted annually in the United States, across a large geographical area, under standardized survey guidelines. The BBS is a large-scale inventory of North American birds coordinated by the Patuxent Wildlife Research Center under the USGS (Sauer et al. 2008). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, as a result of variable local habitat and climatic conditions. Trends can be determined using different population equations and statistically tested to determine if a trend is statistically significant.

Estimates of population trends from BBS data are derived primarily from route-regression analysis (Geissler and Sauer 1990) and are dependent upon a variety of assumptions (Link and Sauer 1998). The statistical significance of a trend for a given species is reflected in the calculated P-value (*i.e.*, the probability of obtaining the observed data or more extreme data given that a hypothesis of no change is true). The level of statistical significance (*e.g*, 0.01, 0.05, 0.10) can vary and is often set by those conducting the analysis. Often BBS or other geographically large survey data is not statistically significant at the local level because of relatively smaller sample size (*i.e.*, fewer routes surveyed), more routes with zero observations of a particular bird species which results in larger statistical variance, and low P-values set for statistical significance. The data reported from the BBS has a statistical level of significance set at $P<0.05$.

Christmas Bird Count

The CBC is conducted in December and early January annually by numerous volunteers under the guidance of the National Audubon Society (NAS). The CBC reflects the number of birds frequenting a location during the winter months and is based on birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but can be used as an indicator of trends in the population over time. Researchers have found that population trends reflected in CBC data tend to correlate well with those from censuses taken by more stringent means (NAS 2002).

Partners in Flight Landbird Population Estimate

The BBS data are intended for use in monitoring bird population trends, but it is also possible to use BBS data to develop a general estimate of the size of bird populations. Using relative abundances derived from the BBS, Rich et al. (2004) extrapolated population estimates for many bird species in North America as part of the Partners in Flight Landbird Population Estimate database. The Partners in Flight system involves extrapolating the number of birds in the 50 quarter-mile circles (total area/route = 10 mi^2) along routes surveyed during the BBS to an area of interest. The model used by Rich et al. (2004) makes assumptions on the detectability of birds, which can vary for each species. Some species of birds that are more conspicuous (visual and auditory) are more likely to be detected during bird surveys when compared to bird species that are more secretive and do not vocalize often. Information on the detectability of a species is combined to create a detectability factor which may be combined with relative abundance data from the BBS to yield a population estimate (Rich et al. 2004).

Annual Harvest Estimate

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. Migratory bird hunting seasons are established under frameworks developed by the USFWS and implemented in the State by the AGFC. Canada geese, snow geese, lesser scaup, ring-necked ducks, American coots, and crows are the only species of birds addressed in this EA that have established hunting seasons the State.

For geese, take can also occur under several depredation orders established by the USFWS. Therefore, the take of Canada geese can occur during annual hunting seasons and under depredation orders that allows geese to be taken to alleviate damage and to alleviate threats of damage. Crows can also be taken under the blackbird depredation order. For many migratory bird species considered harvestable during a hunting season, the number of birds harvested during the season is reported by the USFWS and/or the AGFC in published reports.

Bird Conservation Regions

Bird Conservation Regions are areas in North America that are characterized by distinct ecological habitats that have similar bird communities and resource management issues. A large portion of central and southwestern Arkansas lies within the West Gulf Coastal Plain. The West Gulf Coastal Plain, also known as Bird Conservation Region 25, overlaps areas of Arkansas, Oklahoma, Texas, and Louisiana. This region is characterized by pin forests with shortleaf pine dominating in the north portion and the longleaf pine dominating the southern portion of the area. The region also includes the areas of the hardwood-dominated bottomlands along the Arkansas River and other drainages.

Areas within the State along the Mississippi River and the Mississippi Delta Region lie within the Mississippi Alluvial Valley, also known as Bird Conservation Region 26. The Mississippi Alluvial Valley consists of areas along the Mississippi River floodplain south of the Ohio River confluence encompassing areas along the Mississippi River in Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. Historically, the Mississippi Alluvial Valley was dominated by bottomland hardwood forests that were subject to annual flooding events of the Mississippi River. Today, less than 25 percent of the region remains forested and flooding has been reduced by 90 percent. However, the regions still acts as an important area for nesting and migrating waterfowl and other waterbirds (USFWS 2000).

The northern edge of Arkansas lies within the Central Hardwoods region, otherwise known as Bird Conservation Region 24. The Central Hardwoods regions encompasses forested areas in Oklahoma, Arkansas, Missouri, Illinois, Indiana, Ohio, Kentucky, Tennessee, and Alabama. This region is characterized by oak-hickory deciduous forest and contains some of the most extensive forests in the central United States.

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

The issue of non-target species effects, including effects on T&E species arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. To reduce the risks of adverse affects to non-target wildlife, WS would select damage management methods that are as target-selective as possible or apply such methods in ways to reduce the likelihood of capturing non-target species. Before initiating management activities, WS would select locations which are extensively used by the target species. WS would also use SOPs designed to reduce the effects on non-target species'

populations. SOPs and WS' Directives are further discussed in Chapter 3. Methods available for use under the alternatives are described in Appendix B.

Concerns have also been raised about the potential for adverse affects to occur to non-target wildlife from the use of registered toxicants. Chemical methods being considered for use to manage damage and threats associated with birds in Arkansas are further discussed in Appendix B. Chemical methods considered for use to manage damage or threat associated with birds includes immobilizing drugs, reproductive inhibitors, and repellents.

The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. WS conducts Section 7 consultations with the USFWS to ensure compliance with the ESA and 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)].

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. WS has consulted with the USFWS on programmatic activities under Section 7 of the ESA concerning potential impacts of methods available for use by WS on T&E species. The USFWS issued a BO on WS' programmatic activities in 1992 (USDA 1997). This issue in relationship to the alternatives is further discussed in Chapter 4 of this EA.

Issue 3 - Effects of Damage Management Methods[7] on Human Health and Safety

An additional issue often raised is the potential risks associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse affects on human safety. WS' employees use and recommend only those methods which are legally available, selective for target species, and effective to resolve the wildlife conflict. Still, some concerns exist regarding the safety of WS' methods despite their legality. As a result, WS will analyze the potential for proposed methods to pose a risk to members of the public or employees of WS.

In addition to the potential risks to the public associated with methods, risks to employees are also an issue. WS' employees are potentially exposed to damage management methods as well as subject to workplace accidents. Selection of methods, as part of an integrated approach, includes consideration for public and employee safety.

Safety of Chemical Methods Employed

The issue of using chemicals methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods would include immobilizing drugs, the avicide DRC-1339, reproductive inhibitors, and repellents. Alpha-chloralose is an immobilizing drug available to WS' employees for use to live-capture waterfowl. The avicide DRC-1339 is registered for use to alleviate damage associated with pigeons, starlings, red-winged blackbirds, cowbirds, common grackles, and gulls. The only reproductive inhibitor currently available is nicarbazin which is registered to reduce the reproductive potential of Canada geese and rock

[7]A complete list of chemical and non-chemical methods available for use under the identified alternatives, except the alternative with no damage management (Alternative 3), can be found in Appendix B. However, listing methods neither implies that all methods will be used by WS to resolve requests for assistance nor does the listing of methods imply that all methods will be used to resolve every request for assistance.

pigeons. Several avian repellents are commercially available to disperse birds from an area or discourage birds from feeding on desired resources. The most common ingredients of avian repellents are polybutene, anthraquinone, and methyl anthranilate. In addition, Avitrol is registered as a flock dispersing agent registered for crows, cowbirds, grackles, red-winged blackbirds, gulls, and pigeons. Chemical methods are further discussed in Appendix B.

The use of chemical methods is regulated by the EPA through the FIFRA, the AAD, and by WS Directives. WS' use of chemical methods is also discussed in WS' programmatic FEIS (USDA 1997).

Safety of Non-Chemical Methods Employed

Non-chemical methods employed to reduce damage and threats to safety caused by birds, if misused, could potentially be hazardous to human safety. Non-chemical methods are also discussed in detail in Appendix B. The cooperator requesting assistance is made aware through a MOU, cooperative service agreement, or a similar document that those devices agreed upon could potentially be used on property owned or managed by the cooperator; thereby, making the cooperator aware of the use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods.

Effects of Not Employing Methods to Reduce Threats to Human Safety

An issue identified is the concern for human safety from not employing methods or not employing the most effective methods to reduce the threats that birds can pose. The risks to human safety from diseases associated with certain bird populations were addressed previously. The low risk of disease transmission from birds does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concern is raised with inadequately addressing threats to human safety associated with aircraft striking birds at airports in the State. Birds have the potential to cause severe damage to aircraft and can threaten the safety of passengers. Limiting or preventing the use of certain methods to address the potential for aircraft striking birds could lead to higher risks to passenger safety. This issue will be fully evaluated in Chapter 4 in relationship to the alternatives.

Issue 4 - Effects on the Aesthetic Values of Birds

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target birds to the public, resource owners, or neighboring residents. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public shares a similar bond with animals and/or wildlife in general and in modern societies a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals and birds as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing wildlife. Therefore, the public reaction is variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal

attitudes, values, and opinions about the best ways to manage conflicts/problems between humans and wildlife.

Wildlife populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and may take the form of direct consumptive use (*i.e*., using parts of or the entire animal) or non-consumptive use (*i.e*., viewing the animal in nature or in a zoo, photographing) (Decker and Goff 1987).

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Public attitudes toward wildlife vary considerably. Some people believe that all wildlife should be captured and translocated to another area to alleviate damage or threats to protected resources. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations or sites. Some people totally opposed to wildlife damage management want agencies to teach tolerance for damage and threats caused by wildlife, and that wildlife should never be killed. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

The effects on the aesthetic value of birds from implementation of the identified alternatives, including the proposed action, are analyzed in Chapter 4.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

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

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain and identifying the causes that elicit pain responses in humans would "*…probably be causes for pain in other*

animals…" (AVMA 1987). However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

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

Pain and suffering, as it relates to methods available for use to manage birds has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to recognize the complexity of defining suffering, since *"…neither medical nor veterinary curricula explicitly address suffering or its relief"* (California Department of Fish and Game 1991). Research suggests that some methods can cause "*stress*" (USDA 1997). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness.

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

The issue of humanness and animal welfare are further discussed as it relates to the methods available for use under the alternatives in Chapter 4. SOPs to alleviate pain and suffering are discussed in Chapter 3.

Issue 6 – Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

Another issue commonly identified is a concern that bird damage management activities conducted by WS would affect the ability of persons to harvest game birds during the regulated hunting seasons by reducing local populations. Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to reduce or alleviate damage caused by those birds species are used to reduce bird densities through dispersal in damage management areas. Similarly, lethal methods used to reduce damage associated with those birds could lower densities in areas where damage is occurring resulting in a reduction in the availability of those species during the regulated harvest season. Bird damage management activities would primarily be conducted in areas where hunting access is restricted (*e.g.*, airports, urban areas) or has been ineffective. The use of non-lethal or lethal methods often disperses birds from areas where damage is occurring to areas outside the damage area which could serve to move those bird species from those less accessible areas to places accessible to hunters. Those species addressed in this assessment that can be harvested in the State during regulated hunting seasons include Canada geese, snow geese, ring-necked ducks, lesser scaup, American coots, American crows, and fish crows.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

Additional issues were also identified by WS and the AGFC during the scoping process of this EA that were considered but will not receive detailed analyses for the reasons provided. The following issues were considered but will not be analyzed in detail:

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

A concern was raised that an EA for an area as large as the State of Arkansas would not meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of federal or other regulatory agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to accurately describe such locations or times in an EA or EIS. Although WS can predict some of the possible locations or types of situations and sites where some kinds of wildlife damage would occur, the program cannot predict the specific locations or times at which affected resource owners would determine a damage problem has become intolerable to the point that they request assistance from WS. In addition, the WS program would not be able to prevent such damage in all areas where it might occur without resorting to destruction of wild animal populations over broad areas at a much more intensive level than would be desired by most people, including WS and other agencies. Such broad scale population management would also be impractical or impossible to achieve within WS' policies and professional philosophies.

Lead agencies have the discretion to determine the geographic scope of their analyses under the NEPA (Kleppe v Sierra Club, 427 U.S. 390, 414 (1976), CEQ 1508.25). Ordinarily, according to APHIS procedures implementing the NEPA, WS' individual wildlife damage management actions could be categorically excluded (7 CFR 372.5(c)). The intent in developing this EA is to determine if the proposed action would potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS or a Finding of No Significant Impact. This EA addresses impacts for managing damage and threats to human safety associated with birds in the State to analyze individual and cumulative impacts and to provide a thorough analysis.

In terms of considering cumulative effects, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If a determination is made through this EA that the proposed action would have a significant impact on the quality of the human environment, then an EIS would be prepared. Based on previous requests for assistance, the WS program in Arkansas would continue to conducted bird damage management in a very small area of the State where damage is occurring or is likely to occur.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife in the State. WS operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. Methods available are employed to target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or reproduction replaces the animals removed. WS operates on a small percentage of the land area in Arkansas and only targets those birds identified as causing damage or posing a threat. Therefore, those activities that would occur under any of the alternatives that involved bird damage management would not adversely affect biodiversity in the State.

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that a threshold of loss should be established before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. Some damage and economic loss can be tolerated by cooperators until the damage reaches a threshold where damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. Establishing a threshold would be difficult or inappropriate to apply to human health and safety situations.

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

Bird Damage Management Should Not Occur at Taxpayer Expense

An issue identified through the development of WS' programmatic FEIS is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based (USDA 1997). Funding for bird damage management activities is derived from federal appropriations and through cooperative funding. Activities conducted in the State for the management of damage and threats to human safety from birds would be funded through cooperative service agreements with individual property owners or associations. A minimal federal appropriation is allotted for the maintenance of a WS program in Arkansas. The remainder of the WS program is entirely fee-based. Technical assistance would be provided to requesters as part of the federally-funded activities, but all direct assistance in which WS' employees perform damage management activities would be funded through cooperative agreements between the requester and WS.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. However, the methods determined to be most effective to reduce damage and threats to human safety caused by birds and that prove to be the most cost effective would receive the greatest application. As part of an integrated approach, evaluation of methods would continually occur to allow for those methods that are most effective at resolving damage or threats to be employed under similar circumstance where birds are causing damage or pose a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. The cost effectiveness of methods and the effectiveness of methods are linked. The issue of cost effectiveness as it relates to the effectiveness of methods is discussed in the following issue.

Effectiveness of Bird Damage Management Methods

The effectiveness of any damage management program could be defined in terms of losses or risks potentially reduced or prevented, how accurately practitioner's diagnosis the problem, the species responsible for the damage, and how actions are implemented to correct or mitigate risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to non-target animals and the environment, while at the same time, using methods as humanely as possible within the limitations of current technology. The most effective approach to resolving any wildlife damage problem is to use an adaptive integrated approach which may call for the use of several management methods simultaneously or sequentially (USDA 1997, Courchamp et al. 2003).

The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on humans, target and non-target species, and the

environment[8]. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and, for WS' personnel, the guidance provided by WS' Directives and policies.

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

A common issue raised is that the use of lethal methods is ineffective because additional birds are likely to return to the area, either after removal occurs or the following year when birds returns to the area which creates a financial incentive to continue the use of only lethal methods. This assumes birds only return to an area where damage was occurring if lethal methods are used. However, the use of non-lethal methods is also often temporary which could result in birds returning to an area where damage was occurring once those methods are no longer used. The common factor when employing any method is that birds would return if suitable conditions continue to exist at the location where damage was occurring and bird densities are sufficient to occupy all available habitats to the extent that damage occurs. Therefore, any reduction or prevention of damage from the use of methods addressed in Appendix B would be temporary if habitat conditions continue to exist that attract birds to an area where damage occurs.

Therefore, any method that disperses or removes birds from areas would only be temporary if habitat containing preferred habitat characteristics continues to exist the following year when birds return. Dispersing birds using non-lethal methods addressed in Appendix B often requires repeated application to discourage birds from returning to roosting location which increases costs, moves birds to other areas where they could cause damage, and are temporary if habitat conditions at the roost remain unchanged. Dispersing and translocating birds could be viewed as moving a problem from one area to another which would require addressing damage caused by those birds at another location which increases costs and could be perceived as creating a financial incentive to continue the use of those methods since birds would have to be addressed annually and at multiple locations. WS' recommendation of or use of techniques to modify existing habitat or making areas unattractive to birds is discussed in Appendix B. WS' objective is to respond to request for assistance with the most effective methods and to provide for the long-term solution to the problem using WS' Decision Model to adapt methods in an integrated approach to managing bird damage that is agreed upon by the cooperator.

As part of an integrated approach to managing bird damage, WS would have the ability to adapt methods to damage situations to effectively reduce or prevent damage from occurring. Under the proposed integrated approach, all methods, individually or in combination, could be employed as deemed appropriate through WS' Decision Model to address requests for assistance. WS' objective when receiving a request for assistance under the proposed action is to reduce damage and threats to human safety or to prevent damage from occurring using an integrated approach to managing bird damage. Therefore, under the proposed action, WS would employ methods adaptively to achieve that objective.

Managing damage caused by birds can be divided into short-term redistribution approaches and long-term population and habitat management approaches (Cooper and Keefe 1997). Short-term approaches focus on redistribution and dispersal of birds to limit use of an area where damage or threats were occurring.

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

Short-term redistribution approaches may include prohibiting feeding, the use of pyrotechnics, propane cannons, effigies, and other adverse noise, erecting access barriers such as wire grids, and taste aversion chemicals (Cooper and Keefe 1997). Population reduction by limiting survival or reproduction, removing birds, and habitat modification are considered long-term solutions to managing damage caused by birds (Cooper and Keefe 1997).

Redistribution methods are often employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing birds are often short-term solutions that move birds to other areas where damages or threats could occur (Smith et al. 1999, Gorenzel et al. 2000, Gorenzel et al. 2002, Avery et al. 2008, Chipman et al. 2008). Chipman et al. (2008) found that crows could be dispersed from roost locations using non-lethal methods but crows would return to the original roost site within 2 to 8 weeks. The re-application of non-lethal methods to disperse crow roosts was required every year to disperse crows from the original roost or from roosts that had formed in other areas where damages were occurring (Chipman et al. 2008). Some short-term methods may become less effective in resolving damage as a bird population increases, as birds become more acclimated to human activity, and as birds become habituated to harassment techniques (Smith et al. 1999, Chipman et al. 2008). Non-lethal methods often require a constant presence at locations when birds are present and must be repeated every day until the desired results are achieved which can increase the costs associated with those activities. During a six-year project using only non-lethal methods to disperse crows in New York, the number of events required to disperse crows remained similar amongst years and at some locations, the number of events required to harass crows increased from the start of the project (Chipman et al. 2008). Long-term solutions to resolving bird damage often require management of the population (Smith et al. 1999) and identifying the habitat characteristics which attract birds to a particular location (Gorenzel and Salmon 1995).

For example, Cooper (1991) reported that the removal of geese posing or likely to pose a hazard to air safety at airports considerably reduced the population of local geese, decreased the number of goose flights through airport operations airspace, and significantly reduced goose-aircraft collisions at Minneapolis-St. Paul International Airport. In addition, Dolbeer et al. (1993) demonstrated that an integrated approach (including removal of offending birds) reduced bird hazards at airports and substantially reduced bird collisions with aircraft by as much as 89%. Jensen (1996) also reported that an integrated approach that incorporated the removal of geese, reduced goose-aircraft collisions by 80% during a two year period. Boyd and Hall (1987) showed that a 25% reduction in a local crow roost resulted in reduced hazards to a nearby airport.

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

Impacts of Avian Influenza (AI) on Bird Populations

AI is caused by a virus in the Orthomyxovirus group. Viruses in this group vary in the intensity of illness they may cause (virulence). Wild birds, in particular waterfowl and shorebirds, are considered to be the natural reservoirs for AI (Clark and Hall 2006). Most strains of AI rarely cause severe illness or death in birds although the H5 and H7 strains tend to be highly virulent and very contagious. However, even the strains which do not cause severe illness in birds are a concern for human and animal health officials

because the viruses have the potential to become virulent and transmissible to other species through mutation and reassortment (Clark and Hall 2006).

Recently, the occurrence of highly pathogenic (HP) H5N1 AI virus has raised concern regarding the potential impact on wild birds, domestic poultry, and human health should it be introduced into the United States. It is thought that a change occurred in a low pathogenicity AI virus of wild birds, allowing the virus to infect chickens, followed by further change into the HP H5N1 AI. HP H5N1 AI has been circulating in Asian poultry and fowl resulting in death to those species. HP H5N1 AI likely underwent further change allowing infection in additional species of birds, mammals, and humans. More recently, this virus moved back into wild birds resulting in mortality of some species of waterfowl, and other birds. This is only the second time in history that the HP form of AI has been recorded in wild birds. Numerous potential routes for introduction of the virus into the United Ststes exist including: illegal movement of domestic or wild birds, contaminated products, infected travelers, and the migration of infected wild birds. WS has been one of several agencies and organizations conducting surveillance for AI virus in migrating birds. The nationwide surveillance effort has detected some instances of low pathogenic AI viruses, as was expected given that waterfowl and shorebirds are considered to be the natural reservoirs for AI. Tens of thousands of birds have been tested, but there has been no evidence of the HP H5N1 virus in North America.

Bird Damage Should Be Managed By Private Nuisance Wildlife Control Agents

Private nuisance wildlife control agents could be contacted to reduce bird damage for property owners or property owners when deemed appropriate by the resource owner. Some property owners would prefer to use a private nuisance wildlife control agent because the nuisance wildlife agent is located in closer proximity and thus could provide the service at less expense, or because they prefer to use a private business rather than a government agency. However, some property owners would prefer to contract with a government agency. In particular, large industrial businesses and cities and towns may prefer to use WS because of security and safety issues and reduced administrative burden.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to lethally take birds. As described in Appendix B, the lethal removal of birds with firearms by WS to alleviate damage or threats would occur using a rifle or shotgun. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996). To address lead exposure from the use of shotguns, the standard conditions of depredation permits issued by the USFWS pursuant to the MBTA for the lethal take of birds requires the use of non-toxic shot. To alleviate concerns associated with lead exposure in wildlife, WS would only use non-toxic shot as defined in 50 CFR 20.21(j) when using shotguns to take all birds.

The take of birds by WS in the State occurs primarily from the use of shotguns. However, the use of rifles could be employed to lethally take some species. To reduce risks to human safety and property damage from bullets passing through birds, the use of rifles is applied in such a way (*e.g*., caliber, bullet weight, distance) to ensure the bullet does not pass through birds. Birds that are removed using rifles would occur within areas where retrieval of all bird carcasses for proper disposal is highly likely (*e.g.,* at roost sites). With risks of lead exposure occurring primarily from ingestion of shot and bullet fragments, the retrieval and proper disposal of bird carcasses would greatly reduce the risk of scavengers ingesting or being exposed to lead.

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

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

The take of birds can occur: (1) during regulated hunting seasons, (2) through the issuance of depredation permits, (3) under depredation orders without the need to obtain a depredation permit, or (4) are considered non-native with no depredation permit required for take. Therefore, WS' assistance with removing birds would not be additive to the environmental status quo since those birds removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement. The amount of lead deposited into the environment may be lowered by WS' involvement in bird damage management activities due to efforts by WS to ensure projectiles do no pass through but are contained within the bird carcass which limits the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by WS' employees in firearm use and accuracy increases the likelihood that birds are lethally removed humanely in situations that ensure accuracy and that misses occur infrequently which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. In addition, WS' involvement ensures bird carcasses lethally removed using firearms would be retrieved and disposed of properly to limit the availability of lead in the environment and ensures bird carcass are removed from the environment to prevent the ingestion of lead in carcasses by scavengers. Based on current information, the risks associated with lead bullets that are deposited into the environment from WS' activities due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination of water. As stated previously, when using shotguns, only non-toxic shot would be used by WS.

Impacts of Dispersing a Bird Roost on People in Urban/Suburban Areas

Another issue often raised is that the dispersal of birds from a roost location to alleviate damage or conflicts at one site can result in new damage or conflicts at a new roost site. While the original complainant may see resolution to the bird problem when the roost is dispersed, the recipient of the bird roost may see the bird problem as imposed on them. Thus, on the whole, there is no resolution to the original bird problem (Mott and Timbrook 1988). Bird roosts usually are dispersed using a combination of harassment methods including pyrotechnics, propane cannons, effigies, and electronic distress calls (Booth 1994, Avery et al. 2008, Chipman et al. 2008). A similar continuing conflict can develop when habitat alteration is used to disperse a bird roost. This concern is heightened in large metropolitan areas where the likelihood of birds dispersed from a roost finding a new roost location and not coming into conflict is very low. WS has minimized the impact of dispersing bird roosts in urban/suburban areas by creating a management option to depopulate the bird roost creating the conflict problem.

In urban areas, WS often works with the community or municipal leaders to address bird damage involving large bird roosts that are likely affecting several people. Therefore, WS often consults not only with the property owner where roosts are located but with community leaders to allow for community-based decision-making on the best management approach. In addition, when seeking funding for bird damage management activities involving urban bird roosts, funding is often provided by the municipality where the roost is located which allows for bird damage management activities to occur within city limits where bird roosts occur. This allows for roosts that have been relocated and begin to cause damage or pose threats to be addressed effectively and often times, before roosts become well-established. The community-based decision-making approach to bird damage management in urban areas is further discussed under the proposed action alternative in Chapter 3. Therefore, this issue was not analyzed further.

A Site Specific Analysis Should be Made for Every Location Where Bird Damage Management Could Occur

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

The analysis in this EA was driven by the issues raised during the scoping process during the development of the EA. In addition to the analysis contained in this EA, WS' personnel use the WS Decision Model (Slate et al. 1992, USDA 1997) described in Chapter 3 as a site specific tool to develop the most appropriate strategy at each location. The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to wildlife damage management requests.

As discussed previously, one EA analyzing impacts for the entire State would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas and allows for a better cumulative impact analysis. If a determination is made through this EA that the proposed action could have a significant impact on the quality of the human environment, then an EIS would be prepared.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives which were developed to address the identified issues discussed in Chapter 2. Alternatives were developed for consideration based on the issues using the WS

Decision model (Slate et al. 1992, USDA 1997). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. SOPs for bird damage management in Arkansas are also discussed in Chapter 3.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed to address the identified issues associated with managing damage caused by birds in the State:

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by birds in Arkansas. A major goal of the program would be to resolve and prevent bird damages and to reduce threats to human safety. To meet this goal, WS would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding is available, operational damage management. Funding could occur through federal appropriations or from cooperative funding.

The adaptive approach to managing damage associated with birds would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by site-specific evaluation to reduce damage or threats to human safety for each request. City/town managers, agricultural producers, property owners, and others requesting assistance would be provided information regarding the use of appropriate non-lethal and lethal techniques. WS would work with those persons experiencing bird damage by addressing those birds responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as birds begin to cause damage. Bird damage that has been ongoing can be difficult to resolve using available methods since birds are conditioned to feed, roost, loaf, and are familiar with a particular location. Subsequently, making that area unattractive through the use of available methods can be difficult to achieve once damage has been ongoing. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity. The USFWS could continue to issue depredation permits to WS and to those entities experiencing bird damage when requested by the entity and when deemed appropriate by the USFWS for those species that require a permit.

Under this alternative, WS would respond to requests for assistance by: 1) taking no action if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by birds, or 3) provide technical assistance and direct operational assistance to a property owner or manager experiencing damage. The take of native migratory birds can only legally occur through the issuance of a depredation permit by the USFWS and only at levels specified in the permit or under depredation orders.

Property owners or managers requesting assistance would be provided with information regarding the use of effective and practical non-lethal and lethal techniques. Property owners or managers may choose to implement WS' recommendations on their own (*i.e.*, technical assistance), use contractual services of private businesses, use volunteer services of private organizations, use contractual services of WS (*i.e.*, direct operational assistance), or take no action.

WS' Decision Model is the implementing mechanism for a damage management program under the proposed action alternative that is adapted to an individual damage situation that allows for the broadest range of methods to be used to address damage or the threat of damage in the most effective, most efficient, and mostly environmentally conscious way available. When a request for direct operational assistance is received to resolve or prevent damage caused by birds, WS conducts site visits to assess damage or threats, identifies the cause of the damage, and applies the decision model described by Slate et al. (1992) and in WS' programmatic FEIS (USDA 1997) to apply methods to resolve or prevent damage using those methods available. The use of the Decision model by WS' employees under the proposed action is further discussed below.

Non-lethal methods include, but are not limited to: habitat/behavior modification, lure crops, visual deterrents, live traps, exclusionary devices, frightening devices, reproductive inhibitors, immobilizing drugs, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods considered by WS include: live-capture followed by euthanasia, nest/egg destruction, the avicide DRC-1339, the recommendation of take during hunting seasons, and shooting. However, listing methods neither implies that all methods would be used or recommended by WS to resolve requests for assistance nor does listing of methods imply that all methods would be used to resolve every request for assistance. Euthanasia of live-captured birds would occur through the use of cervical dislocation or carbon dioxide once birds are live-captured using other methods. Carbon dioxide is an acceptable form of euthanasia for birds while cervical dislocation is a conditionally acceptable[9] method of euthanasia (AVMA 2007). On occasion, birds could be euthanized by gunshot once live-captured which is a method of euthanasia considered appropriate by the AVMA for free-ranging wildlife (AVMA 2007).

Lethal and non-lethal methods are intended to be short-term attempts at reducing damage occurring at the time those methods are employed. Long-term solutions to managing bird damage would include limited habitat manipulations and changes in cultural practices which are addressed further below and in Appendix B.

Non-lethal methods can disperse or otherwise make an area unattractive to birds causing damage; thereby, reducing the presence of birds at the site and potentially the immediate area around the site where non-lethal methods are employed. Non-lethal methods would be given priority when addressing requests for assistance (WS Directive 2.101). However, non-lethal methods would not necessarily be employed to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model, especially when the requesting entity has used non-lethal methods previously and found those methods to be inadequate to resolving the damage or threats of damage. Non-lethal methods are used to excluded, harass, and disperse target wildlife from areas where damage or threats are occurring. When effective, non-lethal methods would disperse birds from the area resulting in a reduction in the presence of those birds at the site where those methods were employed. The use of non-lethal methods in an integrated approach has proved effective in dispersing birds. Avery et al. (2002) and Seamans (2004) found that the use vulture effigies were an effective non-lethal method to disperse roosting vultures. The use of non-lethal methods in an integrated approach have proved effective in dispersing crows (Gorenzel et al. 2000, Chipman et al. 2008), including the use of crow effigies (Avery et al. 2008), lasers (Gorenzel et al. 2002), and electronic distress calls (Gorenzel and Salmon 1993). Chipman et al. (2008) found the use of only non-lethal methods to disperse urban crow roosts often requires a long-term commitment of affected parties, including financial commitments, to achieve and maintain the desired result of reducing damage. Non-lethal methods are generally regarded as having minimal impacts on overall populations of wildlife since those species are unharmed. The continued use of non-lethal methods often leads to the habituation of birds to those methods which can decrease the effectiveness of those methods (Avery et al.

[9]The AVMA (2007) defines conditional acceptable as "...[methods] *that by the nature of the technique or because of greater potential for operator error or safety hazards might not consistently produce humane death or are methods not well documented in the scientific literature".*

2008, Chipman et al. 2008). For any management methods employed, the proper timing is essential in effectively dispersing those birds causing damage. Employing methods soon after damage begins or soon after threats are identified increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of bird damage.

Lethal methods would be employed to resolve damage associated with those birds identified by WS as responsible for causing damage or threats to human safety only after receiving a request for the use of those methods. The use of lethal methods would result in local population reductions in the area where damage or threats were occurring since birds would be removed from the population. Lethal methods are often employed to reinforce non-lethal methods and to remove birds that have been identified as causing damage or posing a threat to human safety. The use of lethal methods would result in local reductions of birds in the area where damage or threats were occurring. The number of birds removed from the population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, and the efficacy of methods employed. Under the proposed action, the lethal methods being considered are shooting with firearms, nest/egg destruction, the avicide DRC-1339, the live-capture of birds that are subsequently euthanized, and the recommendation of hunting as a population management tool.

Most lethal methods are intended to reduce the number of birds present at a location since a reduction in the number of birds at a location leads to a reduction in damage which is applicable whether using lethal or non-lethal methods. The intent of non-lethal methods is to harass, exclude, or otherwise make an area unattractive to birds which disperses those birds to other areas which leads to a reduction in damage at the location where those birds were dispersed. The intent of using lethal methods is similar to the objective trying to be achieved when using non-lethal methods which is to reduce the number of birds in the area where damage is occurring which can lead to a reduction in the damage occurring at that location.

Although the use of firearms can reduce the number of birds using a location (similar to dispersing birds), the use of a firearm is most often used to supplement and reinforce the noise associated with non-lethal methods. The capture of birds using live-traps and subsequently euthanizing those birds is employed to reducing the number of birds using a particular area where damage is occurring. Similarly, the recommendation that birds be harvested during the regulated hunting season for those species in the State is intended to manage those populations in an area where damage is occurring.

The avicide DRC-1339 is also being proposed for use under the proposed action which would be applied as part of an integrated approach which could include non-lethal harassment methods. The avicide DRC-1339 is registered for use to alleviate damage associated with pigeons, starlings, red-winged blackbirds, cowbirds, common grackles, and gulls. Like other methods, including non-lethal methods, the intent in using DRC-1339 is to reduce the number of birds present at a location where damages or threats of damage are occurring. Reducing the number of birds at a location where damage or threats are occurring either through the use of non-lethal methods or lethal methods can lead to a reduction in damage. The dispersal of birds using non-lethal methods reduced the number of birds using a location which was correlated with a reduction in damage occurring at that location (Avery et al. 2008, Chipman et al. 2008). Similarly, the use of DRC-1339 is intended to reduce the number of birds using a location. Hall and Boyd (1987) found the use of DRC-1339 to reduce local crow roosts by up to 25% could lead to a reduction in damage associated with those crows.

Often of concern with the use of lethal methods is that birds that are lethally taken would only be replaced by other birds either during the application of those methods (either from other birds that immigrate or emigrate into the area) or by birds the following year (increase in reproduction that could result from less competition). As stated previously, the use of lethal methods are not intended to be used as population

management tools (except for hunting) over broad areas. The use of lethal methods are intended to reduce the number of birds present at a location where damage is occurring by targeting those birds causing damage or posing threats. Since the intent of lethal methods is to manage those birds causing damage and not to manage entire bird populations, those methods are not ineffective because birds return the following year.

Chipman et al. (2008) found that crows returned to roosts previously dispersed using non-lethal methods within 2 to 8 weeks. In addition, Chipman et al. (2008) found that the use of non-lethal methods had to be re-applied every year during a six-year project evaluating the use of only non-lethal methods. At some roost locations, Chipman et al. (2008) found the number of crows that returned each year to roosts over a six-year period actually increased despite the use of non-lethal methods each year. Despite the need to re-apply non-lethal methods yearly, the return of birds to roost locations previously dispersed, and the number of crows using roost locations increasing annually at some roost locations, Chipman et al. (2008) determined the use of non-lethal methods could be effective at dispersing urban crow roosts in New York. Similar results were found by Avery et al. (2008) during the use of crow effigies and other non-lethal methods to disperse urban crow roosts in Pennsylvania. Crows returned to roost locations in Pennsylvania annually despite the use of non-lethal methods and effigies (Avery et al. 2008). Gorenzel et al. (2002) found that crows returned to roost locations after the use of lasers. Therefore, the use of both lethal and non-lethal methods may require repeated use of those methods. The return of birds to areas where damage management methods were previously employed does not indicated previous use of those methods were ineffective since the intent of those methods are to reduce the number of birds present at a site where damage is occurring at the time those methods are employed.

Another concern when employing methods to resolve bird damage associated with bird roosts is the apparent success of methods being claimed when birds actually have dispersed from an area naturally. This could apply to both lethal and non-lethal methods. Bird migration periods vary during the spring and fall depending on the geographical region and other natural stimuli (Verbeek and Caffrey 2002). For example, many of the studies evaluating methodologies for alleviating crow damage occurred during periods of time when crows could have been dispersing naturally which must be considered when evaluating the success of methods in reducing damage. Boyd and Hall (1987) determined a reduction in the number of crows using local roost locations in Arkansas and Kentucky by 25% using DRC-1339 could reduce damage occurring from those crows. However, work conducted using DRC-1339 occurred in January and February when roosts could have been breaking up naturally as crows disperse to breeding areas. Chipman et al. (2008) found the use of non-lethal methods could be effective in dispersing urban crow roosts in New York. However, hazing projects did not occur until after pre-treatment assessments of crow roosts were conducted from November through January during the six-year project (Chipman et al. 2008). Thus, similar to the work conducted by Boyd and Hall (1987), those non-lethal methods employed by Chipman et al. (2008) in New York occurred in January and could have occurred during the period of time when crows begin to disperse naturally. Avery et al (2008) noted that the use of effigies and other non-lethal methods at crow roosts in Pennsylvania during December 2005 were successful in breaking up the large roost into smaller roosts but the roosts did not begin to disperse until January. Therefore, to effectively evaluate the future use of methods, in bird damage management activities, WS would consider the time of year those methods were employed in relationship to when those birds may have dispersed naturally.

Most lethal and non-lethal methods currently available provide only short-term benefits when addressing bird damage. Those methods are intended to reduce damage occurring at the time those methods are employed but do not necessarily ensure birds would not return once those methods are discontinued or the following year when birds return. Long-term solutions to resolving bird damage are often difficult to implement and can be costly. In some cases, long-term solutions involve exclusionary devices, such as wire grids, or other practices such as closing garbage cans. When addressing bird damage, long-term

solutions generally involve modifying existing habitat or making conditions to be less attractive to birds. To ensure complete success, alternative sites in areas where damage is not likely to occur are often times required to achieve complete success in reducing damage and avoid moving the problem from one area to another. Modifying a site to be less attractive to birds would likely result in the dispersal of those birds to other areas where damage could occur or could result in multiple occurrences of damage situations.

However, little is known about roost site characteristics that are preferable to birds but likely involves many factors. One factor often noted when describing characteristics of crow roost sites is the presence of brightly illuminated sites (Gorenzel and Salmon 1995, Peh and Sodhi 2002, Johnson 2005, Avery et al. 2008). Crow roost trees were found to have greater height, trunk diameter, crown diameter, and crown volume compared to non-roost trees in California (Gorenzel and Salmon 1995). Roost trees were more often found over asphalt or concrete substrate in commercial areas than non-roost trees, including greater ambient light levels and interior canopy temperatures (in winter) (Gorenzel and Salmon 1995).

An understanding of preferred roost characteristics could allow city planners and managers to design areas that would discourage birds from roosting in those areas (Gorenzel and Salmon 1995). Understanding preferred bird roost characteristics would also allow for alternative roost sites to be indentified to allow for birds to be harassed from undesired locations (as determined by affected parties) to designated areas that exhibit preferred roosts characteristics but are in areas where damages would likely not occur. Birds in those areas would not be disturbed and would be allowed to roost in those locations where damages were not likely to occur. Gorenzel and Salmon (1995) recommended that the planting of evergreen trees be avoided in areas with asphalt or concrete substrate to avoid winter crow roosts forming. In addition, Gorenzel and Salmon (1995) recommended trees growing more than 7.6 meters in California should be pruned or not planted in areas around parking lots and industrial sites to make them less attractive to crows.

WS would continue to work with communities and research staff to identify characteristics about current bird roosts in attempts to modify those attributes to make those areas less attractive to birds. In addition, WS would continue to work with other entities to identify alternative roosts sites where birds roosting in those areas are not likely to cause damage or pose threats of damage in attempts to create areas where birds can be disperse to. This approach would allow long-term solutions to be implemented when dealing with urban bird roosts.

WS may recommend waterfowl and crows be harvested during the regulated hunting season in an attempt to reduce the number of birds causing damage. Managing bird populations over broad areas could lead to a decrease in the number of birds causing damage. Establishing hunting seasons and the allowed take during those seasons is the responsibility of the AGFC under frameworks developed by the USFWS. WS does not have the authority to establish hunting seasons or to set allowed harvest numbers during those seasons.

Appendix B contains a thorough discussion of the methods available for use in an integrated wildlife damage management approach to address requests for assistance to manage damage or reduce threats to human safety. WS' programmatic FEIS contains additional discussion on adaptive management using an integrated approach to address damage to resources and threats to human safety (USDA 1997). As part of an integrated approach, WS may provide technical assistance and direct operational assistance to those experiencing damage associated with birds.

Technical Assistance Recommendations

Under the proposed action, WS would provide technical assistance to those persons requesting bird damage management as part of an integrated approach to managing damage. Technical assistance would

occur as described in Alternative 2 of this EA. Technical assistance is also further discussed in WS' programmatic FEIS (USDA 1997). Between FY 2006 and FY 2009, the WS program in Arkansas has conducted 967 technical assistance projects that involved bird damage to agricultural resources, property, natural resources, and threats to human safety.

Operational Damage Management Assistance

Operational damage management assistance includes damage management activities that are directly conducted by or supervised by personnel of WS. Operational damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone and there is a written agreement between WS and the entity requesting assistance. The initial investigation defines the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS' personnel are often required to effectively resolve problems, especially if restricted-use chemicals are necessary or if the problems are complex.

Educational Efforts

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

Research and Development

The National Wildlife Research Center (NWRC) functions as the research arm of WS by providing scientific information and development of methods for wildlife damage management that are effective and environmentally responsible. NWRC research biologists work closely with wildlife managers, researchers, and others to develop and evaluate wildlife damage management techniques. For example, research biologists from the NWRC were involved with developing and evaluating mesurol for reducing crow predation on eggs. NWRC biologists have authored hundreds of scientific publications and reports, and are respected world-wide for their expertise in wildlife damage management.

WS' Decision Making Procedures

WS' personnel use a thought process for evaluating and responding to damage complaints which is depicted by the WS Decision Model (WS Directive 2.201) and described by Slate et al. (1992). WS' programmatic FEIS also provides further discussion and examples of how the Decision Model is used to address damage and threats associated with wildlife (USDA 1997). WS' personnel are frequently contacted after requesters have tried or considered methods and found them to be impractical, too costly, or inadequate for effectively reducing damage. WS' personnel assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, methods deemed to be practical for the situation are incorporated into a damage management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the WS Decision Model, most damage management efforts consist of continuous feedback between receiving the request and monitoring

the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

Community-based Decision Making

The WS program in Arkansas follows the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS provides technical assistance regarding the biology and ecology of birds and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This includes non-lethal and lethal methods. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources are available. Resource owners and others directly affected by bird damage or conflicts in the State have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Under a community based decision-making process, WS would provide information, demonstration, and discussion on all available methods to the appropriate representatives of the community for which services were requested to ensure a community-based decision is made. By involving decision-makers in the process, damage management actions can be presented to allow for decisions on damage management to involve those individuals that the decision maker(s) represents. As addressed in this EA, WS would provide technical assistance to the appropriate decision-maker(s) to allow for information on damage management activities to be presented to those persons represented by the decision-maker(s), including demonstrations and presentation by WS at public meetings to allow for involvement of the community. Requests for assistance to manage birds often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives, the decision-maker(s) are able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentation by WS on bird damage management activities. This process allows decisions on bird damage management activities to be made based on local input.

Community Decision-Makers

The decision-maker for the local community would be the popularly elected officials of the local community who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. If no local official represents the affected resource then WS would provide technical assistance to the individual owner or locally appointed decision-maker. Identifying the decision-maker for local business communities is more complex because the lease may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. WS would provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Direct control would be provided by WS only if requested by the local community decision-maker(s), funding is provided, and if the requested direct control was compatible with WS' recommendations.

Private Property Decision-Makers

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has the discretion to involve others as to what occurs or does not occur on property they own or manage. Due to privacy issues, WS can not disclose cooperator information to others. Therefore, in the case of an individual property owner or manager, the

involvement of others and to what degree others are involved in the decision-making process is a decision made by that individual. Direct control would be provided by WS if requested, funding is provided, and the requested management was according to WS' recommendations.

Public Property Decision-Makers

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

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under this alternative, WS would provide those cooperators requesting assistance with managing damage and threats associated with birds with technical assistance only. Technical assistance would provide those cooperators experiencing damage or threats associated with birds with information, demonstrations, and recommendations on available and appropriate methods available. The implementation of methods and techniques to resolve or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that are of limited availability for use by private entities (*e.g*., loaning of propane cannons). Generally, several management strategies are described to the requester for short and long-term solutions to damage problems; those strategies are based on the level of risk, need, and the practicality of their application. In some instances, wildlife-related information provided to the requestor results in tolerance/acceptance of the situation. In other instances, management options are discussed and recommended. Only those methods legally available for use by the appropriate individual would be recommend or loaned by WS. Similar to Alternative 1, those methods described in Appendix B would be available to those experiencing damage or threats associated with birds in the State except for alpha-chloralose and DRC-1339 which are only available to WS. However, a product containing the same active ingredient as DRC-1339 is commercially available as a restricted-use pesticide for managing damage associated with starlings, red-winged blackbirds, common grackles, and brown-headed cowbirds at livestock and poultry operations.
The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, State, and local government agencies for managing bird damage. Technical assistance includes collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator has attempted to resolve the problem. WS then provides information on appropriate methods that the cooperator may consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Between FY 2006 and FY 2009, WS has conducted 967 technical assistance projects that involved bird damage to agricultural resources, property, natural resources, and threats to human safety.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those persons experiencing damage or are concerned with threats posed by birds could seek assistance from other governmental agencies, private entities, or conduct damage management on their own. Those persons experiencing damage or threats could take action using those methods legally available to resolve or prevent bird damage as permitted by federal, state, and local laws and regulations or those persons could take no action.

Alternative 3 – No Bird Damage Management Conducted by WS

This alternative precludes any and all activities by WS to reduce threats to human health and safety, and alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management in the State. All requests for assistance received by WS to resolve damage caused by birds would be referred to the USFWS, the AGFC, or to private entities.

Despite no involvement by WS in resolving damage and threats associated with birds in the State, those persons experiencing damage caused by birds could continue to resolve damage by employing those methods legally available. All methods described in Appendix B would be available for use by those persons experiencing damage or threats except for the use of alpha-chloralose and DRC-1339 which can only be used by WS. Birds could be lethally taken (1) through the issuance of depredation permits by the USFWS, (2) during the hunting seasons for waterfowl and crows, (3) under depredation orders for cormorants, geese, and blackbirds, and (4) without the need for a depredation permit issued by the USFWS for pigeons and starlings. For those species addressed in this EA, a depredation permit from the USFWS is not required when using non-lethal methods to alleviate damage or threats of damage.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

In addition to those alternative analyzed in detail, several alternatives were identified by WS but will not receive detailed analyses for the reasons provided. Those alternatives considered but not analyzed in detail include:

Use of Non-lethal Methods before Lethal Methods

This alternative would require that all non-lethal methods or techniques described in Appendix B be applied to all requests for assistance to reduce damage and threats to safety from birds in the State. If the use of all non-lethal methods failed to resolve the damage situation or reduce threats to human safety at each damage situation, lethal methods would be employed to resolve the request. Non-lethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by those persons experiencing bird damage but would only prevent the use of those methods by WS until all non-lethal methods had be employed.

Those persons experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used by the individual requestor would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of non-lethal methods can be evaluated. The proposed action described (Alternative 1) is similar to a non-lethal before lethal alternative because the use of non-lethal methods is considered before lethal methods by WS (WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not add additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

Under this alternative, WS would be required to implement non-lethal methods only to resolve damage caused by birds in Arkansas. Only those methods discussed in Appendix B that are considered non-lethal would be employed by WS. No lethal take of birds would occur by WS. The use of lethal methods could continue to be used under this alternative by those persons experiencing damage by birds. Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary

exclusionary methods are netting and over-head lines. Exclusion is most effective when applied to small areas to protect high value resources. However, exclusionary methods are neither feasible nor effective for protecting human safety, agriculture, or native wildlife species from birds across large areas. The non-lethal methods used or recommended by WS under this alternative would be identical to those identified in any of the alternatives.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS would refer requests for information regarding lethal information to AGFC, USFWS, local animal control agencies, or private businesses or organizations. Under this alternative, however, property owners/managers might be limited to using non-lethal methods only as they may have difficulty obtaining permits for lethal methods, especially in urban areas.

Property owners or managers could conduct management using shooting or any non-lethal method that is legal. Property owners or managers might choose to implement WS' non-lethal recommendations, implement lethal methods, or request assistance from some private or public entity other than WS. Property owners/managers frustrated by lack of WS' assistance with the full range of bird damage management techniques may try methods not recommended by WS (*e.g.*, poisons). In some cases, property owners or managers may misuse some methods or use some methods in excess of what is necessary.

The proposed action, using an integrated damage management approach, incorporates the use of non-lethal methods when addressing requests for assistance. In those instances where non-lethal methods would effectively resolve damage from birds, those methods would be used or recommended under the proposed action. Since non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with birds. However, non-lethal methods can be effective in preventing damage in certain instances. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating bird damage. For example, the use of non-lethal methods has been effective in dispersing vulture roosts (Avery et al. 2002, Seamans 2004). In those situations where damage could be alleviated using non-lethal methods deemed effective, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

Trap and Translocate Birds Only

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Birds would be live-captured using live-traps, cannon nets, rocket nets, bow nets, or mist nests. All birds live-captured through direct operational assistance by WS would be translocated. Translocation sites would be identified and have to be approved by the USFWS, the AGFC, and/or the property owner where the translocated birds would be placed prior to live-capture and translocation. Live-capture and translocation could be conducted as part of the alternatives analyzed in detail. However, the translocation of wildlife could only occur under the authority of the USFWS and/or AGFC. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the AGFC, WS could translocate birds under any of the alternatives analyzed in detail except the alternative where WS was not involvement with any aspect of bird damage management. Since WS does not have the authority to translocate birds in the State unless

permitted by the USFWS and/or the AGFC, this alternative was not considered in detail since translocation of birds could occur under any of the alternatives analyzed in detail.

Translocation of birds causing damage to other areas following live-capture generally would not be effective or cost-effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. Also, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems; therefore, relocation would be unrealistic. Translocation of wildlife is also discouraged by WS policy (WS Directive 2.501) because of stress to the relocated animal, poor survival rates, and difficulties in adapting to new locations or habitats (Nielsen 1988).

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

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

Reproductive control for wildlife could be accomplished either through sterilization (permanent) or contraception (reversible). Sterilization could be accomplished through: 1) surgical sterilization (vasectomy, castration, and tubal ligation), 2) chemosterilization, and 3) through gene therapy. Contraception could be accomplished through: 1) hormone implantation (synthetic steroids such as progestins), 2) immunocontraception (contraceptive vaccines), and 3) oral contraception (progestin administered daily).

Although male Canada geese have been successfully sterilized to prevent production of young, this method is only effective if the female does not form a bond with a different male. In addition, vasectomies can only prevent the production of the mated pair. The ability to identify breeding pairs for isolation and to capture a male bird for vasectomization becomes increasingly difficult as the number of birds increase (Converse and Kennelly 1994). Geese have a long life span once they survive their first year (Cramp and Simmons 1977, Allan et al. 1995); leg-band recovery data indicate that some waterfowl live longer than 20 years. The sterilization of resident geese would not reduce the damage caused by the overabundance of the goose population since the population would remain relatively stable for many years. Keefe (1996) estimated sterilization of a Canada goose to cost over $100 per bird.

Population modeling indicates that reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998). Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproduction control technologies as a wildlife management tool for some species. Currently, no reproductive inhibitors are available for use to manage most bird populations. Given the costs associated with live-capturing and performing sterilization procedures on birds and the lack of availability of chemical reproductive inhibitors for the management of most bird populations, this alternative was not evaluated in detail. If a reproductive inhibitor becomes available to manage a large number of bird populations and has proven effective in reducing local bird populations, the use of the

inhibitor could be evaluated under the proposed action as a method available that could be used in an integrated approach to managing damage. This EA would be reviewed and supplemented to the degree necessary to evaluate the use of the reproductive inhibitor as part of an integrated approach described under the proposed action. Currently, the only reproductive inhibitor registered with the EPA is nicarbazin which is registered for use on Canada geese, feral domestic waterfowl, domestic Muscovy ducks, and pigeons. However, products containing the active ingredient nicarbazin for managing reproduction in Canada geese and pigeons were not registered for use in Arkansas at the time this EA was developed.

Compensation for Bird Damage

The compensation alternative would require WS to establish or work to establish a system to reimburse persons impacted by bird damage. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Analysis of this alternative in WS' programmatic FEIS indicated that a compensation only alternative had many drawbacks. Compensation would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) most likely would be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) not be practical for reducing threats to human health and safety.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of wildlife damage management activities. The current WS program, nationwide and in the State of Arkansas, uses many such SOPs which are discussed in detail in Chapter 5 of WS' programmatic FEIS (USDA 1997). Those SOPs would be incorporated into activities conducted by WS when addressing bird damage and threats in the State.

Some key SOPs pertinent to the proposed action and alternatives include the following:

- The WS Decision Model, which is designed to identify effective wildlife damage management strategies and their impacts, is consistently used and applied when addressing bird damage.

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

- Non-target animals captured in traps are released unless it is determined that the animal would not survive and/or that the animal cannot be released safely.

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

- All personnel who use chemicals are trained and certified to use such substances or are supervised by trained or certified personnel.

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

- The use of non-lethal methods is considered prior to the use of lethal methods when managing bird damage in accordance with WS' Directives.

- Management actions are directed toward specific individual animals or groups of animals posing a threat to human health and safety, causing agricultural damage, causing damage to natural resources, or causing damage to property.

- WS employs methods and conducts activities for which the risk of hazards to public safety and hazard to the environment have been determined to be low according to a formal risk assessment (USDA 1997). Where such activities are conducted on private lands or other lands of restricted public access, the risk of hazards to the public is even further reduced.

- During the use of live-capture methods, WS' personnel would be present on site to monitor the application of the method or would check those methods frequently to address any live-captured wildlife to minimize the amount of time they are restrained.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

- Lethal take of birds by WS would be reported and monitored by WS and by the USFWS to evaluate population trends and the magnitude of WS' take of birds in the State.

- WS would only target those individuals or groups of target species identified as causing damage or posing a threat to human safety.

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

- WS would annually monitor bird damage management activities to ensure activities do not adversely affect bird populations in the State.

- Preference is given to non-lethal methods, when practical and effective. If practical and effective non-lethal control methods are not available and if lethal control methods are available and appropriate for WS to implement, WS may implement lethal methods.

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

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

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

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

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

- Personnel would be present during the use of all live-capture methods for birds or those methods would be checked frequently to ensure non-target species are released immediately or are prevented from being captured.

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

- WS has consulted with the USFWS and the AGFC to evaluate activities to resolve bird damage and threats to ensure the protection of T&E species.

- WS would annually monitor activities conducted under the selected alternative, if activities are determined to have no significant impact on the environment and an EIS is not required, to ensure those activities do not negatively impact non-target species

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

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

- Shooting would be conducted professionally and in the safest manner possible. Shooting would be conducted during time periods when public activity and access to the control areas are restricted whenever possible. Personnel involved in shooting operations would be fully trained in the proper and safe application of this method.

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

- All chemical methods used by WS or recommended by WS would be registered with the EPA and the AAD.

- WS would adhere to all established withdrawal times for waterfowl when using immobilizing drugs for the capture of waterfowl that are agreed upon by WS, the USFWS, the AGFC, and veterinarian authorities. Although unlikely, in the event that WS is requested to immobilize waterfowl either during a period of time when harvest of waterfowl is occurring or during a period of time where the withdrawal period could overlap with the start of a harvest season, WS would euthanize the animal. Similarly, the use DRC-1339 would not occur during a period when crows could be harvested during a hunting season.

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

Issue 4 - Effects on the Aesthetic Values of Birds

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

- All methods or techniques applied to resolve damage or threats to human safety would be agreed upon by entering into a cooperative service agreement, MOU, or comparable document prior to the implementation of those methods.

- European starlings and rock pigeons are non-native, invasive species in the State that can cause harm to native flora and fauna. Any reduction in those populations could be viewed as benefiting the aesthetic value of a more native ecosystem.

- Preference is given to non-lethal methods, when practical and effective. If practical and effective non-lethal control methods are not available and if lethal control methods are available and appropriate for WS to implement, WS may implement lethal methods.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- Personnel would be well trained in the latest and most humane devices/methods for removing problem birds.

- WS' personnel would be present during the use of all live-capture methods or would check those methods frequently to ensure birds captured would be addressed in a timely manner to minimize the stress of being restrained.

- WS' use of euthanasia methods would follow those recommended by WS' directives (WS Directive 2.505) and the AVMA (AVMA 2007).

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

Issue 6 – Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

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

- WS' activities to manage damage and threats caused by birds would be coordinated with the USFWS and the AGFC.

- WS' lethal take (killing) of birds would be reported to and monitored by the USFWS and/or the AGFC to ensure WS' take is considered as part of management objectives for those bird species in the State.

- WS would annually monitor bird damage management activities to ensure activities do not adversely affect bird populations in the State.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as those alternatives relate to the issues identified. The following resource values in the State are not expected to be significantly

impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, critical habitats (areas listed in T&E species recovery plans), visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Those resources will not be analyzed further.

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

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

This section analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. Therefore, the proposed action/no action alternative serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The analysis also takes into consideration mandates, directives, and the procedures of WS, the AGFC, the USFWS, and the AAD.

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

A common issue is whether damage management actions would adversely affect the populations of target bird species, especially when lethal methods are employed. WS maintains ongoing contact with the USFWS and the AGFC to ensure activities are within management objectives for those species. WS submits annual bird damage management activity reports to the USFWS. The USFWS monitors the total take of birds from all sources and factors in survival rates from predation, disease, and other mortality data. Ongoing contact with USFWS and the AGFC assures local, state, and regional knowledge of wildlife population trends are considered.

As discussed previously, the analysis for magnitude of impact from lethal take can be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest trend data. Information on bird populations and trends are often derived from several sources including the BBS, the CBC, the Partners in Flight Landbird Population database, published literature, and harvest data.

The alternatives discussed in Chapter 3 were developed in response to the issues identified in Chapter 2. The issue of the potential impacts of conducting the alternatives on the populations of those bird species addressed in this assessment is analyzed for each alternative below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, WS would continue to provide both technical assistance and direct operational assistance to those persons requesting assistance with managing damage and threats associated with birds in the State. WS would employ those methods described in Appendix B in an adaptive approach that would integrate methods to effectively reduce damage and threats associated with birds in the State.

The issue of the effects on target bird species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. Methods employed in an integrated approach to reduce damage and threats are categorized into non-lethal and lethal methods. As part of an integrated approach

to managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

Non-lethal methods can disperse or otherwise make an area unattractive to birds causing damage; thereby, reducing the presence of birds at the site and potentially the immediate area around the site where non-lethal methods are employed. Non-lethal methods would be given priority when addressing requests for assistance (WS Directive 2.101). However, non-lethal methods would not necessarily be employed to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance, has already attempted to disperse birds using non-lethal harassment methods, WS would not necessarily employ those methods again during direct operational assistance since those methods have already been proven to be ineffective in that particular situation. Non-lethal methods are used to exclude, harass, and disperse target wildlife from areas where damage or threats are occurring. When effective, non-lethal methods would disperse birds from the area resulting in a reduction in the presence of birds at the site where those methods were employed. However, birds responsible for causing damage or threats are moved to other areas with minimal impact on those species' populations. Non-lethal methods are not employed over large geographical areas or applied at such intensity that essential resources (*e.g*., nesting locations, food sources) would be unavailable for extended durations or over a wide geographical scope that long-term adverse affects would occur to a species' population. Non-lethal methods are generally regarded as having minimal impacts on overall populations of wildlife since those species are unharmed. The use of non-lethal methods would have no adverse impacts on bird populations in the State.

Lethal methods would be employed to resolve damage associated with those birds identified by WS as responsible for causing damage or threats to human safety only after receiving a request and only after a permit has been issued for the take of the species by the USFWS, when required. The use of lethal methods would therefore result in local population reductions in the area where damage or threats were occurring since birds would be removed from the population. Lethal methods are often employed to reinforce non-lethal methods and to remove birds that have been identified as causing damage or posing a threat to human safety. The use of lethal methods would therefore result in local reductions of birds in the area where damage or threats were occurring. The number of birds removed from the population using lethal methods under the proposed action would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, and the efficacy of methods employed.

Generally, WS only conducts damage management on species whose population densities are high and usually only after they have caused damage. WS' take is monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse impacts to the viability of native species populations (USDA 1997). The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below.

American White Pelican Population Impact Analysis

American white pelicans are known to migrate through and over-winter in Arkansas where aquaculture ponds provide loafing and ideal feeding opportunities. During the spring migration, pelicans can be observed in the State primarily from late March through mid-May with the peak number of pelicans occurring in mid-April (James and Neal 1986). The fall migration period for pelicans in Arkansas occurs from September through October with those pelicans originating from breeding colonies in the Northern Great Plains and the prairie provinces of Canada based on banding data (James and Neal 1986). No known breeding colonies of white pelicans exist in Arkansas. However, non-breeding pelicans have been observed in Arkansas and surrounding States throughout the summer numbering from a few hundred to

2,000 individuals (King 2005). King and Anderson (2005) recently estimated the population of white pelicans to be greater than 157,000 individuals which was an increase from the 109,000 individuals estimated in the 1980s. Recent surveys of pelicans at known breeding colonies in the United States and Canada have shown an increase in the number of breeding pelicans (King and Anderson 2005). However, the emergence and spread of the West Nile virus may have implications on long-term population trends of pelicans due to the susceptibility of pelican chicks to the virus during the breeding season (Sovada et al. 2008).

The number of pelicans observed along routes surveyed during the BBS has increased survey-wide estimated at 2.3% annually from 1966 through 2007 which is statistically significant (Sauer et al. 2008). From 1980 to 2007, the number of pelicans observed along BBS routes has increased annually estimated at 2.9% survey-wide (Sauer et al. 2008). The number of pelicans observed in the State during the CBC has shown a generally increasing trend since 1966 (NAS 2002). Pelicans were not observed consistently in Arkansas during the CBC until 1984 when one pelican was observed. In comparison, 1,109 pelicans were observed during the CBC conducted in the State during 2009 which was the second highest number of pelicans observed in the State during the survey (NAS 2002). The highest number of pelicans observed during the CBC conducted in the State occurred during the 2001 survey when 1,748 pelicans were observed (NAS 2002). Pelicans consistently being observed in the State during the CBC that occurred in the late 1980s (NAS 2002) corresponds with the increasing number of requests for assistance received to alleviate pelican damage at aquaculture facilities in Arkansas, Louisiana, and Mississippi that occurred during the early 1990s (King 1997). During winter surveys conducted along the coastal areas of Louisiana from 1997 through 1999 by King and Michot (2002), the wintering population of pelicans along this area was estimated at 18,000 to 35,000 individuals. Pelicans in Louisiana are likely to pass through Arkansas during their migration northward to nesting grounds. Since no known breeding colonies exist in Arkansas, most damage caused by pelicans occurs by overwintering pelicans and during the migration periods.

American white pelicans are afforded protection from take under the MBTA. However, the take of pelicans can occur when permitted by the USFWS through the issuance of a depredation permit pursuant to the MBTA. The number of pelicans taken by WS and other entities in Arkansas to alleviate damage or threats in accordance with depredation permits is shown in Table 4.1. From FY 2004 through FY 2009, the WS program in Arkansas has lethally taken 104 pelicans with the highest annual take occurring in FY 2008. In addition to lethal take, WS also employed non-lethal methods to disperse 12,486 pelicans in the State from FY 2004 through FY 2009. The highest number of pelicans addressed using non-lethal methods occurred in FY 2008 when 6,190 pelicans were addressed.

Table 4.1 – Number of American white pelicans addressed in Arkansas from FY 2004 to FY 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	1	0	650
2005	2,000	2	552
2006	2,115	0	722
2007	500	30	812
2008	6,190	53	359
2009	1,680	19	738
TOTAL	**12,486**	**104**	**3,833**

[1]WS' take is reported by federal fiscal year

[2]Total take is reported by calendar year and includes WS' take

In addition to the take of pelicans occurring by WS to alleviate damage, additional take also occurs pursuant to the MBTA by other entities through the issuance of depredation permits by the USFWS to those entities. Between 2004 and 2009, a total of 3,833 pelicans have been lethally taken in the State to alleviate damage and threats which is an average of 639 pelicans taken annually. The range of take has been a low of 359 pelicans taken in 2008 to a high of 812 pelicans taken in 2007. WS' overall take from FY 2004 through FY 2009, has represented 2.7% of the total take of pelicans in the State. WS' highest level of take of pelicans occurred in FY 2008 when 53 pelicans were lethally taken. Over 99% of the pelicans addressed by WS in the State from FY 2004 through FY 2009 were non-lethally harassed and dispersed from areas where damage was occurring. Based on requests for assistance received by WS previously and in anticipation of receiving additional requests for assistance, WS could lethally take up to 100 pelicans annually in the State.

The number of pelicans that overwinter or pass through the State during the migration periods is currently unknown. The best available information on the number of pelicans that may migrate through Arkansas is the estimated population that overwinters in Louisiana which has been estimated at 18,000 to 35,000 pelicans (King and Michot 2002). As stated previously, no breeding populations are known to occur in the State and most requests for assistance to manage damage associated with pelicans occurs during the migration periods and during the winter when large groups of pelicans are present in the State. Take to reinforce non-lethal methods is also most likely to occur during those periods of time when pelicans over-winter in Arkansas and as they migrate through the State. Based on the number of pelicans overwintering in Louisiana estimated at 18,000 to 35,000 (King and Michot 2002), WS' take of up to 100 birds would impact approximately 0.3% to 0.6% of the pelicans overwintering and migrating through Arkansas. It is anticipated that WS' actions would have minimal effects on overall pelican populations in the region.

WS' take of pelicans would only occur at levels authorized by the USFWS through the issuance of depredation permits. All take by WS would occur at the discretion of the USFWS; therefore, WS' take would only occur when permitted by the USFWS pursuant to the MBTA.

Double-crested Cormorant Population Impact Analysis

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Hatch and Weseloh 1999). The double-crested cormorant is one of six species of cormorants breeding in North America and has the widest range (Hatch 1995). Double-crested cormorants range throughout North America, from the Atlantic coast to the Pacific coast (USFWS 2003). The current range of cormorants appears to be expanding in North America (Hatch 1995) especially in the northern and eastern portions of their breeding ranges and along their winter range (Hatch and Weseloh 1999). Cormorants are considered a common migrant in the State (James and Neal 1986) with the largest concentrations occurring during the fall and winter months when the winter migrating population is present (James and Neal 1986, USFWS 2003). During the last 20 years, the cormorant population has expanded to an estimated 372,000 nesting pairs; with the population (breeding and non-breeding birds) in the United States estimated to be greater than 1 million birds (Tyson et al. 1999). The USFWS estimated the continental population at approximately 2 million cormorants during the development of the cormorant management FEIS (USFWS 2003). Tyson et al. (1999) found that the cormorant population increased about 2.6% annually during the early 1990s. The greatest increase was in the Interior region which was the result of a 22% annual increase in the number of cormorants in Ontario and those states in the United States bordering the Great Lakes (Tyson et al. 1999). From the early 1970s to the early 1990s, the Atlantic population of cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995). While the number of cormorants in this region declined by 6.5% overall in the early to mid-1990s, some populations were still increasing during this period (Tyson et al. 1999). The number of breeding pairs of cormorants in the Atlantic and Interior population was estimated at over 85,510 and 256,212 nesting

pairs, respectively (Tyson et al. 1999). The breeding population in the southeastern United States, including Arkansas, has been estimated at 10,600 breeding pairs (Hunter et al. 2006).

The wintering population of cormorants in the State is primarily composed of birds from the Interior population (Dolbeer 1991, Jackson and Jackson 1995). Cormorants are opportunistic feeders and often congregate where a food resource is readily available (Hatch and Weseloh 1999). An increase in the number of cormorants observed overwintering in the region has coincided with an increase in aquaculture production in the region (Glahn and Stickley 1995, Glahn et al. 1999*c*, Glahn et al. 2000*a*).

As wintering populations of cormorants increased and as the production of aquaculture resources has increased, the level of economic damage associated with cormorants feeding on fish raised for sale has also increased. For example, the economic damage to aquaculture production in the State of Mississippi just to replace fish eaten by cormorants has been estimated to be $5 million annually based on wintering cormorant population estimates in the late 1990s (Glahn et al. 2000*a*).

Hunter et al. (2006) estimated the number of breeding cormorants in the State at 200 breeding pairs. Currently, there are no estimates of the breeding population of cormorants in the State. No data from the BBS is available for Arkansas (Sauer et al. 2008). Cormorant breeding populations are showing an increasing trend across the United States estimated at 5.1% annually since 1966, which is a statistically significant trend (Sauer et al. 2008). In the southeastern United States, cormorant breeding populations are also showing an increasing trend estimated at 1.7% annually since 1966 (Sauer et al. 2008). The total nesting population of cormorants for the southeastern United States was estimated at over 13,604 nesting pairs (USFWS 2003). The number of cormorants observed during the BBS conducted along routes in the central region of the United States has shown an increasing trend estimated at 12.7% annually since 1966, which is a statistically significant trend (Sauer et al. 2008). The total nesting population of cormorants for the southeastern United States was estimated at over 13,604 nesting pairs (USFWS 2003). The number of cormorants observed during the BBS conducted along routes in the eastern region of the United States has shown an increasing trend estimated at 4.3% annually since 1966, which is a statistically significant trend (Sauer et al. 2008). The number of cormorants overwintering in the State shows a general increasing trend since 1966 (NAS 2002).

The Southeast United States Regional Waterbird Conservation Plan ranks cormorants in the "*population control*" action level which includes those species' populations that are increasing to a level where damages to economic ventures or adverse affects to populations of other species are occurring (Hunter et al. 2006). One of the objectives in the Conservation Plan is to maintain no more than 1,000 breeding pairs of double-crested cormorants in the West Gulf Coastal Plain and Mississippi Alluvial Plain, which includes portions of Arkansas (Hunter et al. 2006). Cormorants are considered a species that "*...may impact either native species or economic interests in portions of the Southeastern U.S. Region for which no increase and potentially population decreases may be recommended*" (Hunter et al. 2006).

To address cormorant damage to aquaculture resources and other resources, the USFWS, in cooperation with WS, prepared a FEIS that evaluated alternative strategies to manage cormorant populations in the United States (USFWS 2003). The selected alternative in the FEIS modified the existing AQDO and established a PRDO that allow for the take of cormorants without the need for a depredation permit when cormorants are committing or about to commit damage to those resource types. The AQDO allows cormorants to be taken in 13 States, including Arkansas, without a depredation permit to reduce depredation on aquaculture stock at private fish farms and state and federal fish hatcheries (50 CFR 21.47). The PRDO allows for the take of cormorants without a depredation permit in 24 states, including Arkansas, when those cormorants cause or pose a risk of adverse affects to public resources (*e.g*., fish, wildlife, plants, and their habitats) (50 CFR 21.48). All other take of cormorants to alleviate damage requires a depredation permit issued by the USFWS.

The cormorant management FEIS developed by the USFWS predicted the number of cormorants taken by authorized entities under the selected alternative would increase by 4,140 cormorants per State, including Arkansas (USFWS 2003). The FEIS predicted the increased take per State evaluated under the selected alternative would result in the authorized lethal take of up to 8.0% of the continental cormorant population (USFWS 2003).

The take of cormorants by all entities to alleviate damage in the State from FY 2004 through FY 2009 are shown in Table 4.2. Since FY 2004, WS has lethally taken 2,760 cormorants in Arkansas to alleviate damage or threats. In addition to the take occurring by WS, the take of cormorants can also occur by other entities under the depredation orders and through the issuance of a depredation permit by the USFWS. The take of cormorants by entities other than WS are also shown in Table 4.2.

Table 4.2 – Number of double-crested cormorants addressed in Arkansas from FY 2004 to FY 2009

Year	Dispersed by WS[1]	Take		
		WS' Take[1]	Depredation Permit[2]	Depredation Order[2]
2004	0	0	2,810	9,255
2005	22,250	688	2,481	7,315
2006	24,955	125	1,327	9,980
2007	11,002	608	1,327	6,804
2008	31,257	766	1,898	5,917
2009	19,345	573	1,921	5,862
TOTAL	**108,809**	**2,760**	**11,764**	**45,133**

[1]WS' take is reported by federal fiscal year

[2]Total take is reported by calendar year and includes WS' take

Since 2004, a total of 56,897 cormorants have been lethally taken under depredation permits or orders in Arkansas to alleviate damage or threats. The highest take level of cormorants occurred in 2004 when 12,065 cormorants were lethally taken in the State. On average, 9,483 cormorants have been lethally taken annually in the State to alleviate damage and threats from 2004 through 2009. A total of 405 cormorant egg and/or nests were destroyed in the State from 2004 through 2009.

During the CBC conducted in 2008-2009, observers counted 9,481 cormorants in the State with 16 counts reporting cormorants which compared to 20,046 cormorants observed on 15 counts in the State during the 2007-2008 survey (NAS 2002). CBC data compiled since the 1999-2000 survey in the State, indicates an average of 12,755 cormorants have been observed during the CBC conducted annually in the State. WS' highest level of cormorant take occurred in FY 2008 when 766 cormorants were taken. Observers counted 20,046 cormorants in the State during the 2008 CBC survey (NAS 2002). WS' take of 766 cormorants in the State in FY 2008 would represent 3.9% of the wintering count of cormorants in the State. CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the State and is not intended to represent population estimates of wintering bird populations. However, the information is presented in this analysis and compared to WS' take to determine the magnitude of take occurring by WS when compared to the number of cormorants observed in the State during the CBC which would be considered a minimum population estimate given the survey parameters of the CBC.

The annual mid-winter roost survey average for the aquaculture region of Arkansas conducted by WS from 2004 through 2010 was 10,282 cormorants (M. Hoy, WS unpublished data). The numbers of cormorants counted during this survey do not represent all of the cormorants that migrate to or through Arkansas in any winter migration period, but only represent the number present at a relatively short

period of time (*i.e.*, over the 24 hour time period in which the survey is conducted) at specific roost locations in the region. Therefore, this survey information is being used as an index to monitor wintering cormorant trends in this specific region of Arkansas over time. The survey is not a complete census of wintering cormorants in the region or the State. The total number of individual cormorants migrating to or through Arkansas over the course of an entire winter migration period is probably much greater. Therefore, the total number of cormorants killed under depredation permits, depredation orders, and/or by WS is probably a much lower proportion of the total wintering population than is suggested by the roost survey totals.

Breeding populations of cormorants in the southeastern United States are on the rise, with the total nesting population for this region estimated at over 13,604 nesting pairs (USFWS 2003). Little is known about historic nesting populations of cormorants in Arkansas. James and Neal (1986) and Jackson and Jackson (1995) report former Arkansas breeding sites in Mississippi and Phillips Counties during the early 1900s, but the last known cormorant nesting is thought to have occurred at Grassy Lake in Hempstead County in 1951. Nesting cormorants were not found again in Arkansas until Mills (1989) reported five nests with young at Millwood Lake on June 24, 1989. Cormorants reestablished a breeding colony on Millwood Lake in the late 1990s and 72 nesting cormorants were documented by WS on the reservoir in 1999. The cormorant rookery continued to grow with 170 active cormorant nests documented on Millwood Lake by WS in 2003. During the summer of 2004, under the authority of the PRDO, WS initiated a cormorant nest suppression program in Arkansas. Since that time, no successful cormorant breeding colonies have been known to exist in Arkansas.

Nationwide, the USFWS predicted that the implementation of the AQDO, PRDO, and the issuance of migratory bird permits would affect approximately 8% of the continental cormorant population on an annual basis (USFWS 2003). Furthermore, the USFWS predicted that authorized take of cormorants and their eggs for the management of double-crested cormorant damage, including those taken in Arkansas, was anticipated to have no significant impact on regional or continental double-crested cormorant populations (USFWS 2003). Cormorants are a long-lived bird and egg addling programs are anticipated to have minimal effects on regional or continental cormorant populations (USFWS 2003).

To alleviate damage and threats of damage in Arkansas, cormorants and their nests can be taken under the PRDO, the AQDO, and under depredation permits issued by the USFWS. The take of cormorants from 2004 through 2008 under the depredation orders and under depredation permits in the 24 States included in the PRDO are shown in Table 4.3. Between 2004 and 2008, an average of 40,403 cormorants have been taken under the two depredation orders and under depredation permits issued by the USFWS, including those cormorants lethally taken in Arkansas. The USFWS (2009) estimated the take of cormorants under the depredation orders and depredation permits involved primarily those cormorants that are considered a part of the Interior cormorant population. Those cormorants found in Arkansas are considered part of the Interior population of cormorants (Tyson et al. 1999).

Table 4.3 – Double-crested cormorant take in the 24 States included in the PRDO

Year	Take by Depredation Order or Permit		Total Take
	PRDO	AQDO and Permits	
2004	2,334	28,651	**30,985**
2005	11,221	25,009	**36,230**
2006	21,428	33,393	**54,821**
2007	19,960	19,405	**39,365**
2008	18,745	21,868	**40,613**

The cormorant management FEIS developed by the USFWS estimated the number of cormorants lethally taken under an alternative implementing a PRDO, an AQDO, and under depredation permits would increase to 159,635 cormorants annually (USFWS 2003). The FEIS determined the lethal take of up to 159,635 cormorants annually under the depredation orders and under depredation permits would impact approximately 8% of the continental cormorant population. As shown in Table 4.3, the annual take of cormorants from 2004 through 2008 has not exceeded 159,635 cormorants in any given year. The highest level of cormorant take occurred in 2006 when 54,821 cormorants were lethally taken which represents 34.3% of the 159,635 cormorants evaluated in the cormorant management FEIS. The FEIS determined an annual take of 159,635 cormorants would be sustainable at the State, regional, and national level (USFWS 2003). The take that has occurred since the implementation of the preferred alternative in the FEIS which implemented the PRDO and modified the existing AQDO, has only reached a high of 34.3% of the level evaluated in the FEIS which determined the higher level of take would not significantly impact cormorant populations. Upon further evaluation, the USFWS determined the implementation of the preferred alternative in the FEIS that has allowed the annual take level of cormorants under the PRDO, the AQDO, and under depredation permits has not reached a level where undesired adverse affects to cormorant population would occur (USFWS 2009). The USFWS subsequently extended the expiration dates of the PRDO and the current AQDO for another five years (USFWS 2009).

In addition, the USFWS determined the destruction of nests allowed under the PRDO, the AQDO, and under permits would not reach a level where an undesired adverse affect on cormorant populations would occur (USFWS 2003). The USFWS further evaluated nest destruction activities from 2004 through 2008 and determined the number of nests destroyed since 2004 and the continued destruction of nests evaluated in the FEIS would not reach a magnitude that would cause undesired declines in cormorant populations (USFWS 2009).

Bird band recovery models have been developed to estimate temporal trends in hatch-year, second-year, and after second-year survival of cormorants banded in the Great Lakes region from 1979 through 2006 (Seamans et al. 2008). The period of time evaluated encompassed the period of rapid cormorant population increase in the Great Lakes, the establishment of the AQDO in 1998 by the USFWS, and the establishment of the PRDO and changes to the AQDO implemented in 2003 by the USFWS. Survival in hatch-year birds decreased throughout the study period and was negatively correlated with abundance estimates for cormorants in the Great Lakes area. The decline may have been related to density-dependent factors. However, there was also evidence that the depredation orders were contributing to the decreasing survival in hatch-year birds. The data was unclear on whether the depredation orders were reducing the survival of second-year or after-second year cormorants even though lethal removal of cormorants in the Great Lakes increased after the implementation of the depredation orders. Seamans et al. (2008) found that the survival rates of second-year and after second-year cormorants did decrease from 2004 through 2006 based on banding data, but survival rates for those two age classes were still within the range observed for previous years. Additional time may be required before the models used by Seamans et al. (2008) detect any changes in mortality rates resulting from the establishment of the PRDO and the modification of the AQDO that occurred in 2003 due to the lag effect.

Blackwell et al. (2000) examined the relationship between the number of fish-eating birds reported killed under depredation permits issued by the USFWS to aquaculture facilities in New York, New Jersey, and Pennsylvania and population trends of those bird species lethally taken within those respective States. Blackwell et al. (2000) found that the USFWS issued 26 depredation permits to nine facilities from 1985 through 1997 allowing the lethal take of eight species of fish-eating birds but only six species were reported killed to reduce aquaculture damage. Those species lethally taken under those permits included black-crowned night herons, double-crested cormorants, great blue herons, herring gulls, ring-billed gulls, and mallards. The number of birds reported killed, relative to systematic long-term population trends, is considered to have had negligible effects on the population status of those species (Blackwell et al. 2000).

As stated previously, the cormorant management FEIS estimated that annual take in each of the 24 States implementing the PRDO to increase to 4,140 cormorants (USFWS 2003). Based on requests received and in anticipation of an increase in the number of requests received, WS anticipates the annual take of cormorants in the State under the PRDO to reach 75% of the 4,140 cormorants take evaluated in the FEIS developed by the USFWS for each State allowed to implement the PRDO or 3,105 cormorants taken by WS annually under the PRDO. Under the AQDO, WS anticipates up to 2,800 cormorants could be lethally taken in the State to address requests for assistance. In addition, up to 5,000 cormorants could be lethally taken annually by WS under depredation permits issued by the USFWS. When combined, WS' total annual take could increase to 10,905 cormorants in the State to alleviate damage and threats. Take by other entities could occur under the PRDO, AQDO, or under depredation permits issued by the USFWS. However, take by other entities is not likely to reach a magnitude that would elevate the cumulative take of cormorants in the State to a level where adverse affects are likely to occur.

If 10,905 cormorants were lethally taken by WS annually in the State, the take would represent 6.8% of the estimated 159,635 cormorants that was evaluated in the cormorant management FEIS which determined an annual take of up to 159,635 would not significantly impact continental cormorant populations. As shown in Table 4.3, the highest level of cormorant take by all entities under the PRDO, the AQDO, and under depredation permits occurred in 2006 when 54,821 cormorants were lethally taken. If WS had lethally taken 10,905 cormorants in 2006, the total cormorant take would have been 65,726 cormorants which would have represented 41.2% of the estimated 159,635 cormorants that were evaluated in the cormorant management FEIS. Therefore, based on the evaluations of the USFWS, the proposed take by WS would not cumulatively affect cormorant populations.

The USFWS, as the agency with migratory bird management responsibility, would impose restrictions on cormorant damage management at the State, regional, and national levels as needed to assure cumulative take does not adversely affect the long-term sustainability of populations. WS would continue to submit to the USFWS annual work plans in accordance with the PRDO which ensures WS' activities are considered as part of population objectives for cormorants in Arkansas.

Anhinga Population Impact Analysis

Anhingas are considered locally common to an uncommon migrant and summer resident in Arkansas with rare occurrences occurring in the extreme southern portions of the State during the winter (James and Neal 1986). Anhingas can be found on swampy oxbow lakes and rivers in the lower region of the Mississippi Alluvial Plain and the Coastal Plain of Arkansas with rare occurrences in the highlands and has been unreported in the Ozark region of the State (James and Neal 1986). Southern Arkansas is considered the northern limit of the breeding range of anhingas (James and Neal 1986) although some sporadic breeding may occur northward along the Mississippi River and Arkansas River (Frederick and Siegel-Causey 2000). Anhingas begin arriving in the State during late-March but most birds arrive at breeding areas in April (James and Neal 1986). Eggs are laid from late April until early June with May being the peak time for egg laying in Arkansas with clutch sizes ranging from two to five eggs (Meanley 1954, James and Neal 1986). Most anhingas have left the State by early October but reports of anhingas being observed in the State during the latter part of November and December (Meanley 1954, James and Neal 1986, NAS 2002).

Meanley (1954) reported 20 to 25 pairs of anhingas were nesting in a mixed species heronry at Swan Lake in Jefferson County, Arkansas from 1951 to 1953. Surveys conducted in 1980 reported anhingas nesting in Hempstead, Lafeyette, and Little River counties with a single nest reported in Drew County (James and Neal 1986). It was noted during the 1980 survey that 15 anhingas and 50 nests with young were observed at Grassy Lake in Hempstead County (James and Neal 1986). Although suffering

population declines due to hunting and habitat loss (James and Neal 1986), the number of anhingas observed along routes surveyed during the BBS has shown increasing trends since 1966. Sauer et al. (2008) estimated the number of anhingas observed during the BBS has increased annually at a rate of 2.4% per year since 1966 in the State. In the southeastern United States, the number of anhinga observed along BBS routes surveyed has increase at a rate of 1.5% annually since 1966 (Sauer et al. 2008). From 1966 through 2007, the number anhinga observed across all routes surveyed in the United States has shown a declining trend estimated at -0.4%; however, from 1980 through 2007, the number of anhinga observed across all routes surveyed has shown an increasing trend in the United States estimated at 0.7% (Sauer et al. 2008). Currently, the breeding population of anhingas in the State is unknown.

Similar to cormorants, anhingas are primarily fish-eating birds (Meanley 1954, James and Neal 1986, Frederick and Siegel-Causey 2000) and requests for assistance often arise when anhingas are observed feeding on fish and other aquatic wildlife at aquaculture facilities in the State. From 2004 through 2009, the USFWS has authorized the take of up to 95 anhingas each year in the State to alleviate damage. A total of 22 anhingas have been reported taken in the State under depredation permits issued by the USFWS. No take of anhingas has occurred by WS in the State from FY 2004 through FY 2009. Since anhingas are known to depredate on aquatic resources in the State, WS could be requested to address damage or threats of damage associated with anhingas in the future. Since anhingas are considered uncommon in the State and requests for assistance to manage damage or threats associated with damage have been limited, WS anticipates requests for assistance would occur on a limited basis in the State. Subsequently, WS could take up to 10 anhingas per year to alleviate damage or threats of damage when requested.

The take of anhingas by WS would only occur when authorized by the USFWS through the issuance of a depredation permit. Therefore, the take of anhingas by WS would only occur when permitted and only at the level allowed under the depredation permit. Therefore, WS' take of anhingas in the State would occur at the discretion of the USFWS which ensures any take by WS and other entities occurs within population objectives for anhingas.

Great Blue Heron Population Impact Analysis

Great blue herons are a common widespread wading bird that can be found throughout most of North America and can be found year-around in most of the United States, including Arkansas (Butler 1992). Great blue herons are considered a common permanent resident across the State (James and Neal 1986). Great blue herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (MANEM Waterbird Plan 2006). Herons are known to nest in trees, rock ledges, and coastal cliffs and may travel up to 30 km to forage with a mean forage distance of 2.6 to 6.5 km (MANEM Waterbird Plan 2006). Great blue herons feed mainly on fish but are also known to capture invertebrates, amphibians, reptiles, birds, and mammals (Butler 1992).

Great blue herons are showing statistically significant increases across all survey routes of the BBS. Since 1966, the number of great blue herons observed survey-wide during the BBS has increased at an annual rate of 1.3% which is a statistically significant increase (Sauer et al. 2008). In Arkansas, herons observed on BBS routes are showing a statistically significant upward trend estimated at 3.5% annually from 1966 through 2007 (Sauer et al. 2008). Herons observed overwintering in Arkansas have shown an increasing trend since 1966 but have shown recent downward trends (NAS 2002). The number of counts reporting great blue herons during CBC surveys increased from nine counts reporting herons to 21 counts reporting herons during the 2006-2007 survey. The number of birds observed has increased from 71 birds observed in 1966 in Arkansas to 761 individuals in 2007 (NAS 2002). The current population of great blue herons is currently unknown in Arkansas.

A survey of great blue herons in Mississippi found that the population peaked in mid-winter as migrant birds arrived (Glahn et al. 1999*d*). The peak population in Arkansas is also likely to occur in mid-winter as birds arrive in the State as they move northward. Glahn et al. (1999*d*) estimated the great blue heron population in the Delta region of Mississippi likely exceeded 25,000 herons based on density surveys conducted at aquaculture facilities in that region. The Delta region of Mississippi lies across the Mississippi River from the aquaculture producing areas of Arkansas. In 2006, the breeding population of great blue herons was estimated at 69,331 breeding pairs or 138,662 adult herons in the southeastern United States (Hunter et al. 2006). The overall population objective for herons in the southeastern United States is 50,000 to 100,000 breeding pairs (Hunter et al. 2006).

To alleviate damage, WS has lethally taken 529 great blue herons in Arkansas and employed non-lethal methods to disperse 17,540 herons from FY 2004 through FY 2009 (see Table 4.4). In addition to the take of herons by WS to alleviate damage or threats, the USFWS has issued depredation permits to other entities for the take of herons. From 2004 through 2009, 17,864 herons were lethally taken in the State by all entities to alleviate damage or threats associated with great blue herons. From FY 2004 through FY 2009, an average of 88 herons have been lethally taken in the State by WS to alleviate damage with an average of nearly 2,977 herons taken by all entities in the State to alleviate damage as permitted by the USFWS through the issuance of depredation permits from 2004 through 2009.

Table 4.4 – Number of great blue herons addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS' Take[1]	Total Take by All Entities[2]
2004	0	0	4,220
2005	1,250	0	3,238
2006	4,066	97	3,010
2007	4,860	183	2,536
2008	4,687	190	2,435
2009	2,677	59	2,425
TOTAL	**17,540**	**529**	**17,864**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

To address request for assistance to manage damage associated with great blue herons in the future, up to 300 herons could be lethally taken annually by WS to alleviate damage and threats. The increased level of take analyzed when compared to the take occurring by WS from FY 2004 through FY 2009 is in anticipation of requests to address threats of aircraft strikes at airports and to reduce damage to natural resources, such as nest site competition between herons and other colonial nesting waterbirds.

The number of great blue herons present in Arkansas at any given time likely fluctuates throughout the year. No breeding or wintering population estimates are available for great blue herons in Arkansas. The average annual take of herons by other entities in the State has been 2,977 herons from 2004 through 2009. If the average annual take of herons by other entities is reflective of take that would occur in the future, the combined WS' take and take by other entities would total 3,277 herons. If the annual take proposed by WS of up to 300 herons are included with the highest heron take that occurred by all entities of 4,220 herons, the total would be 4,520 herons lethally taken in the State.

From 2004 through 2009, WS has addressed nearly 3,000 great-blue herons annually using non-lethal methods. Based on the estimated population of great blue herons in the Delta region of Mississippi, WS' take of up to 300 herons would result in a reduction of 1.2% of herons estimated to be in the region. The population of herons in the aquaculture region of Arkansas, Mississippi, and Louisiana is likely greater

since the estimate of herons provided by Glahn et al. (1999*d*) only estimates herons in the Delta region of Mississippi.

Great Egret Population Impact Analysis

Great egrets are large white birds of intermediate size between the larger herons and smaller egrets commonly found in the United States (Mccrimmon, Jr. et al. 2001). Great egrets can be found in freshwater, estuarine, and marine wetlands (Mccrimmon, Jr. et al. 2001). In Arkansas, great egrets are considered a local summer resident in the southern regions of the State and is considered a regular transient in the State (James and Neal 1986). During the winter, great egrets are considered irregular visitors in the lowland regions of the State (James and Neal 1986). During the spring migration, great egrets begin arriving in the State around mid-March through May with most nesting records occurring from late March to mid-July with peak nesting occurring in April, May, and June (James and Neal 1986). The fall migration period begins in July with most egrets migrating out of the State by September (James and Neal 1986).

The overharvest of great egrets that occurred primarily from 1870 to 1910 for plumes and the millinery trade reduced the population in North American by >95% (Mccrimmon, Jr. et al. 2001). During surveys conducted in 1911-1912, the total known nesting population of great egrets was estimated at 1,000 to 1,500 breeding pairs in 13 colonies in seven States (Mccrimmon, Jr. et al. 2001). Following regulations that ended plume-hunting, great egret populations rapidly recovered with increases reported in the late 1920s and 1930s (Mccrimmon, Jr. et al. 2001). Similar fluctuations in great egret populations occurred in Arkansas with the number of egrets present in the State increasing during the 1940s and 1950s; however, populations in the State again began to decline rapidly in the 1970s likely due to the conversion of lowland habitats to agricultural uses and the widespread use of organochloride pesticides (James and Neal 1986, Hunter 2006). However, populations of great egrets appear to be recovering. Since the initiation of the BBS in 1966, the number of egrets observed along routes surveyed in Arkansas has shown an increasing trend estimated at 4.7% annually which is a statistically significant upward trend (Sauer et al. 2008). From 1980 to 2007, the number of great egrets observed in the State during the BBS has shown an increasing trend estimated at 4.5% annually (Sauer et al. 2008). Across all BBS routes surveyed in the United States, the number of great egrets observed during the survey has shown an increasing trend estimated at 2.3% annually since 1966 (Sauer et al. 2008). The number of great egrets observed in areas surveyed during the CBC in the State has also shown a general increasing trend since 1966 (NAS 2002). However, trending information indicates great egrets overwintering in Arkansas can be cyclical. Great egrets were not observed on CBC surveys until 1972 where five were noted (NAS 2002).

Of the five tiers of action levels for waterbirds in the southeastern United States, great egrets were assigned to the planning and responsibility tier which includes birds that require some level of planning to maintain sustainable populations in the region (Hunter et al. 2006). The planning and responsibility tier is the second lowest tier in terms of action priority ahead of only the last tier which includes those waterbirds that are considered above management levels and could require population management (Hunter et al. 2006). The North American Waterbird Conservation Plan classifies the great egret in a category of conservation concern considered as not currently at risk (Kushlan et al. 2002).

Like other waterbirds addressed in this assessment, great egrets can cause damage to aquaculture resources through consuming aquatic wildlife raised for sale and from the threats associated with disease transmission between aquaculture ponds and facilities. To address damages and threats associated with great egrets, the USFWS has issued depredation permits pursuant to the MBTA that allow the take of egrets to manage damage and threats. The total take of great egrets per year under depredation permits issued by the USFWS from 2004 through 2009 are shown in Table 4.5. The take of great egrets by WS to alleviate damage and threats are also shown in Table 4.5 along with the number of great egrets dispersed

by WS to alleviate damage or threats of damage using non-lethal methods. On average, nearly 2,700 egrets have been lethally taken in the State annually to alleviate damage or threats of damage. The highest level of take occurred in 2004 when 3,204 egrets were lethally taken in the State by all entities. WS' highest level of take also occurred in FY 2004 when 211 egrets were taken to alleviate damage and threats of damage. WS' take of great egrets has declined annually between FY 2004 and FY 2008 while the number of egrets addressed using non-lethal methods has increased between FY 2004 and FY 2009. WS has dispersed 11,378 great egrets in the State between FY 2004 and FY 2009. Based on previous and current levels of take by WS to alleviate damage and threats of damage associated with great egrets, WS anticipates that up to 200 great egrets could be lethally taken by WS in the State to manage damage and threats.

Table 4.5 – Number of great egrets addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	211	3,204
2005	350	155	2,752
2006	2	106	2,783
2007	2,935	77	2,311
2008	3,191	38	2,430
2009	4,900	41	2,507
TOTAL	**11,378**	**628**	**15,987**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

The population of great egrets in Arkansas likely fluctuates throughout the year and is likely highest during migration periods. Nesting and winter populations of great egrets are currently unknown in Arkansas. Glahn et al. (1999*d*) estimated the great egret population in the Delta region of Mississippi to be 18,000 egrets based on density surveys at aquaculture facilities in that region of Mississippi. As mentioned previously, the Delta Region of Mississippi lies between the border of Mississippi and Arkansas across the Mississippi River. Aquaculture production in Arkansas occurs in a similar geographical location as the aquaculture industry in Mississippi. Since the number of great egrets present in Arkansas at any given time is unknown and the best available information for populations of egrets was derived from an area that lies within close proximity to the area where damage management activities in Arkansas would likely occur, the population estimate for the Delta Region of Mississippi was used. The number of egrets present in the aquaculture producing region of Arkansas and Mississippi is likely greater than 18,000 egrets since the estimate provided by Glahn et al. (1999*d*) only included the Delta Region of Mississippi. In addition, given the close proximity of the Delta Region of Mississippi to the aquaculture producing areas of Arkansas, it is likely the egrets present in the Delta Region of Mississippi could be present in Arkansas since movement between foraging sites could occur. Based on the estimated population in the aquaculture producing region of Mississippi, WS' take of up to 200 egrets would remove an estimated 1.1% of the egret population in the aquaculture producing region along the Mississippi River.

Like other migratory birds addressed in this assessment, the take of great egrets by WS would only occur at the discretion of the USFWS and only at levels permitted by the USFWS. Therefore, all take by WS to alleviate damage or threats associated with great egrets would be evaluated pursuant to the objectives of the MBTA.

Snowy Egret Population Impact Analysis

Snowy egrets are medium-sized herons with entirely white plumage and characteristic black legs with bright yellow feet (Parsons and Master 2000). Snowy egrets feed on a wide range of invertebrate and vertebrate species, including earthworms, annelid worms, shrimp, prawns, crayfish, snails, freshwater and marine fish, frogs, toads, snakes, and lizards (Parsons and Masters 2000). In Arkansas, snowy egrets are considered uncommon migrants and post-breeding season visitors across the State (James and Neal 1986). The egret is also an uncommon local summer resident that nests in small numbers in mixed-species heronries in the lowlands region of the State and the Arkansas River Valley (James and Neal 1986). The spring migration period for snowy egrets begins in late-February and concludes in mid-May with the peak period occurring in March and April (Parson and Masters 2000). In Arkansas, migrants begin arriving in the spring from late-March until the middle of May (James and Neal 1986). The fall migration period begins in mid-July and extends into mid-November with peak periods occurring from August through October (Parson and Masters 2000). Nesting begins in March with eggs being laid from mid-March through early-July. Nestlings are present in nests from mid-April until the first part of August with the peak occurring from early-May through mid-July (Parson and Masters 2000).

Similar to great egrets, snowy egrets were sought for their plumage to meet demands for the millinery trade in the late-1800s and early-1900s. After the passage of laws that ended plume hunting, populations of snowy egrets began to rebound and appeared to expand their breeding range in the United States (Parson and Masters 2000). Since 1966, the number of snowy egrets observed along routes surveyed during the BBS has increased at an estimated rate of 4.7% annually with a 4.9% annual increase observed from 1980 to 2007 which is a statistically significant increase (Sauer et al. 2008). In the southeastern United States, the number of snowy egrets observed across all routes surveyed during the BBS has also shown a statistically significant increasing trend estimated at 5.3% from 1966 through 2007 (Sauer et al. 2008). The number of snowy egrets observed in Arkansas during the BBS has fluctuated since 1966. From 1966 through 2007, the number of egrets observed in the State during the BBS has shown a declining trend estimated at -4.9% annually; however, from 1980 through 2007, the number of snowy egrets observed along routes surveyed during the BBS has shown an increasing trend estimated at 3.1% annually in the State (Sauer et al. 2008).

Hunter et al. (2006) placed snowy egrets in the southeastern United States into the planning and responsibility action level which is the second lowest tier in action priority. The waterbird conservation for the Americas plan ranks snowy egrets as a species of high concern in the Western Hemisphere (Kushlan et al. 2002). Species of high concern are those species that are not highly imperiled but populations of those species are known or thought to be declining and have some known or potential threat in addition to the declining population trends (Kushlan et al. 2002). Known or potential threats could include habitat degradation and loss along with competition for nest sites with cattle egrets which share similar habitat requirements (Burger 1978, Parsons and Master 2000, Hunter et al. 2006). The Arkansas Natural Heritage Commission considered the breeding population of snowy egrets as a "*Watch List Species*" with the breeding population assigned a State ranking of "*S2*" indicating the presence of breeding snowy egrets is very rare in the State with typically between 5 and 20 estimated occurrences; therefore, the species may be of conservation concern in the State (Arkansas Natural Heritage Commission 2010). Those designations do not afford the species any additional protection in the State but simply reflects the limited distribution of the species in the State during the breeding season.

Snowy egrets have also been identified as causing damage to aquaculture resources (Hoy et al. 1989, Parsons and Master 2000). Large mixed species flocks of herons and egrets, including snowy egrets, are commonly found around baitfish ponds in Arkansas from July through September each year during the migration period (Hoy et al. 1989). Damage primarily occurs in the State during the migration periods when snowy egrets are present in the State in higher numbers than compared to number of snow egrets

present in the State during the breeding season. Snowy egrets tend to wander northward from their breeding areas based on banding information (James and Neal 1986). For example, snowy egrets banded in Mississippi during the breeding season were found in Arkansas 58 to 185 miles north of where they were banded (James and Neal 1986).

To alleviate damage and threats of damage, the USFWS has previously issued depredation permits to manage damage and threats associated with snowy egrets in the State. The number of snowy egrets reported as taken pursuant to depredation permits issued by the USFWS is shown in Table 4.6. Between 2004 and 2009, an average of 255 snowy egrets has been reported taken pursuant to depredation permits issued by the USFWS. WS' take of snowy egrets in the State to address damage and threats pursuant to depredation permits from FY 2004 through FY 2009 are also shown in Table 4.6 along with the number of snowy egrets addressed by WS using non-lethal methods. As shown in the table, WS' annual take of snow egrets to address damage or threats of damage has declined annually between FY 2005 and FY 2008 while the number of egrets addressed using non-lethal methods has increased between FY 2004 through FY 2009. Based on requests for assistance received by WS previously, up to 50 snowy egrets could be taken annually in the State by WS pursuant to depredation permits issued by the USFWS to alleviate damage and threats.

Table 4.6 – Number of snowy egrets addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	32	299
2005	0	37	210
2006	2	15	242
2007	200	10	224
2008	50	1	244
2009	150	3	311
TOTAL	**402**	**98**	**1,530**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

Currently, there is limited information on snowy egret populations in Arkansas. The NAS currently estimates the continental population of snowy egrets at 1,365,000 egrets and has assigned a watchlist status of "*green*" for snowy egrets which is the lowest priority category (NAS 2007). Based on a continental population estimated at 1,365,000 egrets, the take of up to 20 snowy egrets by WS annually to alleviate damage and threats in the State would represent 0.001% of the continental population. As stated previously, take by WS primarily occurs during the fall migration periods when the number of birds present in the State is likely higher when compared to the breeding population since birds are likely dispersing northward into the State before migrating to wintering areas along the coastal areas of the Gulf of Mexico. The number of snowy egrets observed in the State during the breeding season since 1980 appears to be increasing in the State (Sauer et al. 2008). The number of snowy egrets observed during the breeding season in the southeastern United States and across all routes surveyed in the central BBS region are also showing increasing trends since 1966 (Sauer et al. 2008). Given the increasing breeding population trends observed in the State and across the United States and the limited number of snowy egrets that could be taken annually by WS to alleviate damage and threats, the magnitude of take by WS could be considered low. The permitting of the take by the USFWS also ensures take by WS and take by other entities does not adversely affect snowy egret populations.

Little Blue Heron Population Impact Analysis

Little blue herons are unique among heron species in exhibiting two color morphs between first-year immature herons which exhibit white plumages while adults show slate-blue plumages (Rodgers and Smith 1995). Little blue herons are opportunistic feeders that feed on a variety of small fish, small amphibians and invertebrates in various shallow freshwater and marine wetland habitats (Rodgers and Smith 1995). In Arkansas, little blue herons are considered a common transient across the State and a summer resident that nests locally on major lakes and rivers, primarily in the lowlands region of the State and the Arkansas River Valley (James and Neal 1986). During the winter, little blue herons are considered a rare and irregular visitor in the southern lowlands of the State (James and Neal 1986).

Little blue herons begin arriving in the State during the spring migration in mid-March which continues into late-April with peak numbers occurring in late-March (James and Neal 1986). Nest building begins shortly after birds arrive with peak periods occurring in late-March and early-April. Dispersal from nesting colonies begins in May with most heronries abandoned by late-August (James and Neal 1986). Similar to snowy egrets, little blue herons appear to disperse northward from breeding colonies. For example, of 37 birds banded in nests from States adjacent to Arkansas, most bands were recovered in the State with distance traveled being approximately 100 miles north of the banding site with one band recovered 234 miles from the banding site (James and Neal 1986). By late-September and early-October, most little blue herons have left the State for wintering grounds along the coast of the Gulf of Mexico (James and Neal 1986).

Similar to other colonial waterbirds, limited information is currently available on the status of little blue herons in Arkansas and elsewhere. Since 1966, the number of little blue herons observed in the State along routes surveyed during the BBS has shown a declining trend estimated at -4.5% annually; however, since 1980 the number of little blue herons observed in the State during the BBS has shown an increasing trend estimated at 2.0% annually (Sauer et al. 2008). In the southeastern United States, the number of little blue herons observed across all routes surveyed during the BBS has shown a declining trend estimated at -2.2% since 1966 which is a statistically significant trend (Sauer et al. 2008). A similar trend has been observed for little blue herons across all routes surveyed in the United States estimated at -2.6% which is also a statistically significant trend (Sauer et al. 2008). The North American Waterbird Conservation Plan ranked the little blue heron as a species of "*high concern*" in the Western Hemisphere (Kushlan et al. 2002). The Watchlist developed by the NAS currently assigns a "*green*" ranking for little blue herons which is the lowest priority ranking. The Arkansas Natural Heritage Commission currently includes the little blue heron on the Watch List and has assigned a State rank of "*S2*" indicating the species breeds in very small numbers or breeds in Arkansas in substantial numbers but are showing declining trends.

One of the recommended conservation priorities listed in the Southeast United States Regional Waterbird Conservation Plan is to increase populations of little blue herons in the region and to evaluate the take of little blue herons for damage management purposes on maintaining stable breeding populations of little blue herons (Hunter et al. 2006). The Plan places the little blue heron into an "*immediate action*" category due to declines across the range of the species in the United States (Hunter et al. 2006). The cause of the decline is likely due to habitat loss but other factors could also be contributing to the declines, including competition with cattle egrets (Hunter et al. 2006). One recommendation in the Plan is to evaluate the impacts that cattle egrets have on nesting little blue herons (Hunter et al. 2006). Another objective of the Plan is to increase the number of breeding pairs of little blue herons from approximately 57,000 pairs to approximately 75,000 breeding pairs across the southeastern United States. In the Mississippi Alluvial Valley (Bird Conservation Region 26) that includes parts of Arkansas, the objective is to increase the breeding pairs to approximately 22,500 pairs. The current population estimated for little blue herons in the Mississippi Alluvial Valley is 16,800 breeding pairs with

approximately 2,000 breeding pairs occurring in Arkansas (Hunter et al. 2006). In the West Gulf Coastal Region (Bird Conservation Region 25), which also includes parts of Arkansas, the objective is approximately 13,500 breeding pairs of little blue herons. The current population in the West Gulf Coastal Region is estimated at 10,650 breeding pairs of little blue heron with an estimated 4,000 breeding pairs occurring in Arkansas (Hunter et al. 2006).

As with other colonial waterbirds, the food habits of little blue herons includes feeding on small fish and invertebrates which has lead to requests for assistance to manage damage and threats of damage at aquaculture facilities in the State. To address damage and threats occurring at aquaculture facilities in the State, the USFWS has issued depredation permits to take little blue herons. The number of little blue herons lethally taken to address damage and threats in the State from 2004 through 2009 is shown in Table 4.7. The number of little blue herons addressed by WS to reduce damage at aquaculture facilities in the State from FY 2004 through FY 2009 is also shown in Table 4.7. On average, a total of 381 little blue herons have been lethally taken in the State by all entities to alleviate damage to agricultural resources pursuant to depredation permits issued by the USFWS. WS has lethally taken a total of 54 little blue herons from FY 2004 through FY 2009 which is an average of nine herons per year. The number of little blue herons lethally taken by WS has declined every year since FY 2005 with no herons addressed in FY 2008 and FY 2009. Based on previous requests for assistance, WS could be requested to lethally take up to 50 little blue herons annually in the State to alleviate damage and threats of damage.

Table 4.7 – Number of little blue herons addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	16	378
2005	75	24	563
2006	0	8	392
2007	600	6	364
2008	0	0	451
2009	0	0	134
TOTAL	**675**	**54**	**2,282**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

Based on information in the Southeast United States Regional Waterbird Conservation Plan, a statewide breeding population in Arkansas could be estimated at approximately 6,000 breeding pairs which equates to 12,000 little blue herons and does not include non-breeders that could be present in the State. If WS' annual take of little blue herons reached 50 herons and the breeding population remains relatively stable, WS' take would represent 0.4% of the estimated statewide breeding population. WS' annual take from FY 2004 through FY 2009 has been a minimal component of the overall take of little blue herons in the State. If the take of herons by all entities remains stable at an average of 381 herons lethally taken per year and the breeding population remains relatively stable in the State, the annual take of up to 381 herons would represent 3.2% of the estimated breeding population. Since little blue herons show a tendency to disperse northward shortly after the nestlings have fledged, the take of little blue herons that breed outside of the State is likely what lowers the representative take herons that breed in Arkansas. The number of herons lethally taken annually that could have nested outside of the State is unknown. Therefore, WS' proposed take and take by other entities in the State is not likely to reach a magnitude that adverse affects would occur to the breeding population in the State. The permitting of the take by the USFWS ensures cumulative take does not reach a magnitude that adverse affects would occur.

Tricolored Heron Population Impact Analysis

Tricolored herons breed primarily along the immediate coastal areas of the Atlantic Ocean and the Gulf of Mexico in the United States with nesting occurring in coastal estuaries, salt marshes, mangrove swamps, river deltas, lagoons, and Salinas. Tricolored herons appear to prefer saltwater habitats over freshwater habitats (Frederick 1997). Some sporadic nesting has been documented occurring at interior locations (Frederick 1997). Tricolored herons are considered rare and irregular summer residents in Arkansas with a few breeding attempts occurring in the lowland region of the State and is considered a rare transient in the rest of the State (James and Neal 1986). Other sightings of tricolored herons in the State have occurred from late-June to early-November and involved only a few individuals with the high number documented being seven tricolored herons (James and Neal 1986).

Across all routes surveyed in the United States during the BBS, the number of tricolored herons observed has remained stable since 1966 with a slight increase in the number of herons observed across all routes in the United States estimated at 0.7% between 1980 and 2007 (Sauer et al. 2008). In the Central BBS Region, the number of tricolored herons observed along survey routes has increased 6.4% annually since 1966 which is a statistically significant increasing trend (Sauer et al. 2008). The Southeast United States Regional Waterbird Conservation Plan currently ranks tricolored herons in the second lowest action plan which is considered the "*Planning and Responsibility*" level. The "*Planning and Responsibility*" level contains those waterbird species where some planning to maintain sustainable populations may be required (Hunter et al. 2006).

Small fish comprise more than 90% of the tricolored heron's diet with insects, crustaceans, and frogs taken when superabundant (Frederick 1997). The increases in aquaculture production in the southeastern United States could be benefiting wintering populations of tricolored herons (Frederick 1997). Given the sporadic appearance of tricolored herons in the State, very few requests for assistance have been received by WS to address damage or threats. Only one tricolored heron has been lethally taken in the State to address damage or threats of damage between FY 2004 through FY 2009. No other take has occurred by WS or other entities in the State.

Based on the limited distribution of tricolored herons in the State and the limited number of requests received by WS to address damage associated with tricolored herons, it is anticipated that up to five tricolored herons could be taken annually in the State to alleviate damage or threats of damage when requested. The MANEM Regional Waterbird Plan indicates the breeding population of tricolored herons in North America is less than 194,000 herons (MANEM Regional Waterbird Plan 2006) which does not include non-breeding tricolored herons. Based on a breeding population of 194,000 tricolored herons in North America, the take of up to five tricolored herons in Arkansas to alleviate damage or threats of damage would constitute 0.003% of the breeding population.

Based on the limited take proposed by WS and the permitting of the take by the USFWS ensures, the take of tricolored herons by WS to alleviate damage or threats of damage would be of low magnitude when compared to the overall breeding population.

Cattle Egret Population Impact Analysis

The cattle egret is a relatively new arrival to the North American continent with the first record for the continental United States occurring in south Florida in 1941 (Telfair II 2006). The first record of the cattle egret in Arkansas occurred in 1962 (James and Neal 1986). Today, cattle egrets can be found across much of North America, including Arkansas (Telfair II 2006, Sauer et al. 2008). As their name implies, cattle egrets are closely associated with cattle where they forage on invertebrates disturbed by

foraging livestock, primarily grasshoppers, crickets, and flies (Telfair II 2006). Cattle egrets are also known to consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2006).

Cattle egrets form gregarious nesting colonies, or heronries, generally in medium to tall upland trees found in woodlands, swamps, and wooded islands adjacent to water. However, proximity to water is not a requirement of egret nesting sites with many heronries located in or near residential areas (Telfair II 2006). The accumulation of guano under heronries can defoliate and kill vegetation (Wiese 1979, Telfair II 1983) which can cause herons to abandon nest sites and create heronries in other areas (Telfair II 2006). Telfair II and Bister (2004) noted that the composition of vegetation under heronries rapidly changed within two- to three-years after the establishment of a cattle egret heronry in Texas due to large concentrations of feces. Egret heronries located near airports also pose a threat from the potential for egrets being struck by aircraft which can cause damage to property and threaten passenger safety.

In Arkansas, cattle egrets are considered a common to fairly common migrant and summer resident across the State with birds primarily found in the lowlands and Arkansas River Valley. In winter, cattle egrets are considered irregularly visitors in the southern portions of the State (James and Neal 1986). Cattle egrets begin arriving in the State during the spring migration in February and March in the southern portions of the State and begin moving into more northerly areas around mid-March and early-April with nesting occurring in early May (James and Neal 1986). Most cattle egrets have migrated out of the State by mid-October with sporadic records of cattle egrets occurring in the state during the winter, mainly in the southern portion of the State (James and Neal 1986).

The breeding population of cattle egrets in Arkansas is currently unknown. BBS data indicates the number of egrets observed in the State during the breeding season has increased annually at an estimated rate of 5.7% since 1966 which is a statistically significant increasing trend (Sauer et al. 2008). In the southeastern United States, the number of egrets observed during the BBS are showing a declining trend estimated at -0.6% annually since 1966 (Sauer et al. 2008). The total population of cattle egrets in North America has been estimated to range from 750,000 to 1,500,000 egrets (MANEM Regional Waterbird Plan 2006). The Southeast United States Regional Waterbird Conservation Plan ranks cattle egrets in the "*population control*" action level meaning those species' populations are increasing to a level where damages to economic ventures or adverse affects to populations of other species are occurring (Hunter et al. 2006). The increases in populations and the range expansion exhibited by cattle egrets have been attributed to the species broad use of terrestrial habits relative to other waterbirds (Hunter et al. 2006, Telfair 2006). Cattle egrets have also been implicated as contributing to the declining trends of little blue herons and snowy egrets given the aggressive behavior exhibited by cattle egrets and the use of similar nesting habitats (Burger 1978, Hunter et al. 2006, Telfair II 2006). The cattle egret population in the southeastern Bird Conservation Regions has been estimated at approximately 350,000 breeding pairs with nearly 70,000 breeding pairs occurring in the West Gulf Coastal Plain and approximately 35,000 breeding pairs occurring in the Mississippi Alluvial Plain, both of which include parts of Arkansas (Hunter et al. 2006). The Conservation Plan calls for the reduction of cattle egret populations in the southeastern Bird Conservation Regions to less than 200,000 breeding pairs of cattle egrets with 40,000 breeding pairs in the West Gulf Coastal Plain and 35,000 breeding pairs in the Mississippi Alluvial Plain which encompass parts of Arkansas. Therefore, the Plan calls for reducing the cattle egret population by 300,000 egrets in the southeastern United States (Hunter et al. 2006). In the West Gulf Coastal Plain and Mississippi Alluvial Plain which includes those egrets nesting in Arkansas, the Plan calls for reducing the cattle egret breeding population by 60,000 egrets (Hunter et al. 2006).

Similar to other bird species addressed in this assessment, the take of cattle egrets is prohibited under the MBTA unless a depredation permit has been issued by the USFWS pursuant to the Act. The number of cattle egrets taken by all entities in Arkansas as permitted by the USFWS to alleviate damage and reduce threats is shown in Table 4.8. As shown in Table 4.8, the take of cattle egrets by entities other than WS

has occurred from 2004 through 2009. Since FY 2004, WS has not provided direct operational assistance to address damage or threats associated with egrets in the State. Other entities have lethally taken 27 cattle egrets in the State to alleviate damage and threats from 2004 through 2009.

If the number of requests for assistance increases and the number of egrets addressed to manage those requests increase, the lethal take of egrets could also increase under the proposed action along with an increase in the use of non-lethal methods. The use of non-lethal methods is generally regarded as having no effect on bird populations since those birds addressed are only dispersed to other areas and the disturbance is not widespread enough to cause adverse affect to reproduction or survivability that would result in population declines. If the number of requests for assistance to manage damage and threats associated with cattle egrets increases, WS could take annually up to 20 cattle egrets in the State.

Table 4.8 – Number of cattle egrets addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	0
2005	0	0	10
2006	0	0	10
2007	0	0	4
2008	0	0	3
2009	0	0	0
TOTAL	**0**	**0**	**27**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

As was stated previously, the objective of the Waterbird Conservation Plan for the Southeastern United States is to reduce the breeding population of cattle egrets. In those Bird Conservation Regions where cattle egrets are found in Arkansas, the Plan calls for a reduction of nearly 60,000 egrets. A take of up to 20 egrets annually by WS would represent 0.03% of the population reduction of 60,000 egrets. If the objective of the Plan is met, a take of up to 20 egrets would represent 0.01% of the estimated 150,000 breeding cattle egrets in those Bird Conservation Regions that encompass parts of Arkansas.

Since the take of cattle egrets is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits, WS' take of up to 20 cattle egrets annually in the State would only occur when authorized by the USFWS through the issuance of a depredation permit. Therefore, the number of egrets taken annually by WS in the State would be at the discretion of the USFWS based on allowable harvest levels and population information.

Green Heron Population Impact Analysis

Green herons are a small, compact heron characterized by its secretive nature (Davis and Kushlan 1994). In Arkansas, green herons are considered a common migrant and summer resident statewide where appropriate habitat exists. Green herons can be found nesting and foraging along streams and lakes in the State (James and Neal 1986). Green herons begin arriving in the State in late-March with nesting activity being documented from April to early-August (James and Neal 1986). Unlike many waterbird species, green herons are primarily solitary nesters with some documented records of small colonies occurring (James and Neal 1986, Davis and Kushlan 1994). Nest sites in Arkansas are characterized by thickets of small trees, such as willows along streams and lakes but have included woodlots or cedar groves away from water (James and Neal 1986). Large groups of herons can be found in the State after the breeding season from mid-July through early-September with a few records occurring in the State from late-

October through December (James and Neal 1986). During the fall migration periods, large groups of herons can be found around fish ponds and fish hatcheries in the State (James and Neal 1986).

The number of green herons present in the State during the migration periods and during the breeding season is currently unknown. Information from populations of green herons in the State from direct counts is currently not available, primarily due the secretive and solitary nesting behaviors of green herons (Hunter et al. 2006). The breeding population of green herons in those Bird Conservation Regions found in Arkansas has been estimated at 29,133 breeding pairs with a range of 10,000 to 50,000 in the Mississippi Alluvial Valley and 39,867 breeding pairs in the West Gulf Coastal Plain Bird Conservation Region with a range of 10,000 to 50,000 breeding pairs (Hunter et al. 2006). The Conservation Plan set a population objective for green herons in the West Gulf Coastal Plain at 52,000 to 78,000 breeding pairs and a population objective of 36,000 to 54,000 breeding pairs in the Mississippi Alluvial Valley (Hunter et al. 2006).

The number of herons observed in the State along routes surveyed during the BBS has shown a declining trend since 1966 estimated at -1.0% and a -2.1% downward trend from 1980 through 2007 (Sauer et al. 2008). In the southeastern United States, the number of green herons observed during the BBS has also shown a declining trend estimated at -1.7% which is a statistically significant decline with a declining trend estimated at -2.8% in the southeastern United States from 1980 through 2007 (Sauer et al. 2008). However, the data quality rating for data used to derive trends associated with green herons in the southeastern United States that was assigned by Sauer et al. (2008) indicates important deficiencies in the data exist that may prevent accurate trend estimates. The trend for the number of green herons observed along routes in the southeastern United States during the BBS has deficiencies likely due to the heron's secretive nature and lack of vocalizations. The North American Waterbird Conservation Plan ranked the green heron as a species of low concern in North American (Kushlan et al. 2002). The Conservation Plan for the Southeastern United States placed the population of green herons into a category that included species requiring "*management attention*" (Hunter et al. 2006).

Like other waterbird species, green herons feed primarily on fish species but their diet can include other vertebrate aquatic species and invertebrates depending on availability (Davis and Kushlan 1994). Requests for assistance to manage damage and threats associated with green herons are often associated with their feeding on aquaculture resources when herons are congregated in large numbers during the fall migration periods at aquaculture facilities in the State. WS has been requested to reduce damage caused by green herons at aquaculture facilities in Arkansas. The number of green herons addressed by WS from FY 2004 through FY 2009 during direct operational assistance is shown in Table 4.9. In addition to WS' take, take by other entities in Arkansas also occurs pursuant to depredation permits issued by the USFWS. The number of green herons reported as lethally taken in the State from 2004 through 2009 is also shown in Table 4.9.

From 2004 through 2009, nearly 175 green herons have been lethally taken in the State on average to alleviate damage. From FY 2004 through FY 2009, WS' take has represented 5.1% of the overall take of green herons in the State. However, no green herons were lethally taken by WS from FY 2007 through FY 2009 in the State. As part of an integrated approach to managing damage, WS has also dispersed 350 green herons in the State to alleviate damage and threats using non-lethal methods. Based on previous requests for assistance, up to 25 green herons could be lethally taken in the State by WS to alleviate damage or threats of damage. If WS had taken 25 green herons annually in the State from FY 2004 through FY 2009 and if the number of green herons lethally taken by other entities in the State remains relatively stable, the average annually take would have been 200 green herons which is an increase of 14.3% above the actually average annual take of green herons of 175 herons that occurred from 2004 through 2009.

Table 4.9 – Number of green herons addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	24	133
2005	300	10	125
2006	0	19	123
2007	0	0	140
2008	50	0	213
2009	0	0	314
TOTAL	**350**	**53**	**1,048**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

The number of breeding pairs of green herons in the Mississippi Alluvial Plain and the West Gulf Coastal Plain has been estimated at 69,000 breeding pairs or 138,000 green herons (Hunter et al. 2006). The number of green herons that breed in Arkansas is currently unknown. Based on a breeding population of 138,000 herons, WS' proposed take would represent 0.02% of the breeding population in those Bird Conservation Regions. If an average of 200 green herons is taken annually in the State by all entities, the take would represent 0.1% of the breeding population.

As with other bird species addressed in this assessment, the take of green herons by WS only occurs after a depredation permit has been issued by the USFWS and only at take levels designated on the permit. Therefore, take only occurs by WS and other entities at the discretion of the USFWS.

Black-crowned Night Heron Population Impact Analysis

Black-crowned night herons are common in North America and can be found breeding on all continents except Australia and Antarctica (Davis, Jr. 1993). Similar to other heron species, black-crowned night herons feed primarily on fish and are gregarious nesters (Davis, Jr. 1993). Damage or threats associated with night herons primarily occur from economic losses to aquaculture facilities. Night herons can also cause damage by denuding vegetation under heronries and the threats associated with aircraft strikes when nesting, roosting, or foraging near airports.

Black-crowned night herons are considered a local summer resident in the lowlands and are a common migrant across the State (James and Neal 1986). Black-crowned night herons begin arriving in the State in early-March and continue through April. Nesting occurs from April until mid-July in the State with nests often located mixed in with other waterbird species (James and Neal 1986). The fall migration begins in the State from July through mid-October where groups of herons are often observed. There are a few records of night herons being present in the State during December and January (James and Neal 1986). Similar to other waterbirds, the number of birds present in the State during the migration periods or during the breeding season is limited. Although black-crowned night herons are known to be present in the State during the breeding season, no BBS trend data is currently available for the State (Sauer et al. 2008). Sauer et al. (2008) indicates the data collected for the black-crowned night heron in many states has important deficiencies that may prevent accurate interpretation of the results. This deficiency is likely a result of the inconspicuous nature of night herons, especially during the nesting season which makes accurate counts difficult (Davis, Jr. 1993). In the southeastern United States (USFWS Region 4), the number of night-herons observed along routes surveyed during the BBS has shown a declining trend estimated at -12.2% annually from 1966 through 2007 which is a statistically significant trend; however,

from 1980 through 2007, the number of black-crowned night herons observed during the BBS in the southeastern United States has shown an increasing trend estimated at 2.4% annually (Sauer et al. 2008).

The North American Waterbird Conservation Plan classified the black-crowned night heron as a species of "*moderate concern*" across North America and associated oceanic regions (Kushlan et al. 2002). The Southeastern Waterbird Conservation Plan classified the black-crowned night heron as a species requiring "*management attention*" and that the breeding populations of black-crowned night herons could be experiencing steep declines in the southeastern United States (Hunter et al. 2006). The breeding population in the Mississippi Alluvial Valley has been estimated at 1,000 breeding pairs and the breeding population in the West Gulf Coastal Plain has been estimated at 667 breeding pairs with the regional population estimated at 7,333 breeding pairs (Hunter et al. 2006). However, those population estimates provided by Hunter et al. (2006) were derived from BBS data which was assigned a data quality ranking that indicated the data had important deficiencies that could prevent the accurate interpretation of the results from the BBS data (Sauer et al. 2008) and is considered as a "*very poor*" way of deriving population data for night herons but is currently the best available information for which to derive population estimates (Hunter et al. 2006). Data is deficient primarily due to the secretive and nocturnal behavior of black-crown night herons which makes conducting direct count surveys difficult. The population objective for the southeastern United States is 9,000 to 20,000 breeding pairs of black-crowned night herons with approximately 810 to 1,800 breeding pairs in the West Gulf Coastal Plain and 1,260 to 2,800 breeding pairs in the Mississippi Alluvial Valley (Hunter et al. 2006).

Requests for assistance to manage damage associated with black-crowned night herons have been received previously by WS in Arkansas. Requests for assistance to manage damage associated with night herons occurs primarily from aquaculture producers due to economic losses associated with herons feeding on aquaculture stock which can cause economic losses. To address damage and threats of damage, the USFWS has issued depredation permits to WS and to other entities in the State to address predation and other damage caused by black-crowned night herons. As with other native bird species, the take of black-crowned night herons is prohibited unless authorized by the USFWS through the issuance of depredation permits pursuant to the MBTA. The number of black-crowned night herons lethally taken in the State through the issuance of depredation permits is shown in Table 4.10.

From FY 2004 through FY 2009, WS has lethally taken nine black-crowned night herons in the State to alleviate damage and threats of damage. WS did not receive requests for direct operational assistance to manage damage associated with black-crowned night herons in Arkansas from FY 2007 through FY 2009. From 2004 through 2009, a total of 301 black-crowned night herons have been lethally taken in the State to alleviate damage or threats which is an average of 51 herons lethally taken annually. WS' take of black-crowned night herons from FY 2004 through FY 2009 has represented 3.0% of the total known take of black-crowned night herons in the State.

Based on previous requests for assistance received to manage damage caused by night herons, up to 10 black-crowned night herons could be lethally taken by WS to alleviate damage and threats annually in the State. As was stated earlier, no take of black-crowned night herons would occur by WS in Arkansas unless authorized by the USFWS through the issuance of a depredation permit pursuant to the MBTA. Therefore, any take by WS would occur at the discretion of the USFWS in consideration of the take level allowable for the species. The permitting of the take by the USFWS ensures WS' take of black-crowned night herons is below a level that would cause undesirable adverse affects on heron populations in the State.

Table 4.10 – Number of black-crowned night herons addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	1	47
2005	0	3	54
2006	0	5	49
2007	0	0	32
2008	0	0	56
2009	0	0	63
TOTAL	**0**	**9**	**301**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

From 2004 through 2009, an average of 51 black-crowned night herons has been lethally taken in the State to alleviate damage and threats of damage. If WS had lethally taken 10 black-crowned night herons each year from 2004 through 2009, the average annual take would have increased to 61 herons. Based on the current population estimated in those areas where night herons are known to breed in Arkansas, the average total take of 61 herons would have represented 1.8% of estimated breeding population.

Yellow-crowned Night Heron Population Impact Analysis

Yellow-crowned nigh herons can be found in wooded swamps, lakes, and stream bottomlands across the State during the migration periods and during the summer breeding season (James and Neal 1986). Birds begin arriving in the State during the spring migration primarily in April and continue until early-May at which time birds begin nesting in the State. The nesting season begins in April and continues through June in the State (James and Neal 1986). Yellow-crowned night herons begin staging in large groups during mid-July with most birds migrating out of the State by mid-October (James and Neal 1986).

Similar to black-crowned night herons, yellow-crowned night herons are primarily active at night and during early dawn and dusk during low-light conditions. Yellow-crowned night herons are also somewhat solitary and secretive. Nesting normally occurs in small colonies and rarely with other waterbirds with nest sites restricted to areas near water (Watts 1995). Yellow-crowned night herons feed on fresh- and saltwater crustaceans along water margins (Watts 1995). In Arkansas, requests for assistance to manage damage or threats of damage occur primarily from heron feeding behavior and the economic losses that can occur from excessive feeding on readily available food sources that aquaculture facilities can provide (Hunter et al 2006).

The number of yellow-crowned night herons found within the State during the migration periods and during the breeding season is currently unknown. Similar to other night herons, the secretive behavior of yellow-crowned night herons makes direct count surveys difficult to conduct. The best available information on trends that could be occurring in Arkansas is the BBS. Like black-crowned night herons, population estimates for yellow-crowned night herons have been derived from BBS data but the data quality rating has been assigned a low ranking by Sauer et al. (2008) which indicates the data may be insufficient to accurately determine trends or population estimates. However, the BBS data and the population estimates derived from the BBS are the best available information for the species in Arkansas.

In the Western Hemisphere, the North American Waterbird Conservation Plan has labeled the yellow-crown night heron as a species of "*moderate concern*" (Kushlan et al. 2002). Yellow-crowned night herons have also been assigned an action level ranking of "*management attention*" in the southeastern United States (Hunter et al. 2006). Populations of yellow-crowned night herons are also showing

declining trends in certain areas. The number of yellow-crowned night herons observed in the State during the BBS has shown a declining trend estimated at -3.3% annually from 1966 through 2008 with a -13.4% downward trend estimated during the BBS conducted in the State from 1980 to 2007 (Sauer et al. 2008). In the southeastern United States (USFWS Region 4), the number of yellow-crowned night herons observed across all BBS routes has shown an increasing trend estimated at 1.6% annually from 1966 through 2007; however, from 1980 through 2007, the number of yellow-crowned night herons observed have shown a declining trend estimated at -0.5% annually (Sauer et al. 2008). The breeding population in the West Gulf Coastal Plain has been estimated at 1,100 breeding pairs using BBS data with 12,050 breeding pairs of herons estimated in the Mississippi Alluvial Valley with the regional population estimated at 21,300 breeding pairs (Hunter et al. 2006). A population objective for yellow-crowned night herons in the southeastern United States has been set at 40,000 to 60,000 breeding pairs with 2,000 to 3,000 breeding pairs occurring in the West Gulf Coastal Plain area and 22,800 to 34,200 breeding pairs occurring in the Mississippi Alluvial Valley (Hunter et al. 2006).

Since yellow-crowned night herons feed on small fish and crustaceans, damage and threats occur primarily to the baitfish and crayfish industries in the State. From FY 2004 through FY 2009, the WS program in Arkansas did not receive requests for direct operational assistance to alleviate damage or threats associated with yellow-crowned night herons in the State. As shown in Table 4.11, a total of 140 yellow-crowned night herons have been lethally taken in the State pursuant to depredation permits issued by the USFWS which is an average of nearly 24 herons taken annually in the State.

Table 4.11 – Number of yellow-crowned night herons addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	17
2005	0	0	17
2006	0	0	16
2007	0	0	13
2008	0	0	14
2009	0	0	63
TOTAL	**0**	**0**	**140**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

Since yellow-crowned night herons are known to predate on small fish and crustaceans in the State, WS could be requested to assist with managing damage or threats of damage associated with yellow-crowned night herons in the State. The number of yellow-crowned night herons that could be addressed by WS annually if requested would be variable. Under the proposed action, WS could lethally take yellow-crowned night herons to alleviate damage using those methods described in Appendix B of this EA. If damage or threats of damage are addressed using lethal methods, WS anticipates that up to 10 yellow-crowned night herons could be lethally taken in the State to address those requests for assistance. If WS had lethally taken 10 herons each year from 2004 through 2009 and if the number of herons lethally taken to address damage remains relatively stable in the State, the average annual take of yellow-crowned night herons in the State would increase to nearly 34 herons.

With a breeding population estimated at 26,300 herons in the Mississippi Alluvial Valley and the West Gulf Coastal Plain Bird Conservation Regions, which include those areas in Arkansas where herons are known to nest, the lethal take of up to 34 herons annually would represent 0.1% of the breeding population if the breeding population remains relatively stable in those two Conservation Regions.

Black Vulture Population Impact Analysis

Historically in North America, black vultures occurred in the southeastern United States, Texas, New Mexico, and parts of Arizona (Wilbur 1983). Black vultures have been expanding their range northward in the eastern United States (Wilbur 1983, Rabenhold and Decker 1989). Black vultures are considered local residents in the United States (Parmalee and Parmalee 1967, Rabenhold and Decker 1989); however, some populations will migrate (Eisenmann 1963 cited from Wilbur 1983). Black vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Black vultures typically feed by scavenging but occasionally take live prey, especially newborn livestock (Brauning 1992). Black vultures have been reported to live to 25 years of age (Henny 1990).

Black vultures are considered a permanent resident in Arkansas. Due to recent range expansion, black vultures are now commonly found throughout the State but are more common in livestock production regions. Nesting occurs in the State during March and April. Although considered a permanent resident in the State, some movement of vultures does occur. For example, three black vultures banded in Louisiana during the winter months were later found in subsequent winter months due north in southeastern Arkansas near the Mississippi River, traveling 219 to 289 miles north (James and Neal 1986). Large winter vulture roosts have been observed in the State and usually include black vultures and turkey vultures (James and Neal 1986).

According to BBS trend data provided by Sauer et al. (2008), the number of black vultures observed in the State during the breeding season has increased at an annual rate of 8.6% from 1966 through 2007, which is a statistically significant increase. During this same time period, the number of black vultures observed in the southeastern United States (USFWS Region 4) during the BBS has also increased at an annual rate of 2.8%, which is also a statistically significant increase (Sauer et al. 2008). Black vultures overwintering in the State have shown a general increasing trend since 1966 (NAS 2002). Rich et al. (2004) estimated the statewide black vulture population at 3,000 vultures based on BBS data available from surveys conducted in the State.

The data quality rating assigned by Rich et al (2004) for the population estimate for black vultures in the State indicates that the population estimates for vultures is poor in Arkansas due to high variance on BBS counts, low sample size, and/or due to other species-specific limitations of BBS survey methods. Population estimates calculated by Rich et al. (2004) were derived from BBS data for individual species using detectability factors developed for each species. BBS survey data is derived from surveyors identifying bird species based on visual and auditory cues of birds at stationary points. Vultures produce very few auditory cues that would allow for identification (Buckley 1999) and thus, surveying for vultures is reliant upon visual identification. For visual identification to occur during surveys, vultures must be either flying or visible while roosting. Coleman and Fraser (1989) estimated that vultures spend 12% to 33% of the day in summer and 9% to 27% of the day in winter flying. Most vultures during surveys are counted while flying since counting at roosts can be difficult due to obstructions limiting sight and due to the constraints of boundaries used during the surveys, especially the BBS survey since observers are limited to counting only those bird species within a quarter mile of a survey point. Bunn et al. (1995) reported vulture activity increased from morning to afternoon as temperatures increased. Therefore, surveys for vultures should occur later in the day to increase the likelihood of vultures being observed by surveyors. Observations conducted for the BBS are initiated in the morning since mornings tend to be periods of high bird activity. Since vulture activity tends to increase from morning to afternoon when the air warms and vultures can find thermals for soaring, vultures are probably under-represented in BBS data. The limitations associated with surveying for vultures under current BBS guidelines is the likely cause of the poor data quality ratings assigned by Rich et al. (2004) for the populations estimates of black

vultures in Arkansas. Given the limitations of current survey protocols, populations of vultures in Arkansas are likely much higher than currently derived from survey data.

The number of black vultures addressed by WS and other entities are shown in Table 4.12. From FY 2004 through FY 2009, WS has lethally taken three black vultures in the State to alleviate damage and threats. In addition, WS has employed non-lethal harassment methods to disperse 613 vultures in the State to address requests for assistance to manage damage. A total of 816 black vultures have been lethally taken in the State under depredation permits issued by the USFWS.

Table 4.12 – Number of black vultures addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	123
2005	500	1	205
2006	0	0	164
2007	105	2	146
2008	1	0	81
2009	7	0	97
TOTAL	**613**	**3**	**816**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

BBS trend data for the number of black vultures observed in the State along routes surveyed appears to be increasing. CBC data also appears to indicate increasing population trends in the State. Based on the increasing number of black vultures in the State during the breeding and winter season, the number of requests to assist with damage or threats of damage associated with black vultures received by WS is also likely to increase in the State. Based on the increasing trends and the possibility of receiving more requests for assistance, WS anticipates that up to 25 black vultures could be lethally taken annually in the State to address those requests for assistance.

As shown in Table 4.12, a total of 816 black vultures have been taken in the State from 2004 through 2009 to alleviate damage which is an average of 136 vultures taken annually by all entities. Based on a stable population trend that is at least stable, the take of up to 25 black vultures annually by WS would represent 0.8% of the estimated statewide population of black vultures. If the number of black vultures taken by other entities in the State remains similar to the number of black vultures taken from 2004 through 2009 and if 25 vultures were taken by WS annually, the annual take of vultures would be 161 vultures which would represent 5.4% of the estimated statewide population if the population remains at least stable.

Previous levels of lethal take has not reduced the number of breeding black vultures in the State based on the increasing number of black vultures observed during the BBS conducted in the State. Similar to the other native bird species addressed in this assessment, the take of vultures can only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take ensures the cumulative take of black vultures annually occurs within allowable take levels to achieve desired population objectives for the species. Therefore, the take of vultures by WS would only occur at levels permitted by the USFWS through the issuance of depredation permits.

Turkey Vulture Population Impact Analysis

Turkey vultures can be found throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenhold and Decker 1989). Turkey vultures can be found in virtually all habitats but it is most abundant where forest is interrupted by open land (Brauning 1992). Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Walsh et al. 1999). Turkey vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Turkey vultures prefer carrion but will eat virtually anything, including insects, fish, tadpoles, decayed fruit, pumpkins, and recently hatched heron and ibis chicks (Brauning 1992). Turkey vultures have been reported to live up to 16 years of age (Henny 1990).

Turkey vultures are considered a common to fairly common permanent resident across the State except for the northeastern lowlands (James and Neal 1986). The spring migration period occurs from March through April in the State with the breeding season occurring from April through June (James and Neal 1986). From September through November, turkey vultures have been observed migrating southward in the State (James and Neal 1986).

The statewide population of turkey vultures is currently unknown but has been estimated at 18,000 turkey vultures based on BBS data (Rich et al. 2004). Trending data from the BBS indicates the number of turkey vultures observed along BBS routes in the State have shown an increasing trend estimated at 0.4% annually in the State from 1966 through 2007 (Sauer et al. 2008). The number of turkey vultures observed in the State from 1980 through 2007 has also shown an increasing trend estimated at 2.9% annually (Sauer et al. 2008). The number of turkey vultures observed in the southeastern United States (USFWS Region 4) has also shown increasing trends estimated at 1.9% annually from 1966 through 2007 which is a statistically significant trend (Sauer et al. 2008). The number of turkey vultures observed during the CBC conducted annually in the State is also showing an increasing trend (NAS 2002).

The take of turkey vultures is also prohibited under the MBTA except when authorized pursuant to the Act through the issuance of depredation permits issued by the USFWS. The number of turkey vultures addressed in Arkansas by all entities to alleviate damage is shown in Table 4.13. From FY 2004 through FY 2009, the WS program in Arkansas has lethally taken four turkey vultures in the State and employed non-lethal methods to disperse 63 turkey vultures to alleviate damage. Overall, 130 turkey vultures have been lethally taken from 2004 through 2009 by all entities in the State pursuant to depredation permits issued by the USFWS. From 2004 through 2009, an average of 22 turkey vultures has been lethally taken in the State by all entities to alleviate damage pursuant to depredation permits.

Table 4.13 – Number of turkey vultures addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	29
2005	0	1	22
2006	0	0	35
2007	0	3	10
2008	54	0	10
2009	9	0	24
TOTAL	**63**	**4**	**130**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

Based on trending data from the BBS and the CBC, the number of turkey vultures present in the State continues to increase annually. Based on current population trends for turkey vultures in the State, the number of requests for assistance with managing damage associated with turkey vultures in the State and the number of vultures addressed to meet those requests is also likely to increase. Therefore, based on previous requests for assistance and in anticipation of an increasing number of requests and the subsequent need to address more vultures, up to 25 turkey vultures could be lethally taken annually by WS to alleviate damage and threats in the State.

If up to 25 turkey vultures were taken annually by WS, WS' take would represent 0.1% of the estimated statewide population of turkey vultures estimated at 18,000 vultures if the population remains at least stable. From 2004 through 2009, all entities have lethally taken 130 vultures which is an average of 22 vultures taken annually. If the take by other entities remains at least stable, the cumulative take of vultures annually by all entities would be 47 vultures. The cumulative take of vultures would represent 0.3% of the statewide population if the population remains at least stable. The permitting of the take by the USFWS pursuant to the MBTA ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for turkey vultures in the State.

Canada Goose Population Impact Analysis

There are four primary migratory routes in North America, each of which has a Flyway Council governing migratory game bird management. Those councils are comprised of representatives from member States and Canadian Provinces, and they make recommendations to the USFWS on management of migratory bird populations. The flyway system is divided into four administrative units; the Atlantic, Mississippi, Central, and Pacific Flyway Councils. The State of Arkansas is considered part of the Mississippi Flyway Council designated for the management of migratory birds, including Canada geese.

The WS program has received requests for assistance to manage damage and threats to human safety associated with Canada geese throughout the State of Arkansas, where there are two behaviorally distinct types of Canada goose populations: resident and migratory.

Resident Canada Geese

Canada geese are considered residents when one of the following criteria are met: 1) nests and/or resides on a year round basis within the contiguous United States; 2) nests within the lower 48 States in the months of March, April, May, or June; or 3) resides within the lower 48 States and the District of Columbia in the months of April, May, June, July, and August (Rusch et al. 1995, Ankney 1996, USFWS 2005). Giant Canada geese (*Branta canadensis maxima*) are the principal subspecies that nest in the Mississippi Flyway. The Mississippi Flyway Council defines giant Canada geese as geese nesting in states comprising the Mississippi Flyway as well as Canada south of latitude 50° N in Ontario and 54° N in Manitoba (Mississippi Flyway Council Technical Section 1996). Giant Canada geese were nearly extirpated from the Mississippi Flyway by the early 1930s (Mississippi Flyway Council Technical Section 1996). The historical nesting range of giant Canada geese included only small portions of Arkansas with few giant Canada geese nesting in the State prior to the 1980s (Hanson 1965, Mississippi Flyway Council Technical Section 1996). Nesting prior to the 1980s only occurred in the extreme northeastern corner of the State (Hanson 1965). The AGFC began introducing giant Canada geese into the State during 1981 to enhance hunting and viewing opportunities (Mississippi Flyway Council Technical Section 1996). From 1981 to 1990, approximately 4,750 giant Canada geese were released in western Arkansas with approximately 4,200 geese released into the Arkansas River valley (Mississippi Flyway Council Technical Section 1996). Therefore, those geese present in Arkansas during the breeding season are giant Canada geese and are considered resident geese in the State (USFWS 2005).

Resident Canada geese become sexually mature and breed at two to three years of age and have a relatively high nesting success compared to migrant Canada geese (USFWS 2005). The highest concentration of breeding Canada geese in Arkansas occurs in the Arkansas River valley and near the White River Lakes along the border with Missouri, but birds can be observed throughout the State (Mississippi Flyway Council Technical Section 1996, Sauer et al. 2008). Resident Canada geese primarily nest from March through May each year. Resident Canada geese molt, and are flightless, from mid-June through mid-July each year in Arkansas. Molting is the process whereby geese annually replace their primary and secondary flight (wing) feathers (Welty 1982). Portions of a flock of geese can be flightless from about one week before and two weeks after the primary molt period due to the asynchronous molting by individual birds. Non-breeding resident Canada geese which have failed nesting attempts sometimes move to other areas in late spring prior to molting (Nelson and Oetting 1998).

The first management plans for Canada geese in the Mississippi Flyway were developed in 1996, to help manage harvest and manage human/goose conflicts. The Mississippi Flyway Giant Canada Goose Management Plan outlines the main goals relating to Canada geese in the Mississippi Flyway (Mississippi Flyway Council Technical Section 1996). There are three main subject areas covered in the Plan as those subject areas relate to population management focusing on population objectives, harvest management, and population control.

Population objectives as outlined in the management plan are to maintain a population of approximately 1 million giant Canada geese, as measured by coordinated spring surveys, distributed in the Flyway in proportion to state and provincial objectives. Harvest objectives are to provide maximum harvest opportunity for giant Canada geese that is consistent with the population objectives identified in the Plan, the objectives for other Canada geese populations in the Flyway, and the control of over-abundant goose populations in areas with high human/goose conflicts. Population management objectives involving Canada geese were to manage local populations of giant Canada geese where they create conflicts such as endangering human health or safety, damaging crops, damaging habitats important to other wildlife populations, or creating other injurious or nuisance situations which would occur at the discretion of the state or provincial wildlife agency and with the concurrence of the respective federal wildlife agencies (Mississippi Flyway Council Technical Section 1996).

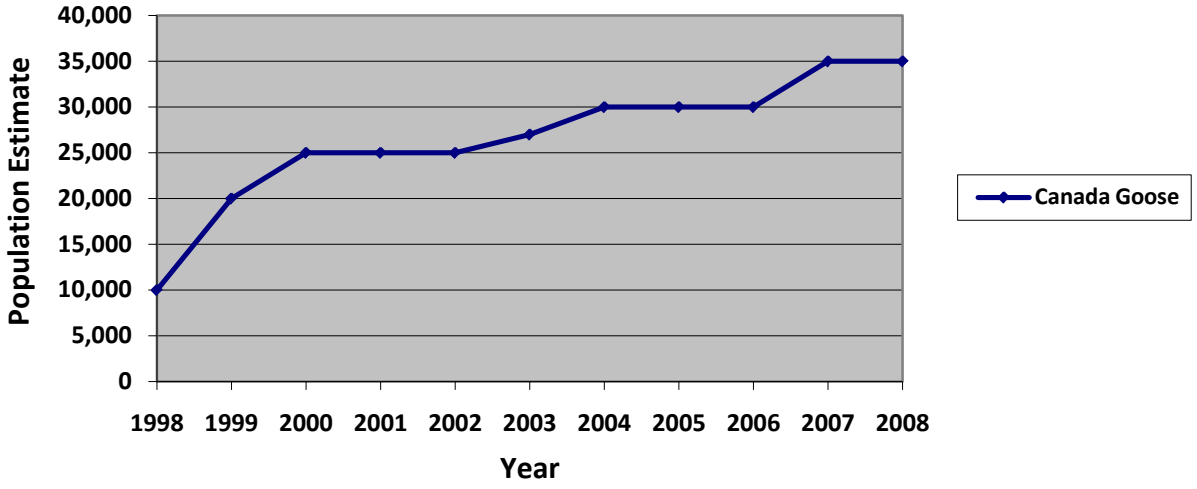
During the development of the FEIS evaluating management strategies for the resident Canada goose population, the USFWS estimated the resident Canada goose population at 3.2 million birds in the United States; which was approximately 30% to 35% above the number the States believed to be acceptable based on their needs to manage conflicts and problems caused by resident Canada geese (USFWS 2005). In the Mississippi Flyway, resident Canada geese were nearly extirpated by the early 1930s through overexploitation and habitat loss. Resident Canada goose restoration efforts began in the 1980s by federal, state, local and private entities and are the foundation of the increasing population trends observed currently (Mississippi Flyway Council Technical Section 1996).

Spring surveys conducted in 2005 indicated there were 1.58 million birds in the Mississippi Flyway, which is similar to the 2002-2004 final estimates of approximately 1.60 million birds (for both the United States and Canada). The survey conducted in 2008 estimated the Canada goose population in the Mississippi Flyway at 1.7 million geese which was 5% higher than the 2007 final estimate (Mississippi Flyway Council 2008). As reported by the BBS, resident breeding populations of Canada geese in Arkansas have increased 4.0% per year from 1966 through 2007 (Sauer et al. 2008). Spring estimates indicate that the Mississippi Flyway Giant Canada goose population has increased at approximately 5% per year since 1996 (USFWS 2005). The population management goal for resident Canada geese in Arkansas is 25,000 geese (USFWS 2005). The population estimate for resident Canada geese in Arkansas for 2008 was 35,000 geese (Mississippi Flyway Council 2008) which exceeds the management goal by nearly 40%.

As discussed previously, Canada geese are considered resident in the State when nesting and/or residing on a year round basis within the State, when nesting in the State during the months of March, April, May, or June, or residing in the State during the months of April, May, June, July, and August (Rusch et al. 1995, Ankney 1996, USFWS 2005). The majority of Canada geese present in the State are resident geese, not migratory. Those birds reside in Arkansas year around, and fly short distances between their summer and wintering grounds. Most requests for assistance received by WS occur under the criteria where geese present in the State are considered resident.

The annual population estimates for resident Canada geese in the State from 1998 through 2008 are shown in Figure 1. In 1998, the resident goose population in the State was estimated at 10,000 geese. In 2008, the resident goose population was estimated at 35,000 geese in the State (Mississippi Flyway Council 2008). The resident Canada goose population estimate in the State has increased 250% since 1998. As resident goose populations have increased across the United States, including the resident population in Arkansas, the number of requests for assistance to manage damage associated with geese has also increased (USFWS 2005). Under the selected alternative in the resident Canada goose FEIS developed by the USFWS, several mechanisms were established to allow the States to further manage resident goose populations and goose damage (USFWS 2005). An additional mechanism in place to address increasing resident goose populations was increased opportunities to address resident geese during regulated hunting seasons.

Figure 1 - Resident Canada goose population estimates in Arkansas, 1998-2008



As was discussed previously in this EA, Canada geese can be harvested during regulated seasons in the State. Under frameworks developed by the USFWS, the AGFC allows Canada geese to be harvested during a September hunting season, the regular waterfowl season, and during a late Canada goose season. To manage increasing populations of resident geese across their range, the USFWS established a framework that allowed the States to implement a harvest season in September which was intended to target resident geese specifically. During the September hunting season in 2008, an estimated 4,600 geese were harvested statewide (Raftovich et al. 2010). In 2009, the USFWS currently estimates that 2,300 geese were harvested in the State (Raftovich et al. 2010). During the regular waterfowl season, an estimated 6,900 geese were harvested in the State during 2008 compared to 23,900 geese harvested in the 2009 (Raftovich et al. 2010). The USFWS estimates no geese were harvested in the State during the late goose season in 2008 and 2009 (Raftovich et al. 2010).

The take of geese under the depredation orders discussed previously that allow for the take of Canada geese once certain conditions have been met must be reported to the USFWS. Therefore, the cumulative impacts of the proposed action on resident Canada geese populations are based upon the anticipated WS' take, hunter harvest, and authorized take by other entities (*e.g.*, agricultural producers, municipalities, homeowners associations, airports). The cumulative take of geese in Arkansas from 2004 through 2009 is shown in Table 4.14.

Most requests for assistance received by WS to address damage caused by Canada geese occurs during those months when geese present in the State are considered resident. Therefore, WS' take will be analyzed here as if all birds taken were resident geese. Distinguishing resident and migratory geese is not possible through visual identification. However, based on those requests received and the type of damage occurring, those geese addressed by WS from FY 2004 through FY 2009 were likely resident geese (present in the State all year).

WS lethally removed a total of 52 Canada geese in Arkansas from FY 2004 through FY 2009. WS' take of six geese in FY 2006 would represent 0.02% of the estimated statewide population of geese in Arkansas during 2006. The take of 46 geese by WS in FY 2007 represented 0.1% of the estimated statewide population in 2007 of 35,000 geese. In addition, WS has addressed resident Canada geese using non-lethal methods. WS dispersed 3,523 geese from FY 2004 through FY 2009 to alleviate damage and threats in the State. Despite WS' take of geese in the State, the statewide population of resident geese continues to increase.

Table 4.14 – Cumulative Take of Canada Geese in Arkansas from 2004 through 2009

Year	WS' Take[1]	Hunter Harvest			Depredation Take[2]	Total Take
		September	Regular	Late		
2004	0	0	10,100	0	0	**10,100**
2005	0	0	20,000	0	0	**20,000**
2006	6	0	39,900	0	0	**39,906**
2007	46	6,900	9,700	0	0	**16,646**
2008	0	4,600	6,900	0	8	**11,508**
2009	0	2,300	23,900	0	40	**26,240**
TOTAL	**52**	**13,800**	**110,500**	**0**	**48**	**124,400**

[1]WS' take is reported by federal fiscal year

[2]Data provided by the USFWS (M. Outlaw, USFWS pers. comm. 2010).

From 2004 through 2009, a total of 13,800 geese were harvested in the State during the September hunting season intended to target resident populations of Canada geese. The take of 6,900 geese during the September season in 2007 represented 19.7% of the estimated statewide population of geese. Based on a statewide population of 35,000 geese, the take of 2,300 geese during the September season in 2009 represented 6.6% of the estimated population. The cumulative take of geese in 2007, if all geese taken were resident geese, would represent 47.6% of the estimated resident population.

WS' take of geese to alleviate damage since FY 2004 represent 0.04% of the total take of geese that has occurred in the State since 2004. WS' take of geese to alleviate damage has been a minor component of the total number of geese taken in the Sate during the regulated harvest season and the take of geese under depredation permits or depredation orders. Resident goose populations in the State continue to increase despite the take of geese by WS to alleviate damage, take during the regulated hunting seasons, and the take of geese under the depredation orders and depredation permits. The resident goose population goal

for Arkansas is 25,000 geese (USFWS 2005). The 2008 resident goose population in the State was estimated at 35,000 geese which exceeds the population goal by 40%.

Under the proposed action, the nests and/or eggs of resident Canada geese could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, up to 20 nests could be destroyed annually by WS. WS' take of nests, including any associated eggs, would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests and/or eggs would not exceed 20 nests annually and would not exceed the level permitted under depredation permits. Since FY 2004, no nests or eggs have been destroyed by WS in Arkansas to alleviate goose damage.

Impacts due to nest and egg removal and destruction should have little adverse impact on the resident goose population in Arkansas. Nest and egg destruction methods are considered non-lethal when conducted before the development of an embryo. Additionally, geese are a long lived species and have the ability to identify areas with regular human disturbance and low reproductive success which causes them to relocate and nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected, this activity has no long term effect on breeding adult geese. Nest and egg removal is not used by WS as a population management method. This method is used by WS to inhibit nesting in an area experiencing damage due to the nesting activity and is employed only at the localized level. The resident Canada goose management FEIS developed by the USFWS concluded that a nest and egg depredation order would have minimal impacts on goose populations with only localized reductions in the number of geese occurring (USFWS 2005).

Label requirements of OvoControl® G restrict the application of the product to urban areas which limits the extent of the products use for reducing localized waterfowl populations. Based on current information, WS' use or recommendation of nicarbazin formulated under the trade name OvoControl® G would not adversely affect goose populations in Arkansas since WS' activities would not be additive to those activities that could occur in the absence of WS' use of the product. Given that the effects of nicarbazin are only temporary if birds are not fed an appropriate dose of nicarbazin daily, the reduction in the population could be fully reversed if treated bait is no longer supplied and other conditions (*e.g.*, food, disease) are favorable for population growth.

Based upon past requests for WS' assistance and in anticipation of receiving additional requests for assistance, WS anticipates that no more than 50 resident Canada geese would likely be killed by WS in Arkansas annually under the proposed action. WS anticipates the number of requests to address damage associated with resident Canada geese would increase at airports, municipal parks, golf courses, public beaches, and other public use areas where geese congregate. All take of geese by WS occurs under depredation permits issued by the USFWS. Therefore, the take of geese by WS is considered as part of the management objectives for geese in the State and across the flyway.

Based on the 2008 resident goose population estimate in the State of 35,000 geese, the take of 50 geese by WS would represent less than 0.1% of the estimated statewide population. Therefore, if the resident Canada goose population in the State remains at least stable, WS' take of up to 50 geese annually would not exceed 0.1% of the estimated population. Since 1998, survey data of resident goose populations in the State indicate the population has increased an average of 22.7% each year. As stated previously, the population goal in Arkansas is 25,000 resident Canada geese. The take of 50 geese by WS would represent 0.2% of the population goal if the goal is reached in the State. All take by WS occurs under depredation permits issued by the USFWS for the take of geese. WS' take of up to 50 geese annually would be dependent upon the USFWS authorizing the take at that level annually. Take by WS would not exceed the permitted take allowed under depredation permits issued by the USFWS. With management authority for migratory birds, the USFWS can adjust allowed take through the regulated harvest season

and take under depredation permits and orders to meet population objectives. Therefore, all take by WS is authorized by the USFWS and considered as part of population objectives for geese.

Migratory Canada Geese

Canada geese are endemic to North America, where they occur in each state of the United States (except Hawaii), each Province of Canada, and many States of Mexico. Most authorities currently recognize 11 subspecies of Canada geese, which differ primarily in body size and color (Bellrose 1980). Canada goose migrations may encompass up to 3,000 miles, like that of the Richardson's Canada goose (*B. c. hutchinsii*) which nests as far north as Baffin Island, Nunavut, Canada and winters as far south as the eastern States of Mexico. Migrant geese nest across the arctic, subartic, and boreal regions of Canada and Alaska and range in size from the 2-4 pound cackling Canada goose (*B. c. minima*) to the 7-10 pound dusky Canada goose (*B. c. occidentalis*).

In the Mississippi Flyway, migratory Canada geese consist primarily of four distinct populations. Those populations include the Mississippi Flyway Giant Population (MFGP), the Mississippi Valley Population (MVP), the Eastern Prairie Population (EPP), and the Southern James Bay Population (SJBP) (USFWS 2010). The wintering migratory population in Arkansas is mostly comprised of geese from the MFGP and the EPP but the MVP of geese could be present in extreme northeastern Arkansas (USFWS 2010). The number of Canada geese observed in the State during the CBC has shown a general stable trend since 1980 (NAS 2002).

Most geese found in the Mississippi Flyway are of the giant Canada goose subspecies collectively referred to as the MFGP. Although nearly extirpated from the Flyway in the early 1900s, through restoration efforts giant Canada geese can now be found in all of the states that make up the Mississippi Flyway. During the spring of 2006, biologists tallied 1,686,300 MFGP geese, a record high, and 7% more than were tallied in 2005 (USFWS 2006). In 2010, the MFGP was estimated at 1,608,100 geese which was a 10% increase when compared to the 2009 estimate (USFWS 2010).

The EPP of geese nests along the Hudson Bay Lowlands of Manitoba. The EPP of geese concentrate during winter in Manitoba, Minnesota, and Missouri but may extend southward into northern Arkansas (USFWS 2010). Surveys conducted in 2010 estimated the spring EPP at 251,300 (± 73,600) geese which was a decline of 10% over the 2009 estimate (USFWS 2010). From 2001 through 2010, the estimated single and paired EPP of geese has increased an average of 3% per year (USFWS 2010). However, the number of productive geese (nesting pairs and singles) in the EPP during 2010 was 80,000 geese which were 48% higher when compared to the estimate in 2009 (USFWS 2010).

Geese in the MVP nest in northern Ontario, primarily in the Hudson Bay lowlands, west of Hudson Bay and James Bay (USFWS 2010). Populations of the MVP of geese tend to concentrate in Wisconsin, Illinois, and Michigan during the winter following the fall migration. Surveys conducted on the breeding ground of the MVP estimated a breeding population of 339,300 (±86,000) geese which was 42% more geese than were estimated in 2009 (USFWS 2010). Estimates of breeding adults in the MVP from 2001 through 2010 have shown a stable population trend (USFWS 2010). Overall, surveys estimated the MVP of geese at 359,700 geese (±88,000) which is a 31% decrease from the 2009 estimate (USFWS 2010).

As discussed previously, the MFGP, EPP, and the MVP of Canada geese could be found in the State under those conditions where geese present in the State would be considered migratory. Under field conditions, distinguishing geese between population segments can be difficult. Determining whether a Canada goose present in the State is migratory or a resident (present in the State year round) can also be difficult under field conditions. Therefore, for the purposes of this analyses, those Canada geese present in the State from September through March would be considered as migratory geese.

Frameworks have been established by the USFWS and implemented by the AGFC to allow for the harvest of geese in the State during those months when geese present in the State could be migratory. The September season is intended to manage populations of resident geese but migratory geese could be present in the State. In 2008, an estimated 11,500 geese were taken during the September and regular hunting seasons for geese in the State (Raftovich et al. 2010). An estimated 26,200 geese were harvested in both seasons during the 2009 season (Raftovich et al. 2010).

Since FY 2004, no geese have been lethally taken by WS in the State during the period when geese present in the State could be considered migratory. However, based on increasing requests for assistance to manage geese, WS may be required to lethally take geese during those months when geese could be considered migratory if deemed appropriate through the use of the WS Decision Model. WS anticipates that requests for the lethal take of geese during those months when geese are considered migratory would occur primarily at airports where geese can pose a threat to human safety and to property. However, requests could be received to reduce damage or threats to other resources. Based on an increase in the number of requests received for the lethal take of geese during those periods of time when geese present in the State would be considered migratory, WS may take up to 20 geese during those periods when geese could be considered migratory.

All take by WS occurs through the issuance of a depredation permit issued by the USFWS which is reported annually to the USFWS. All take of geese during the hunting seasons occur under frameworks established by the USFWS. Take by other entities in the State occurs under depredation permits or depredation orders established by the USFWS with the requirement that take be reported to the USFWS. Therefore, the permitting of the take by the USFWS ensures cumulative take is considered as part of management objectives for Canada geese. WS' take of up to 20 geese that could be considered migratory annually would have represented 0.2% of the number of geese harvested in the State during the 2008 harvest season and 0.1% of the number of geese harvested in the State during the 2009 hunting season. The magnitude of an annual take of up to 0.2% of the number of geese harvested in the State could be considered low. No take of migratory geese would occur by WS without a depredation permit issued by the USFWS. Therefore, WS' take would only occur at the discretion of the USFWS after population objectives for geese are considered.

Snow Goose Population Impact Analysis

Snow geese breed across the extreme northern portions of Canada and along the arctic coast (Mowbray et al. 2000). No breeding populations of snow geese occur in Arkansas. However, snow geese are common migrants through Arkansas with large concentrations of snow geese overwintering in the State (Mowbray et al. 2000). The fall migration period occurs from September through November with the spring migration occurring from late February through the first part of June (Mowbray et al. 2000). The number of snow geese observed overwintering in the State during the CBC has shown a general increasing trend since 1966 (NAS 2002). The number of snow geese observed during the CBC conducted in the State has ranged from no snow geese to a high of 187,450 snow geese observed (NAS 2002). A total of 187,450 snow geese were observed in the State during the CBC conducted in 2010 (NAS 2002). In the last ten years (2001 through 2010), the number of snow geese observed in areas surveyed during the CBC has averaged over 119,000 geese annually.

Like other waterfowl species, snow geese can be harvested during regulated hunting seasons, including hunting seasons in Arkansas. Snow geese, like many waterfowl species can be harvested during a regular hunting season that traditionally occurs during the fall migration period of waterfowl. However, snow geese can also be harvested during their spring migration period under a Conservation Order established by the USFWS that includes Arkansas (see 50 CFR 21.60) which was authorized under the Arctic Tundra

Habitat Emergency Conservation Act (Public Law 106-108, Nov. 24, 1999, 113 Stat. 1491). The Conservation Order is intended to allow for the maximum number of snow geese to be taken annually in attempts to reduce the overall population of snow geese. The overall population of snow geese has increased dramatically since the mid-1970s and has reached historic highs across their breeding and wintering range. The current population level of snow geese has led to the damage of fragile arctic habitats on their breeding grounds from overgrazing.

Under regulations in Arkansas available during the development of this EA, snow geese could be harvested during a regular season which extends from November through January and during the Conservation Order season that extends from February through April. During the regular harvest season up to 20 geese could be harvested daily with no possession limit. Under the Conservation Order season, there is no daily limit on the number of snow geese that can be harvested and no possession limit (AGFC 2010). During the 2008 snow goose harvest season, an estimated 41,848 snow geese were harvested in the State which compares to 30,743 snow geese harvested during the 2009 harvest season (Raftovich et al. 2010).

Requests for assistance to manage damage and threats associated with snow geese primarily originate from damage to winter wheat production in the State. Large flocks of snow geese often forage on and trample sprouting wheat during the spring migration period. WS received requests in FY 2007 and FY 2009 to provide direct operational assistance to those persons experiencing damage associated with snow geese in the State. Using WS' Decision Model, those geese were dispersed using non-lethal methods to alleviate damage or threats of damage. A total of 16,000 snow geese were dispersed in FY 2007 to alleviate damage and four snow geese were dispersed in FY 2009. Based upon past requests for WS' assistance and in anticipation of receiving additional requests for assistance associated with snow geese, WS anticipates that no more than 100 snow geese could be lethally taken by WS annually under the proposed action. All take of snow geese by WS would occur only after a depredation permit has been issued by the USFWS either to WS or to entities experiencing damage or threats of damage. No depredation permits were issued by the USFWS between 2004 through 2009 to take snow geese in Arkansas.

As stated previously, the number of snow geese observed during the CBC conducted annually in the State has ranged from a low of no geese to a high of 187,450 geese. When compared to the number of snow geese observed in the State during winter surveys since 1966, WS' take of up to 100 snow geese annually would have ranged from zero to 0.1% of the geese observed in the State. The average number of snow geese observed during the CBC conducted in the State from 2001 through 2010 has been 119,284 geese. WS' take of up to 100 snow geese to alleviate damage or threats would represent 0.1% of the average number of geese observed in the State. WS' take could be considered of low magnitude when compare to the number of snow geese observed in the State annually.

Given the unlimited take allowed during the hunting seasons for snow geese and the desire of management agencies to reduce the overall population of snow geese to alleviate damage occurring to fragile habitat on their breeding grounds, the limited take proposed by WS to alleviate damage and threats would not adversely impact snow goose populations. WS' limited proposed take would not limit the ability of those interested persons to harvest snow geese in the State during the hunting seasons. WS' proposed take would be a limited component of the overall take occurring of snow geese.

Ring-necked Duck Population Impact Analysis

With their distinctive white bill markings, the ring-necked duck is considered a diving duck feeding in shallow wetlands and bogs by diving under the water to feed on submerged plant material (Hohman and Eberhardt 1998). The breeding range of the ring-necked duck includes the subarctic deltas, taiga, boreal

forest, aspen parkland, and prairie regions of Canada and the extreme portions of the northern United States. Ring-necked ducks appear to have expanded their breeding range recently with expansion east of the Great Lakes beginning in the 1930s and a westward expansion into Alaska and the Yukon Territory during the 1980s (Hohman and Eberhardt 1998). Ring-necked ducks are most commonly found nesting in freshwater wetlands with emergent vegetation. Wintering populations of ring-necked ducks occur inland along the Gulf of Mexico and the southern Atlantic Coasts of the United States westward into Mexico and west of the Rock Mountains (Hohman and Eberhardt 1998).

In Arkansas, ring-necked ducks are a common migrant and winter resident across the State with the largest numbers occurring in the southern and southeastern lowlands (James and Neal 1986). Ring-necked ducks begin arriving in the northern portions of the State in late October and are commonly found in preferred habitat throughout the State until late April and early May when most birds have left the State on their northward migration (James and Neal 1986). Banding records for ring-necked ducks indicate birds present in the State are most likely from breeding populations in Minnesota and Central Canada with some birds passing through the State on their way to wintering grounds along the coastal areas of Louisiana (James and Neal 1986).

Breeding populations of ring-necked ducks in the United States are showing increasing trends since 1966 estimated at 6.4% annually which is a statistically significant increase with the number of ring-necked ducks observed between 1980 and 2007 showing a 7.1% increasing trend (Sauer et al. 2008). Across all routes surveyed during the BBS, the number of ring-necked ducks observed has shown increasing trends with a 2.7% annual increase estimated from 1966 through 2007 and a 3.3% annual increase between 1980 and 2007 (Sauer et al. 2008). The number of breeding ring-necked ducks observed in 2010 in their eastern breeding range increased 5% when compared to the number observed in 2009 and was 10% above the average number observed from 1990 through 2009 (Zimpfer et al. 2010). The number of ring-necked ducks observed during the CBC conducted annually in the State has shown cyclical patterns with an overall stable to slightly increasing trend (NAS 2002). The average number of ring-necked ducks observed in areas surveyed between 2001 and 2010 during the CBC has been 3,686 ring-necked ducks. The highest number of ring-necked ducks observed during the CBC conducted from 2001 through 2010 has been 9,696 ring-necked ducks observed. The lowest number observed during the CBC from 2002 through 2010 was 840 ringed-billed ducks (NAS 2002). During the 2010 mid-winter waterfowl survey conducted by the USFWS, a total of 279,816 ring-necked ducks were observed in the Central Flyway which represented an increase of 77% above the 2009 estimate and 683% above the average number observed during the survey conducted from 1948 through 2009 (Kruse et al. 2010). Information from the mid-winter survey for the Mississippi Flyway is currently unavailable.

Like other waterfowl species, ring-necked ducks can be harvested during annual waterfowl hunting seasons in the State. The duration of the hunting season and the allowable harvest levels are implemented in the State by the AGFC under frameworks developed by the USFWS. During the 2008 waterfowl hunting season, a total of 24,562 ring-necked ducks were estimated as harvested in State while 12,030 ring-necked ducks were estimated to have been harvested in the State during the 2009 hunting season (Raftovich et al. 2010). Nearly 410,000 ring-necked ducks were harvested in the United States during the 2009 hunting season (Raftovich et al. 2010).

No direct operational assistance has been provided by WS to address damage or threats of damage associated with ring-necked ducks in the State. However, ring-necked ducks are often found on aquaculture ponds within the State during the winter migration period. Of concern with baitfish producers is direct depredation to crops, loss to feed, and the potential spread of diseases by waterfowl that frequent ponds. As was discussed in Chapter 1 of this EA, waterfowl have been implicated in the spread of diseases between aquaculture ponds and between aquaculture facilities. If WS receives a request for assistance associated with ring-necked ducks in the State and if direct operational assistance is

provided by WS, those ducks would likely be addressed using non-lethal harassment methods. However, WS could be requested to lethal take a few ring-billed ducks to reinforce non-lethal methods. If lethal methods are employed, WS anticipates that up to 50 ring-necked ducks could be lethally taken annually in the State.

If up to 50 ring-necked ducks were lethally taken in 2008, the take would have represented 0.2% of the estimated number of ring-necked ducks harvested in the State that year. Similarly, if WS had taken 50 ring-necked ducks in the State to alleviate damage in 2009, the take would have represented 0.4% of the estimated number of ring-necked ducks harvested. Based on the limited take proposed, the increasing population trends estimated from several surveys, and the low magnitude of take proposed when compared to the annual harvest of ducks in the State, the take of up to 50 ring-necked ducks by WS would not reach a magnitude where adverse affects to populations would occur nor would the take limit the ability to harvest ring-necked ducks during the annual hunting season in the State.

Lesser Scaup Population Impact Analysis

Scaup are medium-sized ducks known for their late fall migrations, often not departing areas until the water begins to freeze-up (Austin et al. 1998). Breeding populations occur across most of Canada into Alaska and the north central portion of the United States (Austin et al. 1998). Nesting occurs in the boreal forests and parklands in small seasonal and semipermanent wetlands and lakes with emergent vegetation (Austin et al. 1998). During the fall and winter migration periods, lesser scaup are commonly found on rivers, lakes, and large wetlands where they feed on mollusks, crustaceans, and aquatic insects (Austin et al. 1998). Wintering populations occur along the coasts of the United States and along the southern portions of the country southward into Mexico, Central America, and the Caribbean Islands.

In Arkansas, the lesser scaup is considered a common migrant and winter resident in the State (James and Neal 1986). Individuals do not normally begin arriving in the State until late October with peak numbers occurring in November and early December (James and Neal 1986). Northward migrations begin in March and April with most birds departing the State by the end of May (James and Neal 1986).

Across all BBS routes in the United States, the number of lesser scaup observed from 1966 through 2007 has shown a general increasing trend estimated at 0.4% annually (Sauer et al. 2008). Across all routes surveyed, the number of lesser scaup observed during the BBS from 1966 through 2007 has shown a declining trend estimated at -0.8% annually with a more recent trend of -1.9% annually from 1980 through 2007 (Sauer et al. 2008). Breeding waterfowl surveys often group greater scaup (*Aythya marila*) and lesser scaup together due to the similarity in appearance between the two species and the overlapping breeding range of the two species. Data from breeding waterfowl surveys and mid-winter waterfowl surveys report population estimates and trend data for the two species combined; therefore, the survey information includes both species. During breeding population surveys conducted in 2010 the number of scaup observed showed a 5% decline from the 2009 estimate but was a 17% increase from the average number of scaup observed from 1990 through 2009 (Zimpfer et al. 2010). Mid-winter waterfowl surveys conducted in the Central Flyway estimated the migratory population at 419,805 scaup in 2010 which was a 47% decline in the number observed during the 2009 survey but was an increase of 265% over the average number of scaup observed during the survey from 1948 through 2008 (Kruse et al. 2010). Information for scaup in the Mississippi Flyway from the mid-winter waterfowl survey is currently not available.

Like other waterfowl species, lesser scaup can be harvested in the State during annual hunting seasons. During the 2008 waterfowl season, hunters in the State harvested an estimated 12,885 lesser scaup while 2,904 lesser scaup were harvested in the State during the 2009 waterfowl season (Raftovich et al. 2010).

Overall, hunters across the United States harvested 179,561 lesser scaup in 2008 but harvested 222,066 lesser scaup during the 2009 waterfowl season (Raftovich et al. 2010).

The WS program in Arkansas has received requests to provide direct operational assistance to address threats associated with lesser scaup in the State. Those requests for assistance were addressed using non-lethal dispersal methods to alleviate damage or threats of damage. Between FY 2005 and FY 2009, a total of 22,900 lesser scaup were addressed by WS using non-lethal dispersal methods to alleviate damage or threats of damage. No activities were conducted in FY 2004 and no lethal take of lesser scaup has occurred by WS. Similar to ring-necked ducks, most requests for assistance are associated with depredation to fish, loss of feed, and the potential for diseases to be transmitted by lesser scaup that loaf and feed on baitfish ponds. WS anticipates addressing most requests for assistance associated with lesser scaup using non-lethal dispersal methods. However, WS could be requested to lethal take lesser scaup in the State to reinforce non-lethal methods under the proposed action alternative when determined appropriate using the WS Decision Model. Based on the number of lesser scaup addressed previously, WS could lethally take up to 50 lesser scaup annually under the proposed action alternative to alleviate damage or threats of damage.

If 50 lesser scaup were taken by WS in 2008, the take would have represented 0.4% of the number of lesser scaup harvested in the State during the 2008 waterfowl season. Based on the number of lesser scaup harvested in the State during the 2009 season, a take by WS of up to 50 lesser scaup would have represented 1.7% of the scaup lethally taken in the State. WS' proposed take of up to 50 lesser scaup as part of an integrated approach to managing damage could be considered of low magnitude when compared to the take of scaup during the regulated hunting season in the State. Take by WS would only occur when permitted by the USFWS through the issuance of a depredation permit and only at take levels authorized annually.

American Coot Population Impact Analysis

American coots are the most abundant and widely distributed species of rail in North America (Brisbin and Mowbray 2002). Coots are also likely one of the most recognizable rail species in the United States with their boisterous behaviors and vocalizations. Coots can be commonly found on a variety of freshwater wetlands near the shoreline often found foraging in cattails, bulrushes, and reeds (Brisbin and Mowbray 2002).

In Arkansas, coots are considered common to locally abundant migrants and winter residents across the State with small numbers being observed in the State during the summer (James and Neal 1986). Although coots can be found throughout the year in the State, they are most numerous during the migration periods and during the winter months with fall migrants beginning to arrive in the State in September (James and Neal 1986). Peak number of fall migrants occurs in November in the State with statewide numbers during the winter dependant on the severity of temperatures in the State (James and Neal 1986). Spring migrants begin arriving in the State during March with most migrants moving northward out of the State to breeding grounds by mid-May. Although coots may be present in the State during the breeding season, most coots present in the State are likely non-breeders. However, documentation exists of coots nesting and producing young in the State (James and Neal 1986).

Although coots can be observed in the State during the breeding season, no data is currently available from BBS routes surveyed in the State (Sauer et al. 2008). Across all BBS routes surveyed in the United States, the number of coots observed has shown an increasing trend estimated 0.9% per year since 1966 (Sauer et al. 2008). From 1966 through the late-1980s, the number of coots observed in the State in areas surveyed during the CBC showed a general declining trend; however, from the early-1990s until 2010 the number of coots observed in the State during the CBC has shown a general increasing trend (NAS 2002).

The number of coots observed in 2008 during the CBC was the second highest number recorded since 1966 (NAS 2002). Nearly 15,535 coots were counted during the CBC conducted in the State during 2008 (NAS 2002).

American coots are often identified as a possible conveyance for disease transmission between aquaculture ponds and facilities. Coots primarily feed on aquatic vascular plants and algae but their diet may consist of grains, aquatic invertebrates, and vertebrates, including fish (Brisbin and Mowbray 2002). Coots can also negatively impact fish farming operations when they directly consume fish feed. Coot competition for pelletized feed increases fish farming costs and decreases growth potential of commercial fish. The USFWS has authorized the take of coots in the State to alleviate damage and threats (see Table 4.15). WS has also received requests to provide direct operational assistance with managing damage associated with coots in the State. To address damage and threats caused by coots associated with those requests for assistance, WS has employed an integrated approach using lethal and non-lethal methods. From FY 2004 through FY 2009, WS has employed lethal methods to take 14 coots in the State and employed non-lethal methods to disperse 2,008 coots to address damage and threats (see Table 4.15). Based on previous requests received to provide direct operational assistance, up to 20 coots could be lethally taken by WS as part of an integrated approach to managing damage under the proposed action. A total of 1,229 coots have been lethally taken in the State to alleviate damage and threats which is an average of 205 coots taken annually.

Table 4.15 – Number of American coots addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	265
2005	1,000	0	136
2006	0	0	256
2007	1,000	14	208
2008	8	0	230
2009	0	0	134
TOTAL	**2,008**	**14**	**1,229**

[1]Data reported by federal fiscal year
[2]Data reported by calendar year

American coots maintain sufficient populations to allow for the annual harvest of coots during regulated hunting seasons in the United States. Coots can be harvested in Arkansas during annual regulated hunting seasons under frameworks established by the USFWS and implement in the State by the AGFC. An estimated 2,000 coots were harvested in the State during the 2008 hunting season with an estimated 275,900 coots harvested in the United States (Raftovich et al. 2010). During the 2009 hunting season, no coots were harvested in the State with an estimated 219,000 coots harvested in the United States (Raftovich et al. 2010).

The number of coots present in the State during the migration period and during the winter is currently unknown. Requests for assistance to manage damage in the State primarily occur during the migration periods and during the winter when coots are concentrated in large numbers in the State. If 20 coots had been lethally taken by WS in FY 2008, the take would have represented 1.0% of the estimated take of coots in the State during the regulated hunting season.

During the CBC conducted in 2010, observers counted 4,490 coots in the State with 15 counts reporting coots which compared to 8,565 coots observed during the 2009 survey (NAS 2002). CBC data compiled since the 2001 survey in the State, indicates an average of 5,790 coots have been observed during the

CBC conducted annually in the State. If 20 coots were taken annually by WS, the take would represent 0.3% of the average number of coots observed in the State since the 2001 survey. If 20 coots had been taken annually by WS from FY 2004 through FY 2009 in the State, the average number of coots taken by all entities would have increased to 225 coots taken per year to alleviate damage or threats instead of 205 coots. An annual take of 225 coots by all entities would represent 3.9% of the average number of coots observed in the State during the CBC. The number of coots observed in the State during the CBC conducted from 2001 through 2010 has ranged from a low of 1,829 coots observed during the 2005 survey to a high of 15,535 coots observed during the 2008 survey (NAS 2002). Therefore, the take of up to 20 coots by WS would range from a low of 1.0% to a high of 1.1% based on the range of coots observed in the State during the CBC from 2001 through 2010.

CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the State and is not intended to represent population estimates of wintering bird populations. However, the information is presented in this analysis and compared to WS' proposed take to indicate the low magnitude of take occurring by WS when compared to the number of coots observed in the State during the CBC which would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the State.

Ring-billed Gull Population Impact Analysis

Ring-billed gulls are migratory birds which prefer to nest on islands with sparse vegetation. The breeding population of ring-billed gulls is divided into two populations; the western population and the eastern population. The eastern breeding population of the United States includes New York, Vermont, Ohio, Illinois, Michigan, Wisconsin, and Minnesota (Blokpoel and Tessier 1986). Ring-billed gulls nest in high densities and, in the Great Lakes region, nesting colonies may be located on islands, parklands, slag yards, rooftops, breakwalls, and landfills (Blokpoel and Tessier 1986).

Ring-billed gulls are considered common migrants and a winter resident across the State with most observations occurring on or near large bodies of water (James and Neal 1986). Ring-billed gulls begin arriving in the State during September with peak numbers observed in October with the migrants continuing to arrive in the State during November. Gulls begin exiting the State in March with most birds leaving by early May (James and Neal 1986).

In 1984, the population of ring-billed gulls in the Great Lakes region was estimated at approximately 648,000 pairs (Blokpoel and Tessier 1986). Blokpoel and Tessier (1992) found that the nesting population of ring-billed gulls in the Canadian portion of the lower Great Lakes system increased from 56,000 pairs to 283,000 pairs from 1976 to 1990. Across all BBS routes, the number of ring-billed gulls observed during the survey has shown an increasing trend in the United States estimated at 2.6% since 1966 which is a statistically significant increase (Sauer et al. 2008). In the northeastern United States where breeding populations occur, the number of ring-billed gulls observed during the BBS has increased 4.4% annually since 1966 which is also statistically significant (Sauer et al. 2008). In the southeastern United States, the number of ring-billed gulls observed during the BBS has shown an increasing trend estimated at 0.8% annually since 1966. More recently, the number of ring-billed gulls documented along routes of the BBS has increased annually in the southeastern United States estimated at 2.0% from 1980 through 2007 (Sauer et al. 2008). The numbers of ring-billed gulls observed in areas surveyed during the CBC are also showing a general increasing trend in the State (NAS 2002).

Ring-billed gulls feed primarily on fish, insects, earthworms, rodents, and grains (Ryder 1993). Requests for direct operational assistance received by WS in the Arkansas associated with ring-billed gulls occurs primarily from gulls feeding on aquaculture stock. Large concentrations of gulls on aquaculture ponds can consume enough fish to pose economic concerns to aquaculture producers in the State. As shown in

the Table 4.16, the USFWS has issued depredation permits to entities in Arkansas to alleviate damage and threats which has lead to the lethal take of 834 ring-billed gulls from 2004 through 2009. WS has taken one ring-billed gull to alleviate damage and has employed non-lethal methods to disperse 2,350 ring-billed gulls in the State between FY 2004 and FY 2009.

Table 4.16 – Number of ring-billed gulls addressed in Arkansas from 2004 to 2009

Year	Dispersed by WS[1]	Take Under Depredation Permits	
		WS' Take[1]	Total Take[2]
2004	0	0	42
2005	650	0	272
2006	1,500	0	129
2007	200	1	157
2008	0	0	108
2009	0	0	126
TOTAL	**2,350**	**1**	**834**

Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, up to 20 ring-billed gulls could be taken annually in the State to address damage and threats of damage when a request for assistance is received. Over the last 10-years, an average of 11,137 ring-billed gulls has been observed annually in the State during the CBC (NAS 2002). If 20 ring-billed gulls were taken by WS, WS' take would represent 0.2% of the average number of ring-billed gulls observed in the State during the CBC from 2001 through 2010. Over the 10-year period, the number of gulls observed during the CBC in the State has ranged from 4,464 gulls observed in 2007 to a high of 18,905 gulls observed in 2008 (NAS 2002). Therefore, if WS had taken 20 ring-billed gulls annually from 2001 through 2010 in the State, the annual take by WS would have ranged from a low of 0.1% to a high of 0.5% of the number of gulls observed in the State during the CBC.

From 2004 through 2009, a total of 834 ring-billed gulls were lethally taken under depredation permits issued by the USFWS to alleviate damage and threats of damage in the State which is an average of 139 gulls taken annually. If WS had taken 20 gulls from FY 2004 through FY 2009, the average annual take by all entities would have increased to 159 gulls taken per year in the State. Therefore, the cumulative take of gulls in the State, if WS had taken 20 gulls per year, would represent 1.4% of the average number of gulls observed in the State during the CBC from 2001 through 2010.

Rock Pigeon Population Impact Analysis

Rock pigeons are a non-indigenous species that were first introduced into the United States by European settlers as a domestic bird to be used for sport, carrying messages, and as a source of food (USFWS 1981). Many of those birds escaped and eventually formed the feral pigeon populations that are now found throughout the United States, southern Canada, and Mexico (Williams and Corrigan 1994). However, because pigeons are an introduced rather than a native species, they are not protected by the MBTA or any State law.

Pigeons are closely associated with humans where human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994). Thus, pigeons are commonly found around city buildings, bridges, parks, farm yards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994). Additionally, although pigeons are primarily grain and seed eaters, they will readily feed on garbage, livestock manure, spilled grains, insects, and any other available bits of food (Williams and Corrigan 1994). In Arkansas, pigeons can be found statewide throughout the year and is considered a common resident of the State (James and Neal 1986).

The number of pigeons observed along routes surveyed during the BBS in the State have shown a decreasing trend since 1966 which has been estimated at -0.3% annually. From 1980 through 2007, the number of pigeons observed along routes surveyed has shown a declining trend estimated at -2.1% annually (Sauer et al. 2008). Since 1966, the number of pigeons observed along routes surveyed during the BBS across the southeastern United States (USFWS Region 4) has shown a declining trend estimated at -0.1% annually with a -1.4% annual decline from 1980 through 2007 (Sauer et al. 2008). Based on data from the BBS, Rich et al. (2004) estimated the statewide pigeon populations at 400,000 pigeons. The number of pigeons observed in areas surveyed during the CBC has shown a general increasing trend in the State since 1966 (NAS 2002).

Since pigeons are afforded no protection under the MBTA because the species is not native to the United States, the take of pigeons to alleviate damage or to reduce threats can occur without the need for a depredation permit from the USFWS. Between FY 2004 through FY 2008, WS did not receive requests for direct operational assistance to manage damage or threats of damage associated with rock pigeons in the State. In FY 2009, WS employed non-lethal harassment methods to disperse two rock pigeons to alleviate damage or threats of damage. No lethal take of pigeons has occurred by WS in the State between FY 2004 through FY 2009.

The take of pigeons by other entities in the State to alleviate damage or threats of damage is unknown since the reporting of take to the USFWS or any other entity is not required. Since pigeons are a non-native species that often competes with native wildlife species for food and habitat, any take could be viewed as benefiting the native environment in Arkansas.

Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could annually take up to 100 pigeons in the State to alleviate damage. Based on a population estimated at 400,000 pigeons, the take of up to 100 pigeons by WS would represent 0.03% of the estimated statewide population. WS' proposed pigeon damage management activities would be conducted pursuant to Executive Order 13112. The Executive Order states that each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species.

Belted Kingfisher Population Impact Analysis

Belted kingfishers are one of the most widespread birds in North America where it inhabits a diverse range of aquatic habitats (Kelly et al. 2009). In Arkansas, kingfishers are considered a permanent resident across all regions of the State and can commonly be found around large streams, rivers, lakes, and impoundments (James and Neal 1986). Despite being found throughout the year in the State, kingfishers are more common during the winter in the State when compared to breeding populations (James and Neal 1986). Nesting occurs from late-April until mid-June in the State (James and Neal 1986).

Kingfishers have diverse food habits, feeding primarily on fish but may also consume mollusks, crustaceans, insects, amphibians, reptiles, young birds, small mammals, and berries (Kelly et al. 2009). Their preference for eating fish has been a concern to aquaculture producers as birds routinely feed on fish fry in aquaculture ponds. The USFWS has issued depredation permits to entities in the State to lethally take kingfishers to alleviate damage and threats of damage. From 2004 through 2009, six kingfishers have been lethally taken in the State under depredation permits. No direct operational assistance has been provided by WS from FY 2004 through FY 2009 in the State. However, requests for

assistance to manage damage or threats of damage could be received in the future by WS. If requests for assistance to manage damage associated with kingfishers are received by WS in Arkansas, WS anticipates that up to five belted kingfishers could be lethally taken annually in the State to alleviate damage or threats. Take would not occur by WS unless a depredation permit had been issued by the USFWS and only at levels authorized.

The number of belted kingfisher observed in the State along routes surveyed during the BBS has shown a decreasing trend from 1966 to 2007 estimated at -3.8% annually (Sauer et al. 2008). In the southeastern United States (USFWS Region 4), the number of kingfisher observed in areas surveyed during the BBS has shown a declining trend estimated at -1.5% annually since 1966 which is a statistically significant decline (Sauer et al. 2008). Rich et al. (2004) estimated the statewide breeding population of belted kingfishers at 16,000 birds. The number of kingfishers observed in the State in areas surveyed during the CBC has shown a general increasing trend since 1966 (NAS 2002).

Based on a breeding population estimated at 16,000 kingfishers, a take of up to five kingfishers by WS would represent 0.03% of the estimated population. If WS had lethally taken five kingfishers each year from FY 2004 through FY 2009, the average take by all entities would have been six kingfishers taken per year from 2004 through 2009. Based on a breeding population estimated at 16,000 kingfishers in the State, an annual take of six kingfishers would have represented 0.03% of the estimated statewide breeding population.

American Crow Population Impact Analysis

American crows have a wide range and are extremely abundant, being found across the United States (Verbeek and Caffrey 2002). Crows are found in both urban and rural environments and sometimes forming large communal roosts in cities. In the United States, some crow roosts may reach a half-million birds (Verbeek and Caffrey 2002). American crows are found throughout the State and can be found throughout the year (James and Neal 1986, Robbins and Blom 1996).

Historically, crow populations have benefited from agricultural development because of grains available as a food supply. Crows typically roost in trees with the combination of food and tree availability being favored. In some areas where abundant food and roosting sites are available, large flocks of crows tend to concentrate. In the fall and winter, crows often form large roosting flocks in urban areas. These large flocks disperse to different feeding areas during the day. Crows will fly from 6 to 12 miles from the roost to a feeding site each day (Johnson 1994). Large fall and winter crow roosts may cause serious problems in some areas particularly when located in towns or other sites near people. Such roosts are objectionable because of the odor of the bird droppings, health concerns, noise, and damage to trees in the roost.
The American crow population in Arkansas has been estimated at 710,000 crows statewide based on BBS data (Rich et al. 2004). From 1966 through 2007, trend data from the BBS indicates the number of crows observed in the State during the survey has increased at an annual rate of 1.1% which is statistically significant (Sauer et al. 2008). The number of crows observed in the State in areas surveyed during the CBC has shown a general stable to slightly increasing trend since 1966 (NAS 2002).

Blackbirds, including crows, can be taken without a depredation permit issued by the USFWS when committing or about to commit damage or posing a threat to human safety under a blackbird depredation order (see 50 CR 21.43). In addition, crows can be harvested in the State during a regulated season that allows an unlimited number of crows to be harvested. Since the take of crows can occur without a permit from the USFWS under the blackbird depredation order, there were no reporting requirements for the take of crows to reduce damage or reduce threats. Therefore, the number of crows taken in the State under the depredation order to alleviate damage or reduce threats is unknown. Similarly, hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the AGFC.

From FY 2004 through FY 2009, WS has addressed crows in the State to manage damage or reduce threats. Of those crows addressed by WS, no crows were lethally taken while 16 crows were addressed using non-lethal methods to alleviate damage or threats. As discussed previously, crows can be taken under the blackbird depredation order to alleviate damage or threats and reporting of take was not previously required under the depredation order. Therefore, the take of crows during the hunting season or to alleviate damage is currently unknown. In FY 2008, WS received two requests for direct operational assistance in which non-lethal methods were employed to disperse 16 crows using propane cannons. Based on previous requests for assistance and in anticipation of an increase in the need to address an increasing number of requests for crow damage management, up to 100 American crows could be lethally taken annually by WS to alleviate damage in the State.

The use of population trends as an index of magnitude is based on the assumption that annual harvests do not exceed allowable harvest levels. State wildlife management agencies act to avoid over-harvests by restricting take (either through hunting season regulation and/or permitted take) to ensure that annual harvests are within allowable harvest levels. If crow populations remain stable in the State, WS' annual take of up to 100 American crows would represent 0.01% of the estimated statewide crow population. The take of crows under the depredation order by other entities is likely to be a small contributor to the cumulative take of crows annually. Although some take is likely to occur, take is not expected to reach a high magnitude. Similarly, the take of crows during the annual hunting season is likely of low magnitude when compared to the statewide population. Given that the number of American crows observed during statewide surveys are showing increasing trends (NAS 2002, Sauer et al. 2008), the population of crows have not declined since those population estimates were calculated and have likely remained at least stable despite the take of crows by other entities under the depredation order and during the annual hunting season.

Fish Crow Population Impact Analysis

Fish crows are considered a local permanent resident in Arkansas that are most often found along the large river drainages and lakes of the State, especially in the lowlands region and along the Arkansas River Valley (James and Neal 1986). The peak spring migration period in Arkansas occurs in March and April. Breeding has been documented along the Arkansas, Mississippi, White, Ouachita, and Red Rivers along with Grassy Lake and Lake Millwood (James and Neal 1986). The fall migration period begins in late August and continues through early November (James and Neal 1986). Mcgowan (2001) specifies viable inland habitats as lake shores, pinewoods, and riverine forest with increasing numbers occurring in urban areas. Crows often form mixed species roosts which can contain both American crows and fish crows.

Fish crows are often confused with American crows with the only reliable distinction between the two species being vocal (Mcgowan 2001). Although the fish crow is slimmer and has a narrower beak and smaller legs, it is difficult to distinguish from the American crow (Fussell 1994). Difficulty in identifying this species probably has led to an underestimate of its range, both current and historic. Given the similar physical appearance of the two species, estimating the number of individual fish crows or American crows in a roost or flock of crows based on visual cues can be difficult. Isolating and distinguishing the vocalizations of an individual crow for species identification in a mixed species flock of crows can also be difficult.

Fish crows are not as abundant as American crows and are not as widely distributed across the State. American crows can be found throughout the State while fish crows are most commonly found along the major rivers and the associated drainages. From 1996 through 2007, the BBS estimates the relative abundance of American crows in the State at 34.82 crows observed per BBS route compared with 1.11

fish crows observed per BBS route in Arkansas (Sauer et al. 2008). Although fish crows and American crows form mixed species flocks, most flocks of crows or crow roosts encountered is the State consists primarily of American crows. Based on previous requests for assistance and in anticipation of requests to disperse urban crow roosts, up to 50 fish crows could be taken by WS under the proposed action. Although not as abundant in the State, fish crows could be present in flocks of crows addressed by WS. The number of fish crows observed during the BBS has shown a statistically significant increase in the State since 1966 estimated at 7.3% annually (Sauer et al. 2008). The number of fish crows observed annually during the CBC has been highly variable since 1966 (NAS 2002) which is likely related to the severity of the corresponding winter in the State. Rich et al. (2004) estimated the statewide population of fish crows at 30,000 birds based on BBS data.

During FY 2004 through FY 2009, WS did not use lethal methods to reduce damage caused by fish crows. WS does not anticipate killing more than 50 fish crows per year. Given the general increasing trend of fish crows and that WS' crow damage management activities would only be conducted at a limited number of sites involving a very small portion of the area in the State; the proposed action would not adversely impact the State, regional, or national fish crow population.

Starling and Blackbird Population Impacts

The blackbird group in North America includes about ten species of birds (Dolbeer 1994) including some of the most prolific and abundant birds in North America (Dolbeer and Stehn 1983). Of those ten species, red-winged blackbirds, brown-headed cowbirds, and common grackles are the species most commonly involved with causing damage or posing threats of damage in Arkansas. European Starlings, an introduced species, are also abundant in Arkansas and are often found in mixed flocks with blackbirds or in single species flocks. Starlings are often associated with causing damage to the same resources as blackbirds.

Outside of the nesting season, blackbirds generally feed in flocks and roost at night in congregations varying from a few birds to over a million birds (Dolbeer 1994). Feeding flocks and roosting congregations are sometimes comprised of a single species, but often several species mix together. In Arkansas, winter flocks are often composed of birds and migrants from Canada and the northern United States along with birds that are present in the State throughout the year. The tendency of blackbirds and starlings to form large communal roosts in agricultural producing areas of the State and to travel and feed in large social flocks often results in locally serious damage to crops with monetary losses to individual agricultural producers can be substantial (Glahn and Wilson 1992). Accumulations of fecal droppings under areas where large congregations of blackbirds and starlings roost, loaf, or feed can cause damage to or pose threats of damage to a variety of resources in Arkansas. Reports of damages or threats of damage from accumulations of fecal droppings have occurred at dairies and livestock feedlots (*e.g.*, consumption and contamination of feed), damage to buildings and property (*e.g.*, damage to structures from the acid in fecal droppings), from potential disease risks to human and animal safety (*e.g.*, fecal droppings in public use areas), and aesthetics (*e.g.*, noise, smell).

In Arkansas, large concentrations of blackbirds can cause damage to a variety of agricultural resources. Requests for assistance associated with large concentrations of blackbirds received by WS are associated with those birds feeding on rice. During a crop survey conducted in 2001, rice producers in Louisiana, Arkansas, California, Texas, and Missouri reported the minimum economic loss to rice production in those States from blackbird damage was $21.5 million (Cummings et al. 2005). Although crop damage is often caused by flocks comprised of several species of blackbirds and starlings, red-winged blackbirds appear to be responsible for most rice depredation (Meanley 1971, Cummings et al. 2005). Common grackles and brown-headed cowbirds are also commonly involved in damage to rice crops. The NWRC has recently conducted research on blackbird movements and blackbird damage to rice production in the

extreme southeastern corner of Missouri. The rice production region of Missouri occurs in the Mississippi Alluvial Plain which corresponds with the rice producing areas in Arkansas where blackbirds also cause damage to rice production (*i.e.*, the rice producing areas of Missouri and Arkansas occur in close proximity along the same corridor of the Mississippi Alluvial Plain). During research conducted from September through October from 2003 through 2005 which corresponds with the harvest of rice in the region, biologist identified blackbird roosts in the rice producing areas of Missouri. The number of blackbirds present at those roost sites ranged from 20,000 blackbirds to 3 million birds with an average of nearly 1.3 million blackbirds per roost location (NWRC unpublished data). The species compositions of those roost sites identified were comprised of 65% red-winged blackbirds, 25% brown-headed cowbirds, and 10% common grackles (NWRC unpublished data). No other blackbird species were observed during roost counts conducted in the rice production regions of Missouri (NWRC unpublished data).

Precise counts of blackbird populations do not exist but one estimate placed the United States summer population of the blackbird group at over 1 billion (USDA 1997) and the winter population at 500 million (Royall 1977). The majority of those birds occur in the eastern United States; for example, surveys in the southeastern part of the country estimated 350 million blackbirds and starlings in winter roosts (Bookhout and White 1981). The nationwide starling population has been estimated at 140 million (Johnson and Glahn 1994). Homan et al. (2004) estimated the late-summer blackbird population in the Northern Prairie Region of the United States and Canada at 40 million red-winged blackbirds, 18 million yellow-headed blackbirds, and 19 million common grackles.

Natural mortality in blackbird populations is between 50 and 65% of the population each year regardless of human-caused control operations (USDA 1997). The high mortality rate of blackbirds is offset by the high annual reproductive output of blackbirds which can range from two to four young fledged per female per year (Dolbeer 1994). Dolbeer et al. (1995) indicated that the lethal take of blackbirds and starlings during blackbird damage management activities conducted from 1974 through 1992 that resulted in the lethal take of up to 1.3% of the national winter blackbird population and up to 1.8% of the eastern winter population of blackbirds and starlings did not result in declines in breeding populations of blackbirds.

European Starling Population Impact Analysis

Colonization of North America by the European starling began on March 6, 1890 when a member of the Acclimatization Society, released 80 starlings into Central Park in New York. The released birds were able to exploit the habitat resources in the area and become established. By 1918, the distribution range of migrant juveniles extended from Ohio to Alabama; by 1926, the distribution of starlings in the United States had moved westward and encompassed an area from Illinois to Texas; by 1941, further westward expansion had occurred and starlings were known to occur and breed from Idaho to New Mexico; and by 1946, the range of starlings had expanded to California and western Canadian coasts (Miller 1975). In just 50 years, the starling had colonized the United States and expanded into Canada and Mexico and 80 years after the initial introduction had become one of the most common birds in North America (Feare 1984). The first record of European starlings in Arkansas occurred in December 1925 on Big Island at the confluence of the Arkansas, White, and Mississippi rivers in eastern Arkansas (James and Neal 1986). Today, starlings can be found throughout the State and are considered common permanent residents (James and Neal 1986). However, some migration movements do occur within the State with large flocks often forming during the winter (James and Neal 1986).

From 1966 through 2007, the number of starlings observed along routes surveyed during the BBS has shown a declining trend in the State estimated at -1.1% annually with a -1.7% decline annually occurring from 1980 through 2007 (Sauer et al. 2008). Across all routes surveyed in the United States during the BBS, the number of starlings observed has shown a declining trend estimated at a rate of -0.6% annually from 1966 through 2007 which is a statistically significant trend (Sauer et al. 2008). The number of

starlings observed in those areas surveyed during the CBC in the State has shown a cyclical pattern from 1966 through 2010 with a general overall declining trend (NAS 2002). Using data from the BBS, Rich et al. (2004) estimated the statewide breeding population of starlings at 1.5 million birds.

Starlings are not native to Arkansas and are afforded no protection under the MBTA or any State law. Therefore, a depredation permit from the USFWS or the State is not required to lethally take starlings to alleviate damage or threats of damage. Since the take of starlings to alleviate damage or threats of damage is not reported to the USFWS or the AGFC, the lethal take of starlings in the State to alleviate damage or threats of damage by entities other than WS is unknown.

Based on the flocking behavior of starlings and the potential for damage or threats of damage to arise from that behavior, WS anticipates that up to 1,000 starlings could be lethally taken annually in the State to alleviate damage or threats of damage. In anticipation of receiving requests for assistance to manage damage and threats associated with a large starling roost, take of up to 1,000 starlings could occur despite the limited take that has occurred previously. The take of 1,000 starlings would represent 0.07% of the estimated 1.5 million starlings breeding in the State. However, most requests to address large roosts occur during the migration periods and during the winter when the population in the State likely increases above the 1.5 million starlings estimated to nest in the State. The increase in the population in the State is a result of the arrival of migrants into the State and the presence of juveniles in the population.

Red-winged Blackbird Population Impact Analysis

The red-winged blackbird is one of the most abundant bird species in North America and is a commonly recognized bird that can be found in a variety of habitats (Yasukawa and Searcy 1995). The breeding habitat of red-winged blackbirds includes marshes and upland habitats from southern Alaska and Canada southward to Costa Rica extending from the Pacific to the Atlantic Coast along with the Caribbean Islands (Yasukawa and Searcy 1995). Primarily associated with emergent vegetation in freshwater wetlands and upland habitats during the breeding season, red-winged blackbirds also nest in marsh vegetation in roadside ditches, saltwater marshes, rice paddies, hay fields, pasture land, fallow fields, suburban habitats, and urban parks (Yasukawa and Searcy 1995). Northern breeding populations of red-winged blackbirds migrate southward during the migration periods but red-winged blackbirds are common throughout the year in States along the Gulf Coast and parts of the western United States (Yasukawa and Searcy 1995). During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species.

Red-winged blackbirds are considered an abundant permanent resident in the State (James and Neal 1986). The highest concentrations of red-winged blackbirds in the State occur in the Mississippi Alluvial Plain, in particular the Grand Prairie region of Arkansas, which is currently characterized by the production of rice (James and Neal 1986). The relative abundance (*i.e.*, birds observed per route) of red-winged blackbirds during the breeding season across the State has been estimated at nearly 135 birds (Sauer et al. 2008). From 1966 through 2007, an average of nearly 913 red-winged blackbirds has been observed annually along the BBS route occurring in the Grand Prairie region of the State (Sauer et al. 2008).

In Arkansas, red-winged blackbirds are considered residents throughout the year in the State (Yasukawa and Searcy 1995) with a breeding population estimated at 6.3 million birds (Rich et al. 2004). Trend data from the BBS indicates the number of red-winged blackbirds observed in the State during the breeding season has shown an increasing trend since 1966 estimated at 2.2% annually (Sauer et al. 2008). More recent trend data from 1980 through 2007 indicates a downward trend estimated at -0.2% annually (Sauer et al. 2008). Across all survey routes in the southeastern United States (USFWS Region 4), the number of red-winged blackbirds observed has shown downward trends since 1966 estimated at -1.6% annually

(Sauer et al. 2008). The number of red-winged blackbirds observed during the CBC in the State has shown a highly cyclical pattern since 1966 (NAS 2002). Between 2001 and 2010, the average number of red-winged blackbirds observed in areas surveyed during the CBC has totaled nearly 480,000 red-winged blackbirds. The highest number of red-winged blackbirds recorded during the CBC conducted in Arkansas between 2001 and 2010 occurred in 2006 when nearly 3 million red-winged blackbirds were recorded (NAS 2002). The lowest number of red-winged blackbirds observed in the State during the CBC conducted between 2001 and 2010 occurred in 2001 when 32,646 red-winged blackbirds were recorded (NAS 2002) which provides an indication of the cyclical pattern of the number of blackbirds present in the State during the winter period.

As mentioned previously, CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the State and is not intended to represent population estimates of wintering bird populations. Data from the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the State.

Between FY 2004 and FY 2009, the WS program in Arkansas dispersed nearly 1,804,800 blackbirds in mixed species flocks to alleviate damage or threats of damage in the State. As was mentioned previously, red-winged blackbirds often form mixed species flocks with other blackbird species and determining the number of birds of each species present in mixed species flocks can be difficult. Therefore, of the 1.8 million blackbirds dispersed in mixed species flocks of blackbirds by WS, the number of red-winged blackbirds present in those flocks is unknown. The highest number of blackbirds addressed occurred in FY 2006 when 1.8 million blackbirds in mixed species flocks were addressed by WS. No lethal take of red-winged blackbirds has occurred by WS in the State. Since the take of blackbird species, including the take of red-winged blackbirds, can occur without the need for a depredation permit when committing or about to commit damage, the number of red-winged blackbirds lethally taken by other entities in the State is unknown since reporting of take to the USFWS was not required previously.

Based on the number of blackbirds addressed by WS previously using non-lethal methods and the number of red-winged blackbirds present in the State during the breeding and migration season, WS could be requested to lethally take up to 2,000 red-winged blackbirds annually in the State to alleviate damage or threats of damage. With a breeding population estimated at 6.3 million red-winged blackbirds, the take of up to 2,000 red-winged blackbirds by WS annually would represent 0.03% of the estimated breeding population in the State. Using data from the CBC gathered in the State from 2001 through 2010, the take of up to 2,000 red-winged blackbirds by WS would have represented 0.4% of the average number of red-winged blackbirds observed in the State of 480,000 red-winged blackbirds. The take of up to 2,000 red-winged blackbirds by WS would represent a low of 0.07% to a high of 6.1% of the number of red-winged blackbirds observed in the State during the CBC. The take of red-winged blackbirds by other entities is expected to be of low magnitude when compared to the statewide estimated population for Arkansas.

Common Grackle Population Impact Analysis

Another blackbird species commonly found in mixed species flocks in Arkansas is the common grackle. Common grackles are a semi-colonial nesting species often associated with human activities. Characterized by yellow eyes and iridescent bronze or purple plumage, common grackles are a common conspicuous bird species found in urban and residential environments (Peer and Bollinger 1997). The breeding range of the common grackle includes Canada and the United States east of the Rocky Mountains with grackles found throughout the year in the United States except for the far northern and western portion of the species range in the United States (Peer and Bollinger 1997). Common grackles have likely benefited from human activities, such as the clearing of forests in the eastern United States which provides suitable nesting habitat and the planting of trees in residential areas which has led to an expansion of the species range into the western United States (Peer and Bollinger 1997). The grackle has

an extremely varied diet, which includes insects, crayfish, frogs, other small aquatic life, mice, nestling birds, eggs, sprouting and ripened grains, seeds, and fruits (Bull and Farrand 1977, Peterson 1980).

Common grackles can be found throughout the year in Arkansas (Peer and Bollinger 1997) with an estimated breeding population calculated at 1.5 million grackles (Rich et al. 2004). The number of common grackles observed in the State along routes surveyed during the BBS has shown a declining trend since 1966 which has been estimated at -2.0% which is a statistically significant trend (Sauer et al. 2008). A similar downward trend has also been observed for grackles observed along BBS routes across the southeastern United States (USFWS Region 4) which has been estimated at -2.5% annually since 1966 (Sauer et al. 2008). Across the United States, the number of common grackles observed during the annual BBS has also shown a statistically significant downward trend estimated at -1.0% since 1966 (Sauer et al. 2008). The number of grackles observed in the State during the annual CBC surveys has shown a cyclical pattern since 1966 (NAS 2002). During surveys conducted from 2001 through 2010, the average number of grackles observed during the CBC conducted in the State has been 108,047 grackles. The lowest number of grackles observed during the CBC from 2001 through 2010 occurred in 2005 when 20,639 grackles were recorded. The highest number of grackles recorded in the State during the CBC between 2001 through 2010 occurred in 2006 when 400,356 grackles were observed (NAS 2002).

WS has been requested to provide assistance with managing damage or threats of damage associated with common grackles previously; however, requests to provide assistance specifically associated with common grackles occur infrequently. Between FY 2004 and FY 2009, a total of 3,600 common grackles were dispersed by WS in the State. Since common grackles could be present in mixed species flocks of blackbirds, WS could be requested to employ lethal methods to take up to 1,000 common grackles annually. As was addressed previously, WS has dispersed over 1.8 million blackbirds in mixed species flocks to address damage or threats of damage in the State between FY 2004 and FY 2009. The number of common grackles present in those flocks is unknown. Like other blackbird species, the take of common grackles can occur under the blackbird depredation order which allows blackbirds, including common grackles, to be taken when committing damage or about to commit damage without the need for a depredation permit from the USFWS. Therefore, the number of common grackles taken annually by other entities in the State is currently unknown.

If up to 1,000 common grackles are taken annually by WS, the take would represent 0.07% of the estimated 1.5 million common grackles breeding within the State. Using the data from the CBC, the take of up to 1,000 common grackles by WS would represent 0.9% of the average number of grackles observed in areas surveyed from 2001 through 2010. Using the range of grackles observed during the CBC from 2001 through 2010, a take of up to 1,000 grackles by WS would range from 0.3% to 4.8% of the number of grackles observed in the State. The take of common grackles by other entities is expected to be of low magnitude when compared to the statewide estimated population for Arkansas.

Brown-headed Cowbird Population Impact Analysis

Brown-headed cowbirds are another species of the blackbird family commonly found in mixed species flocks during migration periods. Cowbirds are a common summer resident across the United States and southern Canada (Lowther 1993). Breeding populations in the northern range of the cowbird are migratory with cowbirds present throughout the year in much of the eastern United States and along the west Coast (Lowther 1993). Likely restricted to the range of the bison (*Bison bison*) before the presence of European settlers, cowbirds were likely a common occurrence on the short-grass plains where they fed on insects disturbed by foraging bison (Lowther 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds are still commonly found in open grassland habitats but also inhabit urban and residential areas. Somewhat unique in their breeding habits, cowbirds are known as brood parasites meaning they lay their eggs in the nests of other

bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, of which, 144 species have actually raised cowbird young (Lowther 1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species. The preferred food of brown-headed cowbird includes: insects, small fruits, wild seeds, grain, and small aquatic life (Peterson 1980).

In Arkansas, the number of cowbirds observed in areas surveyed during the BBS has shown a decreasing trend estimated at -1.0% annually between 1966 and 2007 which is a statistically significant trend (Sauer et al. 2008). From 1980 through 2007, the number of cowbirds observed in the State has shown a declining trend estimated at -1.8% annually (Sauer et al 2008). Rich et al. (2004) estimated the statewide breeding population of cowbirds at 660,000 cowbirds based on data from the BBS. In the southeastern United States (USFWS Region 4), cowbirds have shown a declining trend since 1966 estimated at -0.9% annually which is a statistically significant trend (Sauer et al. 2008). Across all BBS routes surveyed in the United States since 1966, the number of cowbirds has shown a declining trend estimated at -0.8% which is also a statistically significant downward trend (Sauer et al. 2008). Similar to other blackbird species, the number of cowbirds observed during the CBC conducted annually in the State has shown a cyclical pattern (NAS 2002). Observers on the CBC have recorded on average a total of 10,640 cowbirds each year from 2001 through 2010 (NAS 2002). During 2005, a total of 1,035 cowbirds were observed during the CBC conducted in the State which was the lowest number observed from 2001 through 2010 (NAS 2002). The highest number of cowbirds observed during the CBC conducted from 2001 through 2010 has been 79,542 cowbirds which were recorded during the CBC in 2009 (NAS 2002).

WS has not previously received requests for assistance directly associated with brown-headed cowbirds in the State. No lethal take has occurred by WS between FY 2004 through FY 2009 and no cowbirds were dispersed. As was discussed previously, WS has dispersed blackbirds using non-lethal methods in mixed species flocks. The number of cowbirds present in those mixed flocks of blackbirds addressed by WS is currently unknown. However, since cowbirds could be present in mixed species flocks of blackbirds, WS could lethally take up to 500 cowbirds annually in the State to alleviate damage or threats of damage. Like other blackbird species, the take of cowbirds can occur pursuant to the blackbird depredation order without the need for a depredation permit from the USFWS; therefore, the number of cowbirds taken annually by other entities to alleviate damage or threats of damage in the State is currently unknown. However, the take of cowbirds by other entities to alleviate damage or threats is likely non-existent to minimal in the State. The take of brown-headed cowbirds by other entities is expected to be of low magnitude when compared to the statewide estimated population and the trend information available for Arkansas.

Based on a statewide breeding population estimated at 660,000 cowbirds, the take of up to 500 cowbirds by WS to alleviate damage or threats of damage would represent 0.08% of the estimated population. The take of up to 500 cowbirds by WS would represent 4.7% of the average number of cowbirds observed annually during the CBC conducted from 2001 through 2010. The take of cowbirds by other entities to alleviate damage or threats of damage under the blackbird depredation order is not likely to reach a level where cumulative adverse affects to the species' population would occur. Although cowbirds can cause damage or pose threats of damage, most take of cowbirds by WS would be the result of addressing flocks of mixed species flocks of blackbirds. That take is not likely to reach a level where adverse affects on the species' population would occur and would be of low magnitude when compared to the statewide population of cowbirds and trend data.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Bird populations in the State would not be directly impacted by WS from a program implementing technical assistance only. However, persons experiencing damage or threats from birds may implement

methods based on WS' recommendations. Under a technical assistance only alternative, WS would recommend and demonstrate for use both non-lethal and lethal methods legally available for use to resolve bird damage. Methods and techniques recommended would be based on WS' Decision Model using information provided from the requestor or from a site visit. Requestors may implement WS' recommendations, implement other actions, or take no action. However, those persons requesting assistance are likely those that would implement damage abatement methods in the absence of WS' recommendations.

Under a technical assistance only alternative, those persons experiencing threats or damage associated with birds in the State could lethally take birds despite WS' lack of direct involvement in the management action. Therefore, under this alternative the number of birds lethally taken would likely be similar to the other alternatives since take could occur through the issuance of a depredation permit by the USFWS, the take of blackbirds, Canada geese, and cormorants could occur under depredation orders without the need for a permit, take of non-native bird species can occur without the need for a depredation permit from the USFWS, and take would continue to occur during the harvest season for those species with hunting seasons. WS' participation in a management action would not be additive to an action that could occur in the absence of WS' participation.

With the oversight of the USFWS and the AGFC, it is unlikely that bird populations would be adversely impacted by implementation of this alternative. Under this alternative, WS would not be directly involved with damage management actions and therefore, direct operational assistance could be provided by other entities, such as the AGFC, the USFWS, private entities, and/or municipal authorities. If direct operational assistance is not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal take, which could lead to real but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (White et al. 1989, USDA 1997, USFWS 2001, FDA 2003).

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct bird damage management activities in the State. WS would have no direct involvement with any aspect of addressing damage caused by birds and would provide no technical assistance. No take of birds by WS would occur in the State. Birds could continue to be lethally taken to resolve damage and/or threats occurring either through depredation permits issued by the USFWS, under the blackbird, Canada goose, and cormorant depredation orders, during the regulated hunting seasons, or in the case of non-native species, take can occur anytime using legally available methods without a depredation permit. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Local bird populations could decline, stay the same, or increase depending on actions taken by those persons experiencing bird damage. Some resource/property owners may take illegal, unsafe, or environmentally harmful action against local populations of birds out of frustration or ignorance. While WS would provide no assistance under this alternative, other individuals or entities could conduct lethal damage management resulting in impacts similar to the proposed action.

Since birds would still be taken under this alternative, the potential effects on the populations of those bird species in the State would be similar among all the alternatives for this issue. WS' involvement would not be additive to take that could occur since the cooperator requesting WS' assistance could conduct bird damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with birds could occur by other entities despite WS' lack of involvement under this alternative.

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

As discussed previously, a concern is often raised about the potential impacts to non-target species, including T&E species, from the use of methods to resolve damage caused by birds. The potential effects on the populations of non-target wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The potential adverse affects to non-targets occurs from the employment of methods to address bird damage. Under the proposed action, WS could provide both technical assistance and direct operational assistance to those persons requesting assistance. The use of non-lethal methods as part of an integrated direct operational assistance program would be similar to those risks to non-targets discussed in the other alternatives.

Personnel from WS are experienced and trained in wildlife identification and to select the most appropriate methods for taking targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that are as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse impacts on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target take during program activities, the potential for adverse impacts to non-target exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse affects to non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected; therefore, non-target species excluded from areas may potentially be adversely impacted if the area excluded is large enough. The use of auditory and visual dispersal methods used to reduce damage or threats caused by birds are also likely to disperse non-targets in the immediate area the methods are employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential impacts on non-target species are expected to be temporary with target and non-target species often returning after the cessation of dispersal methods since most non-lethal methods are applied over small geographical areas.

Other non-lethal methods available for use under this alternative include live traps, nets, reproductive inhibitors, nest destruction, immobilizing drugs, and repellents. The reproductive inhibitor nicarbazin is not currently registered for use in Arkansas, but may become available to the public in the future. Nest destruction would not adversely affect non-target species since identification of the nests of target species would occur prior to efforts to destroy the nest. Nets are virtually selective for target individuals since activation occurs by attending personnel, with handling of wildlife occurring after deployment of the net. Therefore, any non-targets captured using nets can be immediately released on site. Any potential non-targets captured using non-lethal methods would be handled in such a manner as to ensure the survivability of the animal if released. Even though live-capture does occur from those methods, the potential for death of a target or non-target animal while being restrained or released does exist, primarily from being struck by the cannon or rocket assemblies during deployment. The likelihood of non-targets being struck is extremely low and is based on being present when the net is activated and in a position to be struck. Nets are positioned to envelop wildlife upon deployment and to minimize striking hazards. Baiting of the areas to attract target species often occurs when using nets. Therefore, sites can be abandoned if non-target use of the area is high.

Live traps (*e.g.*, cage traps, walk-in traps, corral traps) restrain wildlife once captured and are considered live-capture methods. Live traps have the potential to live-capture non-target species. Trap placement in areas where target species are active and the use of attractants as specific to the target species as possible would minimize the likelihood of capturing non-targets. Any non-target captured could be released unharmed when employing live traps.

Only those repellents registered with the EPA pursuant to the FIFRA would be recommended and used by WS under this alternative. Therefore, the use and recommendation of repellents would not have negative impacts on non-target species when used according to label requirements. Most repellents for birds are derived from natural ingredients that pose a very low risk to non-targets when exposed to or when ingested. Two chemicals commonly registered with the EPA as bird repellents are methyl anthranilate and anthraquinone. Methyl anthranilate naturally occurs in grapes and is used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants like aloe and is also used to make dye. Both products claim to be unpalatable to many bird species. Several products are registered for use to reduce bird damage containing either methyl anthranilate or anthraquinone. Formulations containing those chemicals are liquids that are applied directly to susceptible resources. Methyl anthranilate applied to alleviate goose damage was effective for about four days depending on environmental conditions which was a similar duration experienced when applying anthraquinone as geese continued to feed on treated areas (Cummings et al. 1995, Dolbeer et al. 1998). Dolbeer et al. (1998) found that geese tended to loaf on anthraquinone treated turf, albeit at lower abundance, but the quantity of feces on treated and untreated turf was the same, thus the risk of damage was unabated. Mesurol is applied directly inside eggs that are of a similar appearance to those being predated on by crows. Therefore, risks to non-target would be restricted to those wildlife species that would select for the egg baits. However, adherence to the label requirements of mesurol would ensure threats to non-targets would be minimal. Similarly, when used in accordance with the label requirements, the use of Avitrol would also not adversely affect non-targets.

Immobilizing drugs are applied through hand-baiting that targets specific individuals or groups of target species. Therefore, immobilizing drugs are only applied after identification of the target occurs prior to application. Pre-baiting and acclimation of the target waterfowl occurs prior to the application of alpha-chloralose which allows for the identification of non-targets that may visit the site prior to application of the bait. All unconsumed bait is retrieved after the application session has been completed. Since sedation occurs after consumption of the bait, personnel are present on site at all times to retrieve waterfowl. This constant presence by WS' personnel would allow for continual monitoring of the bait to ensure non-targets are not present. Based on the use pattern of alpha-chloralose by WS, no adverse affects to non-targets are expected from the use of alpha-chloralose.

The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas where non-lethal methods are employed of both target and non-target species. Therefore, any use of non-lethal methods has similar results on both non-target and target species. Though non-lethal methods do not result in the lethal take of non-targets, the use of non-lethal methods can restrict or prevent access of non-targets to beneficial resources. Overall, potential impacts to non-targets from the use of non-lethal methods only would not adversely impact populations since those methods are often temporary.

Since nicarbazin under the tradename OvoControl® G and OvoControl® P could be commercially available to those with a certified applicators license, the use of the product could occur under any of the alternatives discussed in the EA; therefore, the effects of the use would be similar across all the alternatives if the product is used according to label instructions. Under the proposed action, WS could use or recommend nicarbazin as part of an integrated approach to managing damages associated with geese and pigeons if the product becomes registered for use in Arkansas. WS' use of nicarbazin under the proposed action would not be additive since the use of the product could occur from other sources, such

as private pest management companies or those persons experiencing damage could become a certified applicator and apply the bait themselves when the appropriate depredation permits are received.

Exposure of non-target wildlife to nicarbazin could occur either from direct ingestion of the bait by non-target wildlife or from secondary hazards associated with wildlife consuming birds that have eaten treated bait. Several label restrictions of available products are intended to reduce risks to non-target wildlife from direct consumption of treated bait (EPA 2005). The label requires an acclimation period that habituates target bird species to feeding in one location at a certain time period. During baiting periods, the applicator must be present on site until all bait has been consumed. Non-target risks are further minimized by requirements that bait can only be distributed in bait pans or through broadcast application (by hand or mechanical feeders). All unconsumed bait must also be retrieved daily which further reduces threats of non-target consuming treated bait.

In addition, nicarbazin is only effective in reducing the hatch of eggs when blood levels of 4,4'-dinitrocarbanilide (DNC) are sufficiently elevated in a bird species. When consumed by birds, nicarbazin is broken down into the two base components of DNC and 4,4'-dinitrocarbanilide (HDP) which are then rapidly excreted. To maintain the high blood levels required to reduce egg hatch, birds must consume nicarbazin daily at a sufficient dosage that appears to be variable depending on the bird species (Yoder et al. 2005, Avery et al. 2006). For example, to reduce egg hatch in Canada geese, geese must consume nicarbazin at 2,500 ppm compared to 5,000 ppm required to reduce egg hatch in pigeons (Avery et al. 2006, Avery et al. 2008). In pigeons, consuming nicarbazin at a rate that would reduce egg hatch in Canada geese did not reduce the hatchability of eggs in pigeons (Avery et al. 2006). With the rapid excretion of the two components of nicarbazin (DNC and HDP) in birds, non-targets birds would have to consume nicarbazin daily at sufficient doses to reduce the rate of egg hatching.

Secondary hazards also exist from wildlife consuming geese or pigeons that have ingested nicarbazin. As mentioned previously, once consumed, nicarbazin is rapidly broken down into the two base components DNC and HDP. DNC is the component of nicarbazin that limits egg hatchability while HDP only aids in absorption of DNC into the bloodstream. DNC is not readily absorbed into the bloodstream and requires the presence of HDP to aid in absorption of appropriate levels of DNC. Therefore, to pose a secondary hazard to wildlife, ingestion of both DNC and HDP from the carcass would have to occur and HDP would have to be consumed at a level to allow for absorption of the DNC into the bloodstream. In addition, an appropriate level of DNC and HDP would have to be consumed from a carcass daily to produce any negative reproductive affects to other wildlife since current evidence indicates a single dose does not limit reproduction. To be effective, nicarbazin (both DNC and HDP) must be consumed daily during the duration of the reproductive season to limit the hatchability of eggs. Therefore, to experience the reproductive affects of nicarbazin, geese or pigeons that had consumed nicarbazin would have to be consumed by a non-target species daily and a high enough level of DNC and HDP would have to be available in the carcass and consumed for reproduction to be affected. Based on the risks and likelihood of wildlife consuming a treated carcass daily and receiving the appropriate levels of DNC and HDP daily to negatively impact reproduction, secondary hazards to wildlife from the use of nicarbazin are extremely low (EPA 2005).

Although some risks to other non-target species besides bird species does occur from the use of nicarbazin, those risks are likely to be minimal given the restrictions on where and how bait can be applied. Although limited toxicological information for nicarbazin exists for wildlife species besides certain bird species, available toxicology data indicates nicarbazin is relatively non-toxic to other wildlife species (World Health Organization 1998, EPA 2005, California Department of Pesticide Regulation 2007). Given the use restrictions of nicarbazin and the limited locations where bait can be applied, the risks of exposure to non-targets would be extremely low.

Impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal take would occur. Non-lethal methods, except for alpha-chloralose and mesurol, would be available under all the alternatives analyzed. WS' involvement in the use of or recommendation of non-lethal methods would ensure non-target impacts are considered under WS' Decision Model. Impacts to non-targets under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

WS would also employ and/or recommend lethal methods under the proposed action alternative to alleviate damage. Lethal methods available for use to manage damage caused by birds under this alternative would include the recommendation of take by private entities during the hunting season, shooting, DRC-1339, and euthanasia after live capture. The use of firearms is essentially selective for target species since animals are identified prior to application; therefore, no adverse impacts are anticipated from use of this method. The euthanasia of birds by WS' personnel would be conducted in accordance with WS Directive 2.505. Chemical methods used for euthanasia would be limited to carbon dioxide administered in an enclosed chamber after birds have been live-captured. Since live-capture of birds using other methods occurs prior to the administering of euthanasia chemicals, no adverse affects to non-targets would occur under this alternative. WS' recommendation that birds be harvested during the regulated season by private entities to alleviate damage would not increase risks to non-targets. Shooting is essentially selective for target species and non-target take is not likely and would not increase based on WS' recommendation of the method.

A common concern regarding the use of DRC-1339 is the potential non-target risks. All label requirements of DRC-1339 would be followed to minimize non-target hazards. As required by the label, all potential bait sites are pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets are observed feeding on the pre-bait, the plots are abandoned and no baiting would occur at those locations. Treated bait is mixed with untreated bait per label requirements when applied to bait sites to minimize the likelihood of non-targets finding and consuming bait that has been treated. The bait type selected can also limited the likelihood that non-target species would consume treated bait since some bait types are not preferred by non-target species.

Once sites are baited, sites are monitored daily to further observe for non-target feeding activity. If non-targets are observed feeding on bait, those sites are abandoned. By acclimating target bird species to a feeding schedule, baiting can occur at specific times to ensure bait placed is quickly consumed by target bird species, especially when large flocks of target species are present. The acclimation period allows for treated bait to be present only when birds are conditioned to be present at the site and provides a higher likelihood that treated bait is consumed by the target species which makes it unavailable to non-targets. In addition, with many blackbird species, including crows, when present in large numbers, tend to exclude non-targets from a feeding area due to their aggressive behavior and by the large number of conspecifics present at the location. Therefore, risks to non-target species from consuming treated bait only occurs when treated bait is present at a bait location. WS would retrieve all dead birds to the extent possible following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

DRC-1339 Primary Hazard Profile - DRC-1339 was selected for reducing bird damage because of its high toxicity to blackbirds (DeCino et al. 1966, West et al. 1967, Schafer 1972) and low toxicity to most mammals, sparrows, and finches (Schafer and Cunningham 1966, Apostolou 1969, Schafer 1972, Schafer et al. 1977, Matteson 1978, Cunningham et al. 1979, Cummings et al. 1992, Sterner et al. 1992). The likelihood of a non-target bird obtaining a lethal dose is dependent on: (1) frequency of encountering the bait, (2) length of feeding bout, (3) the bait dilution rate, (4) the bird's propensity to select against the treated bait, and (5) the susceptibility of the non-target species to the toxicant. Birds that ingest DRC-

1339 probably die because of irreversible necrosis of the kidney and subsequent inability to excrete uric acid (*i.e.*, uremic poisoning) (DeCino et al. 1966, Felsenstein et al. 1974, Knittle et al. 1990). Birds ingesting a lethal dose of DRC-1339 usually die in one to three days.

The median acute lethal dose (LD_{50})[10] values for starlings, blackbirds, and magpies (Corvidae) range from one to five mg/kg (Eisemann et al. 2003). For American crows, the median acute lethal dose has been estimated at 1.33 mg/kg (DeCino et al. 1966). The acute oral toxicity (LD_{50}) of DRC-1339 has been estimated for over 55 species of birds (Eisemann et al. 2003). DRC-1339 is toxic to mourning doves (*Zenaidura macroura*), pigeons, quail (*Coturnix coturnix*), chickens and ducks (*Anas* spp.) at ≥5.6 mg/kg (DeCino et al. 1966). In cage trials, Cummings et al. (1992) found that 2% DRC-1339-treated rice did not kill savannah sparrows (*Passerculus sandwichensis*). Gallinaceous birds and waterfowl may be more resistant to DRC-1339 than blackbirds, and their large size may reduce the chances of ingesting a lethal dose of poison (DeCino et al. 1966). Avian reproduction does not appear to be affected from ingestion of DRC-1339 treated baits until levels are ingested where toxicity is expressed (USDA 2001).

There have been concerns expressed about the study designs used to derived acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine acute toxicity to pesticides has many views (Lipnick et al. 1995). The use of small sample sizes was the preferred method of screening for toxicity beginning as early as 1948 to minimize the number of animals involved (Dixon and Mood 1948). In 1982, the EPA established standardized methods for testing for acute toxicity that favored larger sample sizes (EPA 1982). More recently, regulatory agencies have again begun to debate the appropriate level of sample sizes in determining acute toxicity based on a growing public concern for the number of animals used for scientific purposes.

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment (ECOFRAM) was established by EPA to provide guidance on ecological risk assessment methods (EPA 1999). The committee report recommended to the EPA that only one definitive LD_{50} be used in toxicity screening either on the mallard or northern bobwhite and recommended further testing be conducted using the up-and-down method (EPA 1999). Many of the screening methods used for DRC-1339 prior to the establishment of EPA guidelines in 1982 used the up-and-down method of screening (Eisemann et al. 2003).

A review of the literature shows that LD_{50} research using smaller sample sizes conducted prior to EPA established guidelines are good indicators of LD_{50} derived from more rigorous designs (Bruce 1985, Bruce 1987, Lipnick et al. 1995). Therefore, acute and chronic toxicity data gathered prior to EPA guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

DRC-1339 Secondary Hazards -Secondary poisoning has not been observed with DRC-1339 treated baits. During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost non-existent.

DRC-1339 is rapidly metabolized and excreted and does not bioaccumulate which probably accounts for its low secondary hazard profile (Schafer 1991, USDA 1997). For example, cats, owls and magpies would be at risk only after exclusively eating DRC-1339-poisoned starlings for 30 continuous days

[10] An LD_{50} is the dosage in milligrams of material per kilogram of body weight required to cause death in 50% of a test population of a species.

(Cunningham et al. 1979). Studies using the American kestrel (*Falco sparverius*) as a surrogate species show that secondary hazards to raptors are small, and those birds are not put at risk by DRC-1339 baiting (USDA 1997). The risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999).

The risks associated with non-target animal exposure to DRC-1339 baits have been evaluated in rice fields in Louisiana (Glahn et al. 1990, Cummings et al. 1992, Glahn and Wilson 1992), poultry and cattle feedlots in several western states (Besser 1964, Ford 1967, Royall et al. 1967), ripening sunflower fields in North Dakota (Linz et al. 2000), and around blackbird staging areas in east-central South Dakota (Knutsen 1998, Linz et al.1999, Smith 1999). Smith (1999) used field personnel and dogs to search for dead non-target animals and found no non-target carcasses that exhibited histological signs consistent with DRC-1339 poisoning. The other studies also failed to detect any non-target birds that had succumbed to DRC-1339. However, DRC-1339 is a slow-acting avicide and thus, some birds could move to areas not searched by the study participants before dying.

DRC-1339 Environmental Degradation - DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation and has a half-life of less than two days (USDA 1997). DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. The chemical tightly binds to soil and has low mobility. The half life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (*i.e.*, degradation chemicals) have low toxicity. Aquatic and invertebrate toxicity is low (USDA 1997). WS' programmatic FEIS contains a thorough risk assessment of DRC-1339 and the reader is referred to that source for a more complete discussion (USDA 1997). That risk assessment concluded that no adverse effects are expected from use of DRC-1339.

Additional concerns have been raised regarding the risks to non-target wildlife associated with crows caching bait treated with DRC-1339. Crows are known to cache surplus food usually by making a small hole in the soil using the bill, by pushing the food item under the substrate, or covering items with debris (Verbeek and Caffrey 2002). Distances traveled from where the food items were gathered to where the item is cached varies but some studies suggests crows can travel up to 100 meters (Kilham 1989) and up to 2 kilometers (Cristol 2001, Cristol 2005). Caching activities appear to occur throughout the year but may increase when food supplies are low. Therefore, the potential for treated baits to be carried from a bait site to surrounding areas exists as part of the food cache behavior exhibited by crows.

Several mitigating factors must be overcome for non-target risks to occur from bait cached by a crow. Those factors being: (1) the non-target wildlife species would have to locate the cached bait, (2) the bait-type used to target crows would have to be palatable or selected for by the non-target wildlife, (3) the non-target wildlife species consuming the treated bait would have to consume a lethal dose from a single bait, and (4) if a lethal dose is not achieved by eating a single treated cached bait, the non-target wildlife would have to ingest several treated baits (either from cached bait or from the bait site) to obtain a lethal dose which could vary by the species.

DRC-1339 is typically very unstable in the environment and degrades quickly when exposed to sunlight, heat, and ultraviolet radiation. The half-life of DRC-1339 in biologically active soil was estimated at 25 hours with the identified metabolites having a low toxicity (EPA 1995). DRC-1339 is also highly soluble in water, does not hydrolyze, and photodegrades quickly in water with a half-life estimated at 6.3 hours in summer, 9.2 hours in spring sunlight, and 41 hours during winter (EPA 1995). DRC-1339 binds tightly with soil and is considered to have low mobility (EPA 1995). Given the best environmental fate information available and the unlikelihood of a non-target locating enough treated bait(s) sufficient to produce lethal effects, the risks to non-target from crows caching treated bait would be low. When baiting, treated baits are mixed with untreated bait to minimize non-target hazards directly at the bait site

and to minimize the likelihood of target species developing bait aversion. Since treated bait is diluted, often times up to 1 treated bait for every 25 untreated baits, the likelihood of a crow selecting treated bait and then caching the bait is further reduced.

While every precaution is taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by birds, the use of such methods can result in the incidental take of unintended species. Those occurrences are rare and should not affect the overall populations of any species under the current program. WS' take of non-target species during activities to reduce damage or threats to human safety associated with birds in Arkansas is expected to be extremely low to non-existent. No non-targets have been taken by WS during prior bird damage management activities in the State. WS would monitor annually the take of non-target species to ensure program activities or methodologies used in bird damage management do not adversely impact non-targets. Methods available to resolve and prevent bird damage or threats when employed by trained, knowledgeable personnel are selective for target species. WS would annually report to the USFWS and/or the AGFC any non-target take to ensure take by WS is considered as part of management objectives established. The potential impacts to non-targets are similar to the other alternatives and are considered to be minimal to non-existent.

The proposed bird damage management could benefit many other wildlife species that are impacted by their predation or competition for habitat. For example, crows are generally very aggressive nesting area colonizers and will force other species from prime nesting areas. American crows and fish crows often feed on the eggs, nestlings, and fledglings of other bird species. Fish crows are known to feed heavily on colonial waterbird eggs (Mcgowan 2001). This alternative has the greatest possibility of successfully reducing bird damage and conflicts to wildlife species since all available methods could possibly be implemented or recommended by WS.

T&E Species Effects

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. Additional SOPs to avoid T&E effects are described in Chapter 3 of this EA.

Federally Listed Species **-** The current list of species designated as threatened and endangered in Arkansas as determined by the USFWS was obtained and reviewed during the development of this EA. Appendix C contains the list of species currently listed in the State along with common and scientific names. Consultation with the USFWS under Section 7 of the ESA concerning potential impacts of WS' programmatic activities on T&E species was conducted as part of the development of WS' programmatic FEIS (USDA 1997). WS obtained a BO from the USFWS addressing WS' programmatic activities. For the full context of the BO, see Appendix F of WS' programmatic FEIS (USDA 1997).

Based on evaluations in this assessment, WS has determined that an integrated approach using those methods available would not adversely affect the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*)**,** Ozark big-eared bat (*Corynorhinus* (=*Plecotus*) *townsendii ingens*), cave crayfish (*Cambarus zophonastes*), leopard darter (*Percina pantherina*), Florida panther (*Puma* (=*Felis*) *concolor coryi*), Curtis pearlymussel (*Epioblasma florentina curtisii*), fat pocketbook (*Potamilus capax*), Least tern (*Sternula antillarum*), gray wolf (*Canis lupus*), turgid blossom (pearlymussel) (*Epioblasma turgidula*), Louisiana pearlshell (*Margaritifera hembeli*), running buffalo clover (*Trifolium stoloniferum*), and pondberry (*Lindera melissifolia*). This determination is based on the conclusions made by the USFWS in their 1992 BO on WS' programmatic activities (see Appendix F in USDA 1997). In addition, WS has determined that the use of methods under this alternative would have no effect on those T&E species not included in

the 1992 BO or their critical habitats. Furthermore, WS has determined that the use of alpha-chloralose, nicarbazin, mesurol, and lasers would have no effect on any listed T&E species in the State.

State Listed Species – The current list of State listed species as endangered or threatened by the State as determined by the AGFC was obtained and reviewed during the development of the EA. Based on the review of species listed in the State, WS has determined that the proposed activities would no effect on those species currently listed by the State.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under a technical assistance alternative, WS would have no direct impact on non-target species, including T&E species. Methods recommended or provided through loaning of equipment could be employed by those persons requesting assistance. Recommendations would be based on WS' Decision Model using information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize non-target impacts associated with the methods being recommended or loaned. Methods recommended could include non-lethal and lethal methods as deemed appropriate by WS' Decision Model and as permitted by laws and regulations. The only methods that would not be available under a technical assistance only alternative would include alpha-chloralose, DRC-1339, and mesurol which are only available to for use by WS' employees.

The potential impacts to non-targets under this alternative would be variable and based on several factors. If methods are employed, as recommended by WS and cooperating agencies, the potential impacts to non-targets are likely similar to the proposed action. If recommended methods and techniques are not followed or if other methods are employed that were not recommended, the potential impacts on non-target species, including T&E species is likely higher compared to the proposed action.

The potential impacts of harassment and exclusion methods to non-target species would be similar to those described under the proposed action. Harassment and exclusion methods are easily obtainable and simple to employ. Since identification of targets occurs when employing shooting as a method, the potential impacts to non-target species are likely low under this alternative.

Those persons experiencing damage from birds may implement methods and techniques based on the recommendations of WS. The potential for impacts would be based on the knowledge and skill of those persons implementing recommended methods. Potential impacts from providing only technical assistance could be greater than those described in the proposed action if those persons experiencing damage do not implement methods or techniques correctly. Incorrectly implemented methods or techniques recommended by WS could lead to an increase in non-target take.

If requestors are provided technical assistance but do not implement any of the recommended actions, the potential impacts to non-targets would be lower compared to the proposed action. If those persons requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-targets would be similar to the proposed action. Methods or techniques not implemented as recommended or used inappropriately would likely increase potential impacts to non-targets. Therefore, the potential impacts to non-targets, including T&E species would be variable under a technical assistance only alternative. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of birds, which could lead to unknown effects on local non-target species populations, including some T&E species (White et al. 1989, USDA 1997, USFWS 2001, FDA 2003).

The ability to reduce negative impacts caused by birds to wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage

management actions. It would be expected that this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with bird damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Birds would continue to be taken during the regulated harvest season, under depredation permits, and under the depredation order for blackbirds, crows, and cormorants. Risks to non-targets and T&E species would continue to occur from those who implement bird damage management activities on their own or through recommendations by the other federal, state, and private entities. Although some risks occur from those persons that implement bird damage management in the absence of any involvement by WS, those risks are likely low and are similar to those under the other alternatives.

The ability to reduce damage and threats of damage caused by birds would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to non-targets and T&E species would be similar across the alternatives since most of those methods described in Appendix B are available across the alternatives. If those methods available are applied as intended, risks to non-targets would be minimal to non-existent. If methods available are applied incorrectly or applied without knowledge of bird behavior, risks to non-target wildlife would be higher under this alternative. If frustration from the lack of available assistance causes those persons experiencing bird damage to use methods that are not legally available for use, risks to non-targets would be higher under this alternative. People have resorted to the use of illegal methods to resolve wildlife damage that have resulted in the lethal take of non-target wildlife (White et al. 1989, USDA 1997, USFWS 2001, FDA 2003).

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

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

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, those methods discussed in Appendix B, would be integrated to resolve and prevent damage associated with birds in the State. WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Non-lethal and lethal methods could be used under the proposed action. WS would continue to provide technical assistance and/or direct operational assistance to those persons seeking assistance with managing damage or threats from birds. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under the other alternatives. The use of non-lethal methods as part of an integrated approach to managing damage that would be employed as part of direct operational assistance by WS would be similar to those risks addressed in the other alternatives.

Lethal methods available under the proposed action would include the use of firearms, DRC-1339, live-capture followed by euthanasia, and the recommendation that birds be harvested during the regulated hunting season established for those species by the USFWS and the AGFC.

WS' employees who conducted bird damage management activities are knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge is incorporated into the decision-making process inherent with the WS' Decision Model that is applied when addressing threats and damage caused by birds. When employing lethal methods, WS' employees considered risks to human safety when employing those methods based on location and method. Risks to human safety from the use of methods is likely greater in urban areas when compared to rural areas that are less densely populated. Consideration is also given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property is controlled and monitored, the risks to human safety from the use of those methods are less likely. If damage management activities occur at parks or near other public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety increases.

The use of live-capture traps have also been identified as a potential issue. Live-capture traps are typically set in situations where human activity is minimal to ensure public safety. Traps rarely cause serious injury and are triggered through direct activation of the device. Live-capture traps available for birds are typically walk-in style traps where birds enter but are unable to exit. Therefore, human safety concerns associated with live traps are minimal.

Other live-capture devices, such as cannon nets, pose minor safety hazards to the public since activation of the device occurs by trained personnel after target species are observed in the capture area of the net. Lasers also pose minimal risks to the public since application occurs directly to target species by trained personnel which limits the exposure of the public to misuse of the method.

Certain safety issues related to misusing firearms and the potential human hazards associated with firearm use when employed to reduce damage and threats are possible. To help ensure safe use and awareness, WS' employees who use firearms to conduct official duties are required to attend an approved firearm safety training course and to remain certified for firearm use. WS' employees must attend a re-certification safety training course in accordance with WS Directive 2.615. WS' employees who carry and use firearms as a condition of employment, are required to sign a form certifying that they have not been convicted of a misdemeanor crime of domestic violence. A thorough safety assessment would be conducted before firearms are deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues are considered before the use of firearms is deemed appropriate. All methods, including firearms, must be agreed upon with the cooperator to ensure the safety. A risk assessment conducted during the development of WS' programmatic FEIS, determined the risks to human safety from the use of firearms was low based on the use profile of the method (USDA 1997).

All WS' personnel who handle and administered immobilizing drugs would be properly trained. WS' employees handling and administering immobilizing drugs are required to be trained according to WS Directive 2.430. Training and adherence to agency directives would ensure the safety of employees administering any drugs. Birds euthanized by WS after the use of immobilizing drugs would be disposed of by deep burial or incinerated to ensure the risks to human safety from euthanized birds are minimal (WS Directive 2.515). All euthanasia would occur in the absence of the public to further minimize risks. SOPs are further described in Chapter 3 of this EA.

The recommendation of repellents or the use of those repellents registered for use to disperse birds in the State could occur under the proposed action as part of an integrated approach to managing bird damage. Those chemical repellents that would be available to recommend for use or would be directly used by WS under this alternative would also be available under any of the alternatives. Therefore, the risks to human safety associated with repellents under the proposed action would be similar to those risks addressed in

the no WS involvement alternative and the technical assistance only alternative. Repellents could be recommended to those persons requesting assistance or employed by WS as part of an integrated approach to managing bird damage. When repellents are applied according to label instructions, no adverse affects to human safety should occur. If repellents are used by WS, the appropriate protective equipment would be used to ensure the safety of employees. Repellents are not likely to be used over large areas, where negative accumulations would threaten human safety, or where repeated use of repellents results in accumulation of chemicals at the application site. Repellents are registered and evaluated by the EPA which ensures the use of those products would not adversely affect the environment.

Mesurol contains the active ingredient methiocarb and is registered by the EPA for use to condition crows not to feed on the eggs of T&E species. Mesurol is currently not registered for use in Arkansas but will be evaluated in this assessment as a repellent that could be employed under the proposed action if the product becomes available. Mesurol is mixed with water and once mixed, placed inside raw eggs that are similar in size and appearance to the eggs of the species being protected. Treated eggs are placed in the area where the protected species are known to nest at least three weeks prior to the onset of egg-laying to condition crows to avoid feeding on eggs. Methicarb is a carbamate pesticide that acts as a cholinesterase inhibitor. Crows ingesting treated eggs become sick (*e.g.*, regurgitate, become lethargic) but recover. Human safety risks associated with the use of mesurol occur primarily to the mixer and handler during preparation. WS' personnel with follow all label requirements, including the personal protective equipment required to handle and mix bait. When used according to label requirements, the risks to human safety from the use of mesurol would be minimal.

Reproductive inhibitors and immobilizing drugs are formulated on bait and are administered to target wildlife through consumption of treated bait. Therefore, the current concern, outside of transport and storage, is the risks directly to the handler and support staff during the handling and distributing the bait on the ground for consumption.

Threats to human safety from the use of nicarbazin would likely be minimal if labeled directions are followed. The use pattern of nicarbazin would also ensure threats to public safety are minimal. The label requires an acclimation period which assists with identifying risks, requires the presence of the applicator at the location until all bait is consumed, and requires any unconsumed bait be retrieved. The EPA has characterized nicarbazin as a moderate eye irritant. The FDA has established a tolerance of nicarbazin residues of 4 parts per million allowed in uncooked chicken muscle, skin, liver, and kidney (21 CFR 556.445). The EPA characterized the risks of human exposure as low when used to reduce egg hatch in Canada geese. The EPA also concluded that if human consumption occurred, a prohibitively large amount of nicarbazin would have to be consumed to produce toxic effects (EPA 2005). Based on the use pattern of the nicarbazin and if label instructions are followed, risks to human safety would be low with the primary exposure occurring to those handling and applying the product. Safety procedures required by the label, when followed, would minimize risks to handlers and applicators.

Similarly, the use of alpha-chloralose once the target birds are acclimated to feeding at a certain location and time requires the applicator to be present on site during application of treated bait. Alpha-chloralose would be administered according to recommended methods and doses from published sources (see Appendix B). The presence of the applicator and supporting staff to retrieve sedated birds ensures the safety of the public. All unconsumed bait must be retrieved after each baiting application which further reduces threats to human safety. As with nicarbazin, the primary risks to human safety occurs to those persons mixing, handling, and applying treated bait. The use of protective equipment would ensure the safety of employees when mixing, handling, and applying treated bait.

Alpha-chloralose is an immobilizing agent available only for use by WS. The FDA has approved the use of alpha-chloralose as an INAD (INAD #6602) to be used for the immobilization and capture of certain species of birds by trained WS' personnel. Alpha-chloralose is administered to target individuals, either as a tablet or liquid solution contained within a bread ball or as a powder formulated on whole kernel corn. Application of either form occurs by hand with applicators present on site for monitoring. Application of the tablet or liquid solution form in bread baits occurs by hand and targets individual or small groups of waterfowl. Alpha-chloralose formulated on whole corn is placed on the ground in designated areas where target birds are pre-conditioned to feed using a pre-bait. All unconsumed baits are retrieved. Since applicators are present at all times during application of alpha-chloralose, the risks to human safety are low. All WS' employees using alpha-chloralose are required to successfully complete a training course on the proper use and handling of alpha-chloralose. All WS' employees who use alpha-chloralose would wear the appropriate personal protective equipment required to ensure the safety of employees.

Of additional concern with the use of immobilizing drugs and reproductive inhibitors is the potential for human consumption of meat from waterfowl that have been immobilized using alpha-chloralose or have consumed nicarbazin. Since waterfowl are harvested during a regulated harvest season and consumed, the use of immobilizing drugs and potentially reproductive inhibitors is of concern. The intended use of immobilizing drugs is to live-capture geese. Geese are conditioned to feed during a period in the day when consumption of treated bait ensures geese do not disperse from the immediate area where the bait is applied. The use of immobilizing drugs and reproductive inhibitors targets geese in urban environments where hunting and the harvest of geese does not occur or is unlikely to occur (*e.g.*, due to city ordinances preventing the discharge of a firearm within city limits). However, it could be possible for target geese to leave the immediate area where baiting is occurring after consuming bait and enter areas where hunting could occur. To reduce this risk, withdrawal times are often established. A withdrawal time is the period of time established between when the animal consumed treated bait to when it is safe to consume the meat of the animal by humans. Withdrawal periods are not well defined for free-ranging wildlife species for all drugs. In compliance with FDA use restrictions, the use of alpha-chloralose is prohibited for 30 days prior to and during the hunting season on waterfowl and other game birds that could be hunted. In the event that WS is requested to immobilize waterfowl or use nicarbazin either during a period of time when harvest of waterfowl is occurring or during a period of time where a withdrawal period could overlap with the start of a harvest season, WS would not use immobilizing drugs or nicarbazin. In those cases other methods would be employed.

Risks to human safety from the use of avicides could occur either through direct exposure of the chemical or exposure to the chemical from birds that have been lethally taken. The only avicide currently registered for use in Arkansas is DRC-1339 (3-chloro-p-toluidine hydrochloride) that could be used for bird damage management. DRC-1339 is currently registered with the EPA to manage damage associated with several bird species and can be formulated on a variety of bait types depending on the label. Technical DRC-1339 (powder) must be mixed with water and in some cases, a binding agent (required by the label for specific bait types). Once the technical DRC-1339, water, and binding agent, if required, are mixed, the liquid is poured over the bait and mixed until the liquid is absorbed and evenly distributed. The treated bait is then allowed to air dry. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Therefore, risks to public safety from the preparation of DRC-1339 are minimal. Some risks do occur to the handlers during the mixing process from inhalation and direct exposure on the skin and eyes. Adherence to label requirements during the mixing and handling of DRC-1339 treated bait for use of personal protective equipment ensures the safety of WS' personnel handling and mixing treated bait. Therefore, risks to handlers and mixers that adhere to the personal protective equipment requirements of the label are low. Before application at bait locations, treated bait is mixed with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

Locations where treated bait may be placed are determined based on product label requirements (*e.g.*, distance from water, specific location restrictions), the target bird species use of the site (determined through prebaiting and an acclimation period), on non-target use of the area (areas with non-target activity are not used or abandon), and based on human safety (*e.g.*, in areas restricted or inaccessible by the public or where warning signs have been placed). Once appropriate locations are determined, treated baits are placed in feedings stations or are broadcast using mechanical methods (ground-based equipment or hand spreaders) and by manual broadcast (distributed by hand) per label requirements. Once baited using the diluted mixture (treated bait and untreated bait) when required by the label, locations are monitored for non-target activity and to ensure the safety of the public. After each baiting session, all uneaten bait is retrieved. Through prebaiting, target birds can be acclimated to feed at certain locations at certain periods of time. By acclimating birds to a feeding schedule, baiting can occur at specific times to ensure bait placed is quickly consumed by target bird species, especially when large flocks of target species are present. The acclimation period allows for treated bait to be placed at a location only when target birds are conditioned to be present at the site and provides a higher likelihood that treated bait is consumed by the target species which makes it unavailable for potential exposure to humans. To be exposed to the bait, someone would have to approach a bait site and handle treated bait. If the bait has been consumed by target species or is removed by WS, then treated bait is no longer available and human exposure to the bait could occur. Therefore, direct exposure to treated bait during the baiting process would only occur if someone approached a bait site that contained bait and if treated bait was present, would have to handle treated bait.

Factors that minimize any risk of public health problems from the use of DRC-1339 are: 1) its use is prohibited within 50 feet of standing water and cannot be applied directly to food or feed crops (contrary to some misconceptions, DRC-1339 is not applied to feed materials that livestock can feed upon), 2) DRC-1339 is highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation. The half-life is about 25 hours; in general, DRC-1339 on treated bait material is almost completely broken down within a week if not consumed or retrieved, 3) the chemical is more than 90% metabolized in target birds within the first few hours after they consume the bait. Therefore, little material is left in bird carcasses that may be found or retrieved by people, 4) application rates are extremely low (EPA 1995), 5) a human would need to ingest the internal organs of birds found dead from DRC-1339 to be exposed, and 6) the EPA has concluded that, based on mutagenicity (the tendency to cause gene mutations in cells) studies, this chemical is not a mutagen or a carcinogen (*i.e.*, cancer-causing agent) (EPA 1995).

Of additional concern is the potential exposure of people to crows harvested during the regulated hunting season that have ingested DRC-1339 treated bait. The hunting season for crows in the State during the development of this assessment occurred from September until the end of February the following calendar year with no daily take limit and no possession limit (AGFC 2010). Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur in the State during the period of time when crows could be harvested. Although baiting could occur in rural areas of the State during those periods of time, most requests for assistance to manage crow damage during the period of time when crows can be harvested in the State occur in urban areas associated with urban crow roosts. Crows using urban communal roost locations often travel long distances to forage before returning to the roost location during the evening.

When managing damage associated with urban crow roosts, the use of DRC-1339 would likely occur at known forage areas (where crows from a roost location are known to travel to) or could occur near the roost location where crows have be conditioned to feed through the use of prebaiting. Crows are known to stage (congregate) in an area prior to entering a roost location in the evenings. The staging behavior of exhibited by blackbirds occurs consistently and can be induced to occur consistently at a particular

location through the use of prebaiting since blackbirds often feed prior to entering a roost location. Prebaiting can also induce feeding at a specific location as crows exit a roost location in the morning by providing a consistent food source. Baiting with DRC-1339 treated baits most often occurs during the winter when the availability of food is limited and crows can be conditioned to feed consistently at a location by providing a consistent source of food. Given the range in which the death of sensitive bird species occurs, crows that consume treated bait could fly long distances. Although not specifically known for crows, sensitive bird species that ingest a lethal dose of DRC-1339 treated bait generally die within 24 to 72 hours after ingestion (USDA 2001). Therefore, crows that ingest a lethal dose of DRC-1339 at the bait site could die in other areas besides the roost location or the bait site.

For a crow that ingested DRC-1339 treated bait to pose a potential risk to human safety to someone harvesting crows during the hunting season in the State, a hunter would have to harvest a crow that ingested DRC-1339 treated bait and subsequently consume certain portions of the crow. The mode of action of DRC-1339 requires ingestion by crows so handling a crow harvested or found dead would not pose any primary risks to human safety. Although not specifically known for crows, in other sensitive species, DRC-1339 is metabolized and/or excreted quickly once ingested. In starlings, nearly 90% of the DRC-1339 administered dosages well above the LD_{50} for starlings was metabolized or excreted within 30 minutes of dosage (Cunningham et al. 1979). In one study more than 98% of a DRC-1339 dose delivered to starlings could be detected in the feces with 2.5 hours (Peoples and Apostolou 1967) with similar results found for other bird species (Eisemann et al. 2003). Once death occurs, DRC-1339 concentrations appear to be highest in the gastrointestinal tract of birds but some residue could be found in other tissue of carcasses examined (Giri et al. 1976, Cunningham et al. 1979, Johnston et al. 1999) with residues diminishing more slowly in the kidneys (Eisemann et al. 2003). However, most residue tests to detect DRC-1339 in tissues of birds have been completed using DRC-1339 dosages that far exceeded the known acute lethal oral dose for those species tested and far exceeds the level of DRC-1339 that would be ingested from treated bait. Johnston et al. (1999) found DRC-1339 residues in breast tissue of boat-tailed grackles (*Quiscalus major*) using acute doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for boat-tailed grackles has been estimated to be ≤ 1 mg/kg which is similar to the LD_{50} for crows (Eisemann et al. 2003). In those boat-tailed grackles consuming a trace of DRC-1339 up to 22 mg/kg, no DRC-1339 residues were found in the gastrointestinal track nor found in breast tissue (Johnston et al. 1999).

In summary, nearly all of the DRC-1339 ingested by sensitive species is metabolized or excreted quickly, normally within a few hours. Residues of DRC-1339 have been found in the tissues of birds consuming DRC-1339 at very high dosage rates that exceed current acute lethal dosages achieved under the label requirements of DRC-1339. Residues of DRC-1339 ingested by birds appear to be primarily located in the gastrointestinal tract of birds. As stated previously, to pose of risks to human safety, a hunter would have to harvest a crow that has ingested DRC-1339 and then, ingest tissue of the crow containing residue. Very little information is available on the acute or chronic toxicity of DRC-1339 on people. However, based on the information available risks to human safety would be extremely low based on several factors. First, a hunter would have to harvest a crow that had ingested DRC-1339. As stated previously, the use of DRC-1339 primarily occurs to address damage associated with urban roosts. Hunting and discharging a firearm is prohibited in most municipal areas. Therefore, a crow would have to ingest treated bait and then travel to an area (typically outside of the city limit) where hunting was allowed. WS would not recommend hunting as a damage management tool in those general areas where DRC-1339 was actively being applied. Secondly, to pose a risk to human safety the crow would have to be consumed and the tissue consumed would have to contain chemical residues. Current information indicates that the majority of the chemical is excreted within a few hours of ingestion. The highest concentration of the chemical occurs in the gastrointestinal tract of the bird which is discarded and not consumed. Although residues have been detected in the tissues that might be consumed, residues appear to only be detectable when the bird has consumed a large dose of the chemical that far exceeds the LD_{50}

for that species and would not be achievable under normal baiting procedures. Although no information is currently available on the number of people that might consume crows in Arkansas, very few, if any, people are likely consuming crows harvested in the State or elsewhere. Under the proposed action, the controlled and limited circumstances in which DRC-1339 would be used would prevent any exposure of the public to this chemical. Based on current information, the human health risks from the use of DRC-1339 would be virtually nonexistent under this alternative.

The recommendation by WS that birds be harvested during the regulated hunting season which is established by the AGFC under frameworks determined by the USFWS would not increase risks to human safety above those risks already inherent with hunting those species. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce local bird populations which could then reduce damage or threats would not increase risks to human safety. Safety requirements established by the AGFC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of birds would not increase those risks.

No adverse affects to human safety have occurred from WS' use of methods to alleviate bird damage in the State from FY 2004 through FY 2009. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, is considered low.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under this alternative, WS would be restricted to making recommendations of methods and the demonstration of methods only to resolve damage. The only methods that would not be available under this alternative would be alpha-chloralose, mesurol, and DRC-1339. WS would only provide technical assistance to those persons requesting assistance with bird damage and threats. Although hazards to human safety from non-lethal methods exist, those methods are generally regarded as safe when used by trained individuals who are experienced in their use. Risks to human safety from the use of non-lethal methods were considered low when evaluated in a formal risk assessment in WS' programmatic FEIS (USDA 1997). Risks to human safety associated with non-chemical methods such as resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, and cage traps were considered low based on their use profile for alleviating damage associated with wildlife (USDA 1997). Although some risk of fire and bodily harm exists from the use of pyrotechnics and propane cannons, when used appropriately and in consideration of those risks, they can be used with a high degree of safety.

Personnel employing nets are present at the site during application to ensure the safety of the public and operators. Although some fire and explosive hazards exist with rocket nets during ignition and storage of the explosive charges, safety precautions associated with the use of the method, when adhered to, pose minimal risks to human safety and primarily occur to the handler. Nets would not be employed in areas where public activity is high which further reduces the risks to the general public. Nets would be employed in areas where public access is restricted whenever possible to reduce risks to human safety. Overall, nets would pose minimal risks to the public.

The use of chemical methods that are considered non-lethal would also be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage birds in the State. Most repellents require ingestion of the chemical to achieve the desired affects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse birds from areas where the repellents are applied. The active ingredients of repellents that are currently registered for use to disperse birds include methyl anthranilate and polybutene. Another common active ingredient in repellents intended to disperse other bird species

contain the active ingredient anthraquinone. Methyl anthranilate (grape derivative) and anthraquinone (plant extract) are naturally occurring chemicals. Repellents, when used according to label directions, are generally regarded as safe especially when the ingredients are considered naturally occurring. Some risk of exposure to the chemical occurs to the applicator and to others from the potential for drift as the product is applied. Some repellents also have restrictions on whether application can occur on edible plants with some restricting harvest for a designated period after application. All restriction on harvest and required personal protective equipment would be included on the label and if followed, would minimize risks to human safety associated with the use of those products.

Reproductive inhibitors are formulated on bait and are administered to target wildlife through hand-baiting and subsequent consumption of treated bait. Therefore, the concern, outside of transport and storage, is the risks directly to the handler and support staff during the handling and distributing the bait on the ground for consumption.

Threats to human safety from the use of nicarbazin would likely be minimal if labeled directions are followed. The use pattern of nicarbazin would also ensure threats to public safety are minimal. The label requires an acclimation period which assists with identifying risks, requires the presence of the applicator at the location until all bait is consumed, and requires any unconsumed bait to be retrieved. The EPA has characterized nicarbazin as a moderate eye irritant. Based on the use pattern of the nicarbazin and if label instructions are followed, risks to human safety would be low with the primary exposure occurring to those persons handling and applying the product. Safety procedures required by the label, when followed, would minimize risks to handlers and applicators.

Given the use profile of many chemical methods to manage damage and threats associated with birds, the risks to human safety from the use of those methods are low when those methods are applied according to label requirements (USDA 1997). The cooperator requesting assistance is also made aware of threats to human safety associated with the use of those methods. SOPs for methods are discussed in Chapter 3 of this EA. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available, except for alpha-chloralose, mesurol, and DRC-1339. If misused or applied inappropriately, any of the methods available to alleviate bird damage could threaten human safety. However, when used appropriately methods available to alleviate damage would not threaten human safety.

The recommendation by WS that birds be harvested during the regulated hunting season which is established by the AGFC would not increase risks to human safety above those risks already inherent with hunting birds. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce local bird populations which could then reduce bird damage or threats would not increase risks to human safety. Safety requirements established by the AGFC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized bird populations would not increase those risks.

The recommendation of shooting with firearms either as a method of direct lethal take or as a harassment method could occur under this alternative. Safety issues due arise related to misusing firearms and the potential human hazards associated with firearms use when employed to reduce damage and threats. When used appropriately and with consideration for human safety, risks associated with firearms are minimal. If firearms are employed inappropriately or without regard to human safety, serious injuries could occur. Under this alternative, recommendations of the use of firearms by WS would include human safety considerations. Since the use of firearms to alleviate bird damage would be available under any of the alternatives and the use of firearms by those persons experiencing bird damage could occur whether WS was consulted or contacted, the risks to human safety from the use of firearms would be similar among all the alternatives.

If non-chemical methods are employed according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to the proposed action. If methods are employed without guidance from WS or applied inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. Non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

Given the use profile of many methods to manage damage and threats associated with birds, the risks to human safety from the use of those methods are low (USDA 1997). The cooperator requesting assistance is also made aware of threats to human safety associated with the use of those methods. Risks to human safety from activities and methods recommended under this alternative would be similar to the other alternatives since the same methods would be available. If misused or applied inappropriately, any of the methods available to alleviate bird damage could threaten human safety. However, when used appropriately and in consideration of human safety, methods available to alleviate damage would not threaten human safety.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management alternative, WS would not be involved with any aspect of managing damage associated with birds in the State, including technical assistance. Due to the lack of involvement in managing damage caused by birds, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage from birds from conducting damage management activities in the absence of WS' involvement when permitted by the USFWS and/or the AGFC. Methods discussed in Appendix B would be available to those persons experiencing damage or threats and could be used to take birds if permitted by the USFWS and/or the AGFC. The direct burden of implementing permitted methods would be placed on those persons requesting assistance.

Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Since most non-chemical methods available for bird damage management involve the live-capture or harassment of birds, those methods are generally regarded as posing minimal risks to human safety. Habitat modification and harassment methods are also generally regarded as posing minimal risks to human safety. Though some risks to safety are likely to occur with the use of pyrotechnics, propane cannons, and exclusion devices, those risks are minimal when those methods are used appropriately and in consideration of human safety. The only methods that would be available under this alternative that would involve the direct lethal taking of birds are shooting and nest destruction. Under this alternative, shooting and nest destruction would be available to those persons experiencing damage or threats of damage when permitted by the USFWS and/or the AGFC. Firearms, when handled appropriately and with consideration for safety, pose minimal risks to human safety.

Similar to the technical assistance only alternative, alpha-chloralose, mesurol, and DRC-1339 would not be available under this alternative to those persons experiencing damage or threats from birds. Chemical methods that would be available to the general public would include repellents and if a person obtained the appropriate restricted use pesticide license, reproductive inhibitors, if registered in the State, could be applied. Since most methods available to resolve or prevent bird damage or threats are available to anyone, the threats to human safety from the use of those methods are similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or are not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, pose minimal risks to human safety.

Issue 4 - Effects on the Aesthetic Values of Birds

People often enjoy viewing, watching, and knowing birds exist as part of the natural environment and gain aesthetic enjoyment in such activities. Those methods available to alleviate damage are intended to disperse and/or remove birds. Non-lethal methods are intended to exclude or make an area less attractive which disperses birds to other areas. Similarly, lethal methods are intended to remove those birds identified as causing damage or posing a threat of damage. The effects on the aesthetic value of birds as it relates to the alternatives are discussed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of birds to resolve damage and threats. In some instances where birds are dispersed or removed, the ability of interested persons to observe and enjoy those birds would likely temporarily decline.

Even the use of exclusionary devices can lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant has been removed or made unavailable, the wildlife would likely disperse to other areas where resources are more vulnerable.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of birds to address or prevent damage and threats. The goal under the proposed action is to respond to requests for assistance and to manage those birds responsible for the resulting damage. Therefore, the ability to view and enjoy birds would still remain if a reasonable effort is made to locate birds outside the area in which damage management activities occurred. Those birds removed by WS are those birds that could be removed by the person experiencing damage.

All activities are conducted where a request for assistance has been received and only after agreement for such services have been agreed upon by the cooperator. Some aesthetic value would be gained by the removal of birds and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high bird densities. Any removal of birds by WS using lethal methods in the State would occur after the appropriate depredation permits are received from the USFWS, when required.

Since those birds removed by WS under this alternative could be removed with a depredation permit issued by the USFWS, under depredation orders, during the regulated hunting seasons, or without the need for a depredation permit, WS' involvement in taking those birds would not likely be additive to the number of birds that could be taken in the absence of WS' involvement.

WS' take of birds from FY 2004 through FY 2009 has been of low magnitude compared to the total known mortality. WS' activities are not likely additive to the birds that would be taken in the absence of WS' involvement. Although birds removed by WS are no longer present for viewing or enjoying, those birds would likely be taken by the property owner or manager under depredation orders or permits, if required. Given the limited take proposed by WS under this alternative when compared to the known sources of mortality of birds, WS' bird damage management activities conducted pursuant to the proposed action would not adversely affect the aesthetic value of birds. The impact on the aesthetic value of birds and the ability of the public to view and enjoy birds under the proposed action would be similar to the other alternatives and is likely low.

Executive Order 13112 directs federal agencies whose actions may affect the status of invasive species to reduce invasion of those species and the associated damages to the extent practicable and permitted by law. All activities are conducted where a request for assistance has been received and only after agreement for such services as been agreed upon by the cooperator. Some loss of aesthetic value would be gained by the removal of an invasive species and the return of a more natural environment, including the return of native wildlife that may be suppressed or displaced by the presence of invasive starlings and rock pigeons.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

If those persons seeking assistance from WS were those persons likely to conduct bird damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of birds in the State similar to Alternative 3. Birds could continue to be lethally taken under this alternative by those entities experiencing bird damage or threats which would result in localized reductions in the presence of birds at the location where damage was occurring. The presence of birds where damage was occurring would be reduced where damage management activities are conducted under any of the alternatives. Even the recommendation of non-lethal methods is likely to result in the dispersal of birds from the area if those non-lethal methods recommended by WS are employed by those persons receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of birds since any activities conducted to alleviate bird damage could occur in the absence of WS' participation in the action, either directly or indirectly.

Under this alternative, the effects on the aesthetic values of birds would be similar to those addressed in the proposed action. When people seek assistance with managing damage either from WS or another entity, the damage level has often reached an unacceptable economic threshold for that particular person. Therefore, in the case of bird damage, the social acceptance level of those birds has reached a level where assistance is requested and those persons are likely to apply methods or seek those entities that would apply those methods based on recommendations provided by WS or by other entities. Based on those recommendations, methods are likely to be employed by the requestor that would result in the dispersal and/or removal of birds responsible for damage or threatening safety. If those birds causing damage are dispersed or removed by those persons experiencing damage based on recommendation by WS or other entities, the potential effects on the aesthetic value of those birds would be similar to the proposed action alternative.

The impacts on aesthetics from a technical assistance program would only be lower than the proposed action if those individuals experiencing damage are not as diligent in employing those methods as WS would be if conducting an operational program. If those persons experiencing damage abandoned the use of those methods then birds would likely remain in the area and available for viewing and enjoying for those persons interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities occurs is not such that birds would be dispersed or removed from such large areas that opportunities to view and enjoy birds would be severely limited.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of birds in the State. Those persons experiencing damage or threats from birds would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. The degree to which damage management activities would occur in the absence of assistance by any agency is unknown but likely lower compared to damage management activities that would occur where some level of assistance was provided. Birds could still be dispersed or removed

under this alternative by those persons experiencing damage or threats of damage. The potential impacts on the aesthetic values of birds could be similar to the proposed action if similar levels of damage management activities are conducted by those persons experiencing damage or threats. If no action is taken or if activities are not permitted by the USFWS, then no impact on the aesthetic value of birds would occur under this alternative.

Since birds would continue to be taken under this alternative, despite WS' lack of involvement, the ability to view and enjoy birds would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of birds dispersed or taken since WS' has no authority to regulate take or the harassment of birds in the State. The USFWS and the AGFC with management authority over birds would continue to adjust all take levels based on population objectives for those bird species in the State. Therefore, the number of birds lethally taken annually through hunting and under the depredation permits and orders are regulated and adjusted by the USFWS and the AGFC.

Those persons experiencing damage or threats would continue to use those methods they feel appropriate to resolve bird damage or threats, including lethal take. WS' involvement in bird damage management is therefore, not additive to the birds already taken in the State. The impacts to the aesthetic value of birds would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare concerns associated with methods available for use to manage bird damage has been raised. As described previously, most of those methods available for use to manage bird damage would be available under any of the alternatives, when permitted by the USFWS and the AGFC. The humaneness of methods available for use in Arkansas, as the use of those methods relates to the alternatives, is discussed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, WS would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS which are generally regarded as humane. Non-lethal methods would include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, cage traps, reproductive inhibitors, nets, and repellents.

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

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

assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

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

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

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

If birds are to be live-captured by WS, WS' personnel would be present on-site during capture events or methods would be checked frequently to ensure birds captured are addressed timely and to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, lethal methods could also be employed to resolve requests for assistance to resolve or prevent bird damage and threats. Lethal methods would include shooting, DRC-1339, the recommendation that birds be harvested during regulated hunting seasons, and euthanasia after birds are live-captured. WS' use of euthanasia methods under the proposed action would follow those required by WS' directives (WS Directive 2.505) and recommended by the AVMA for use on free-ranging wildlife under field conditions (AVMA 2007).

The euthanasia methods being considered for use under the proposed action for live-captured birds are cervical dislocation and carbon dioxide. The AVMA guideline on euthanasia lists cervical dislocation and carbon dioxide as an acceptable method of euthanasia for free-ranging birds which can lead to a humane death (AVMA 2007). The use of cervical dislocation or carbon dioxide for euthanasia would occur after the animal has been live-captured and away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2007). WS' personnel that employ firearms to address bird damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

Although the mode of action of DRC-1339 is not well understood, it appears to cause death primarily by nephrotoxicity in susceptible species and by central nervous system depression in non-susceptible species (Decino et al. 1966, Westberg 1969, Schafer 1984). DRC-1339 causes irreversible necrosis of the kidney and the affected bird is subsequently unable to excrete uric acid with death occurring from uremic poisoning and congestion of major organs (Decino et al. 1966, Knittle et al. 1990). The external appearances and behavior of starlings that ingested DRC-1339 slightly above the LD_{50} for starlings

appeared normal for 20 to 30 hours, but water consumption doubled after 4 to 8 hours and decreased thereafter. Food consumption remained fairly constant until about 4 hours before death, at which time starlings refused food and water and became listless and inactive. The birds perched with feathers fluffed as in cold weather and appeared to doze, but were responsive to external stimuli. As death nears, breathing increased slightly in rate and became more difficult; the birds no longer responded to external stimuli and became comatose. Death followed shortly thereafter without convulsions or spasms (DeCino et al. 1966). Birds ingesting a lethal dose of DRC-1339 become listless and lethargic, and a quiet death normally occurs in 24 to 72 hours following ingestion. This method appears to result in a less stressful death than which probably occurs by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternatives. DRC-1339 to manage damage caused by blackbirds, starlings, gulls, and pigeons is only available to WS' personnel for use.

The chemical Avitrol repels birds by poisoning a few members of a flock, causing them to become hyperactive. Their distress calls generally alarm the other birds and cause them to leave the site. Only a small number of birds need to be affected to cause alarm in the rest of the flock. The affected birds generally die. In most cases where Avitrol is used, only a small percentage of the birds are affected and killed by the chemical with the rest being merely dispersed. In experiments to determine suffering, stress, or pain in affected animals, Rowsell et al. (1979) tested Avitrol on pigeons and observed subjects for clinical, pathological, or neural changes indicative of pain or distress but none were observed. Conclusions of the study were that the chemical met the criteria for a humane pesticide.

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations where non-lethal damage management methods are not practical or effective. Personnel from WS are experienced and professional in their use of management methods. Consequently, management methods are implemented in the most humane manner possible under the constraints of current technology. Those methods discussed in Appendix B to alleviate bird damage and/or threats in the State, except for alpha-chloralose, mesurol, and DRC-1339, could be used under any of the alternatives by those persons experiencing damage regardless of WS' direct involvement. Therefore, the issue of humanness associated with methods would be similar across any of the alternatives since those methods could be employed. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into WS' activities to ensure methods are used by WS as humanely as possible are listed in Chapter 3.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

The issues of humaneness of methods under this alternative are likely to be perceived to be similar to humaneness issues discussed under the proposed action. This perceived similarity is derived from WS' recommendation of methods that some consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requestor employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to the proposed action.

WS would instruct and demonstrate the proper use and placement of methodologies to increase effectiveness in capturing target bird species and to ensure methods are used in such a way as to minimize pain and suffering. However, the efficacy of methods employed by a cooperator would be based on the

skill and knowledge of the requestor in resolving the threat to safety or damage situation despite WS' demonstration. Therefore, a lack of understanding of the behavior of birds or improperly identifying the damage caused by birds along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of being perceived as inhumane. In those situations, the pain and suffering are likely to be regarded as greater than those discussed in the proposed action.

Those persons requesting assistance would be directly responsible for the use and placement of methods and if monitoring or checking of those methods does not occur in a timely manner, captured wildlife could experience suffering and if not address timely, could experience distress. The amount of time an animal is restrained under the proposed action would be shorter compared to a technical assistance alternative if those requestors implementing methods are not as diligent or timely in checking methods. Similar to Alternative 3, it is difficult to evaluate the behavior of individual people and what may occur under given circumstances. Therefore, only the availability of WS' assistance can be evaluated under this alternative since determining human behavior can be difficult. If those persons seeking assistance from WS apply methods recommended by WS through technical assistance as intended and as described by WS, then those methods would be applied as humanely as possible to minimize pain and distress. If those persons provided technical assistance by WS apply methods not recommended by WS or do not employ methods as intended or without regard for humaneness, then the issue of method humaneness would be of greater concern since pain and distress of birds would likely be higher.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, the issues of the humaneness of methods would not be considered by WS. WS would have no involvement in any aspect of bird damage management in the State. Those persons experiencing damage or threats associated with birds could use those methods legally available and permitted by the USFWS, the AGFC, and federal, State, and local regulations. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the general public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods. A method considered inhumane, would still be perceived as inhumane regardless of the person or entity applying the method. However, even methods generally regarded as being a humane method could be employed in inhumane ways if employed by those persons inexperience in the use of those methods or if those persons are not as diligent in attending to those methods.

The efficacy and therefore, the humaneness, of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the general public to use to resolve damage and threats caused by waterfowl. Therefore, those methods considered inhumane would continue to be available for use under this alternative. If those persons experiencing bird damage apply those methods considered to be humane methods as intended and in consideration of the humane use of those methods, then the issue of method humaneness would be similar across the alternatives. If persons employ humane methods in ways that are inhumane, the issue of method humaneness could be greater under this alternative if those persons experiencing bird damage are not provided with information and demonstration on the proper use of those methods. However, the level at which people would apply humane methods inhumanely under this alternative based on a lack of assistance is difficult to determine and could just as likely be similar across the alternatives.

Issue 6 – Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

A common concern when addressing wildlife species with regulated hunting seasons is the potential for wildlife damage management activities to limit the ability to harvest those species during those seasons. Canada geese, snow geese, ring-necked ducks, lesser scaup, American coots, American crows, and fish crows maintain sufficient population densities in the State to sustain annual hunting seasons. Annual hunting seasons for those species have been established by the USFWS pursuant to the MBTA through frameworks that are implemented by the AGFC.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

WS' bird damage management activities would primarily be conducted on populations in areas where hunting access is restricted (*e.g.*, airports) or has been ineffective (*e.g.*, urban areas). The use of non-lethal or lethal methods often disperses birds from areas where damage is occurring to areas outside the damage area which could serve to move birds from those less accessible areas to places accessible to hunters.

The magnitude of take of birds addressed in the proposed action would be low when compared to the mortality of birds from all known sources. When WS' proposed take of those bird species considered harvestable was included as part of the known mortality of those species from 2004 through 2009 and compared to the estimated populations of those species, the impact on those species' population was consistent with management goals set by the USFWS and AGFC. The USFWS and the AGFC would determine the number of birds taken annually by WS through the issuance of depredation permits and by regulating take through the depredation orders.

Bird damage management activities conducted by WS would occur after consultation and approval by the USFWS and the AGFC. With oversight by the USFWS and the AGFC, the number of birds allowed to be taken by WS would not limit the ability of those persons interested to harvest those bird species during the regulated season. All take by WS would be reported to the USFWS annually to ensure take by WS is incorporated into population management objectives established for the populations of those bird species. Based on the limited take proposed by WS and the oversight of by the USFWS and the AGFC, WS' take of birds annually under the proposed action would have no effect on the ability of those persons interested to harvest birds during the regulated harvest season.

Alternative 2 - Bird Damage Management by WS through Technical Assistance Only

Under the technical assistance only alternative, WS would have no direct impact on bird populations in the State. If WS recommends the use of non-lethal methods and those non-lethal methods are employed by those persons experiencing damage, waterfowl are likely to be dispersed from the damage area to areas outside the damage area which could serve to move those birds from those less accessible areas to places accessible to hunters. Although lethal methods could be recommend by WS under a technical assistance only alternative, the use of those methods could only occur after the property owner or manager received a depredation permit from the USFWS, under depredation orders, or take could occur during the regulated hunting season. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of birds allowed to be taken under a depredation permit, under depredation orders, and during the regulated hunting seasons is determined by the USFWS and the AGFC. Therefore, WS' recommendation of shooting or hunting under this alternative would not limit the ability of those persons interested to harvest birds during the regulated season since the USFWS and AGFC determines the number of birds that may be taken during the hunting season, under depredation permits, and under depredation orders.

Alternative 3 – No Bird Damage Management Conducted by WS

WS would have no impact on the ability to harvest birds under this alternative. WS would not be involved with any aspect of bird damage management. The USFWS and the AGFC would continue to regulate populations through adjustments of the allowed take during the regulated harvest season and the continued use of depredation orders and depredation permits.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

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

Under Alternative 1 and Alternative 2, WS would address damage associated with birds either by providing technical assistance (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary agency conducting direct operational bird damage management in the State under Alternative 1 and Alternative 2. However, other federal, State, and private entities could also be conducting bird damage management in the State. The take of native migratory bird species requires a depredation permit from the USFWS pursuant to the MBTA, which requires permit holders to report all take occurring under the permit. Take of Canada geese, cormorants, and blackbirds can occur under depredation orders without the need for a depredation permit. European starlings and rock pigeons can be lethally taken without the need for a depredation permit since those species are considered non-native species.

WS does not normally conduct direct damage management activities concurrently with such agencies or other entities in the same area, but may conduct bird damage management activities at adjacent sites within the same time frame. In addition, commercial pest control companies may conduct bird damage management activities in the same area. The potential cumulative impacts analyzed below could occur either as a result of WS' damage management program activities over time, or as a result of the aggregate effects of those activities combined with the activities of other agencies and private entities. Through ongoing coordination and collaboration between WS, the USFWS, and the AGFC, activities of each agency and the take of birds would be available. Bird damage management activities in the State would be monitored annually to evaluate and analyze activities to ensure they are within the scope of analysis of this EA.

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

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse affects on bird populations when targeting those species responsible for damage. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but are not limited to:

- Natural mortality of birds
- Human-induced mortality of birds through private damage management activities
- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of bird populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage are constrained as to scope, duration, and intensity for the purpose of reducing or avoiding impacts to the environment. WS uses the Decision Model to evaluate damage occurring, including other affected elements and the dynamics of the damaging species; to determine appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992, USDA 1997). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over bird populations, the USFWS and the AGFC can adjust take levels, including the take by WS, to ensure population objectives for birds are achieved. Consultation and reporting of take by WS would ensure the USFWS and the AGFC considers any activities conducted by WS.

WS' take of birds in Arkansas from FY 2004 through FY 2009 was of a low magnitude when compared to the total known take. WS' annual take of birds in the State would occur under the established depredation orders that allow birds to be taken when committing or about to commit damage or posing human safety threats or under depredation permits issued by the USFWS. Rock pigeons and European starlings would be taken without the need for a depredation permit. The USFWS and the AGFC considers all known take when determining population objectives for birds and can adjust the number of birds that can be taken during the regulated hunting season and the number of birds taken for damage management purposes to achieve the population objectives. Any take by WS would occur at the discretion of the USFWS and the AGFC. Any bird population declines or increases would be the collective objective for bird populations established by the USFWS and the AGFC through the regulation of take. Therefore, the cumulative take of birds annually or over time by WS would occur at the desire of the USFWS and the AGFC as part of management objectives for birds in the State.

No cumulative adverse impacts on target and non-target wildlife are expected from WS' bird damage management actions based on the following considerations:

1. Historical outcomes of WS' damage management activities on wildlife

Bird damage management activities are conducted by WS only at the request of a cooperator to reduce damage that is occurring or to prevent damage from occurring and only after methods to be used are agreed upon by all parties involved. Only those birds identified as causing damage or posing a threat of damage are targeted by WS. WS annually monitors activities to ensure any potential impacts are identified and addressed. WS works closely with State and federal resource agencies to ensure damage management activities are not adversely impacting bird populations and that WS' activities are considered as part of management goals established by those agencies. Historically, WS' activities to manage damage caused by birds in Arkansas have not reached a magnitude that would cause adverse impacts to populations in the State based on the population data and harvest data.

2. SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on birds, and are tailored to respond to changes in wildlife populations which could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alterations in programs are defined through SOPs and implementation is insured through monitoring, in accordance with the WS' Decision Model (Slate et al. 1992, USDA 1997).

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

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

The use of lethal methods or those methods used to live-capture target species followed by euthanasia also have the potential to impact non-target wildlife through the take (killing) or capture of non-target species. Capture methods used are often methods that are set to confine or restrain target wildlife after being triggered by a target individual. Capture methods are employed in such a manner as to minimize the threat to non-target species by placement in those areas frequently used by target wildlife, using baits or lures that are as species specific as possible, and modification of individual methods to exclude non-targets from capture. Most methods described in Appendix B are methods that are employed to confine or restrain wildlife that are subsequently euthanized using humane methods since relocation is currently not considered. With all live-capture devices, non-target wildlife captured can be released on site if determined to be able to survive following release. Minimization and SOPs are intended to ensure take of non-target wildlife is minimal during the use of methods to capture target wildlife.

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

Chemical methods available for use under the proposed action are repellents, nicarbazin, DRC-1339, and alpha-chloralose which are described in Appendix B. Except for repellents that are applied directly to the affected resource, all chemical methods are employed using baits that are highly attractive to target species and used in areas where exposure to non-targets are minimal. The use of those methods requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product label which ensures that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals also ensures non-target hazards are minimal.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according the WS and Department of Transportation regulations. The amount of chemicals used or stored by WS would be minimal to ensure

human safety. Based on this information, WS' use of chemical methods, as part of the proposed action, would not have cumulative impacts on non-targets.

Repellents may also be used or recommended by the WS program in Arkansas to manage bird damage. The active ingredient in numerous commercial repellents is methyl anthranilate which has been categorized by the EPA as "*generally recognized as safe*". Methyl anthranilate is a derivative of grapes and used as a flavoring in food and as a fragrance in cosmetics. Other repellents available contain the active ingredient polybutene, which when applied, creates a sticky surface which is intended to prevent perching. Although not registered for use to disperse birds in Arkansas, other bird repellents registered contain the active ingredient anthraquinone, which is a naturally occurring plant extract. Characteristics of those chemicals and potential use patterns indicate that no significant cumulative impacts related to environmental fate are expected from their use in WS' programs in Arkansas when used according to label requirements.

All label requirements of DRC-1339 would be followed to minimize non-target hazards. As required by the label, all potential bait sites are pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets are observed feeding on the pre-bait, the plots are abandoned and no baiting would occur at those locations. Once sites are baited, sites are monitored daily to further observe for non-target feeding activity. If birds are observed feeding on bait, those sites are abandoned. WS would retrieve all dead birds to the extent possible, following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

The methods described in Appendix B all have a high level of selectivity and can be employed using SOPs to ensure minimal impacts to non-targets species. No non-targets were taken by WS during bird damage management activities from FY 2004 through FY 2009. Based on the methods available to resolve bird damage and/or threats, WS does not anticipate the number of non-targets taken to reach a magnitude where declines in those species' populations would occur. Therefore, take under the proposed action of non-targets would not cumulatively impact non-target species. WS' has reviewed the T&E species listed by the AGFC and the USFWS which were addressed in Chapter 4. Cumulative impacts would be minimal on non-targets from any of the alternatives discussed**.**

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

All non-chemical methods described in Appendix B are used within a limited time frame, are not residual, and do not possess properties capable of inducing cumulative adverse impacts on human health and safety. All non-chemical methods are used after careful consideration of the safety of those persons employing methods and to the public. All capture methods are employed where human activity is minimal to ensure the safety of the public. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed would have no effect on human safety. All methods are agreed upon by the requesting entities which are made aware of the safety issues of those methods when entering into a MOU, cooperative service agreement, or other comparable document between WS and the cooperating entity. SOPs also ensure the safety of the public from those methods used to capture or take wildlife. A formal risk assessment conducted by APHIS determined that WS' non-chemical methods, when used as intended, poses a low risk to human safety (USDA 1997). Firearms used to alleviate or prevent damage, though hazards do exist, are employed to ensure the safety of employees and the public.

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

Repellents have been available for use to disperse birds from areas of application are available. All repellents must be registered with the EPA according to the FIFRA. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents are applied according to label requirements, no adverse affects to human safety are expected.

Bird damage management programs which include the use of pesticides as a lethal population management component may have the greatest potential for cumulative impacts on the environment as such impacts relate to the deposit of chemical residues in the physical environment with potential for environmental toxicosis.

DRC-1339 may be used by WS to manage damage or threats associated with blackbirds, starlings, gulls, or pigeons in the State. DRC-1339 has been evaluated for possible residual effects which might occur from buildup of the chemical in soil, water, or other environmental sites. DRC-1339 is formulated on baits and placed in areas only after pre-baiting has occurred and in only those areas where non-targets are not present or would not be exposed to treated baits. Baits treated with DRC-1339 are placed on platforms or other hard surfaces where they seldom come into contact with soil, surface water, and/or ground water. All uneaten bait is recovered and disposed of according to EPA label requirements.

DRC-1339 exhibits a low persistence in soil or water, and bioaccumulation of the chemical is unlikely (USDA 1997). Additionally, the relatively small quantity of DRC-1339 that could potentially be used in bird damage management programs in Arkansas, the chemical's instability which results in degradation of the product, and application protocols used in WS' programs further reduces the likelihood of any environmental accumulation. DRC-1339 has not been used previously by WS to manage bird damage in the State. The use of DRC-1339 under the proposed action is not expected to increase to a level that adverse affects would occur from the cumulative use of the chemical. Based on potential use patterns, the chemical and physical characteristics of DRC-1339, and factors related to the environmental fate, no cumulative impacts are expected from the lethal chemical components used or recommended by the WS program in Arkansas.

WS has received no reports or documented any adverse affects to human safety from WS' bird damage management activities conducted from FY 2004 through FY 2009. No cumulative adverse affects from the use of those methods discussed in Appendix B are expected given the use patterns of those methods for resolving bird damage in the State.

Issue 4 - Effects on the Aesthetic Values of Birds

The activities of WS would result in the removal of birds from those areas where damage or threats were occurring. Therefore, the aesthetic value of birds in those areas where damage management activities were being conducted would be reduced. However, for some people, the aesthetic value of a more natural environment would be gained by reducing bird densities, including the return of native plant species that may be suppressed or killed by accumulations of fecal dropping by high bird densities found under roost areas.

Some people experience a decrease in aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals or the continued presence of birds may lead to further degradation of some people's enjoyment of any wildlife or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of wildlife for those people that are being adversely affected by the target species identified in this EA.

Bird population objectives are established and enforced by the USFWS and the AGFC after consideration of all known mortality factors. Therefore, WS has no direct impact on the status of the bird population since all take by WS occurs at the discretion of the USFWS and the AGFC. Since those persons seeking assistance could remove birds from areas where damage is occurring without WS' direct involvement, WS' involvement would have no effect of the aesthetic value of birds in the area where damage was occurring. When damage caused by birds has occurred, any removal of birds by the property or resource owner would likely occur whether WS was involved with taking the birds or not.

Therefore, the activities of WS are not expected to have any cumulative adverse affects on this element of the human environment if occurring at the request of a property owner and/or manager.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked and monitored to ensure any wildlife confined or restrained are addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured birds would be applied according to AVMA guidelines for free-ranging wildlife. Shooting would occur in limited situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of birds taken by this method.

WS employs methods as humanely as possible by applying measures to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide WS in the use of methods to address damage and threats associated with birds in the State, the cumulative impacts on the issue of method humaneness are minimal. All methods would be evaluated annually to ensure SOPs are adequate to ensure those methods continue to be used to minimize suffering and that wildlife captured are addressed in a timely manner to minimize distress.

Issue 6 – Effects of Bird Damage Management Activities on the Regulated Harvest of Birds

As discussed in this EA, the magnitude of WS' bird take for damage management purposes from FY 2004 through FY 2009 was low when compared to the total take of birds and when compared to the estimated statewide populations. Since all take of birds is regulated by the USFWS and the AGFC, the take of birds by WS that would occur annually and cumulatively would occur pursuant to bird population objectives established in the State. WS' take of birds (combined take) annually to alleviate damage would be a minor component to the known take and mortality factors.

With oversight of bird take, the USFWS and the AGFC maintains the ability to regulate take by WS to meet management objectives for birds in the State. Therefore, the cumulative take of birds is considered as part of the USFWS and the AGFC objectives for bird populations in the State.

CHAPTER 5 - LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS AND REVIEWERS

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Ryan Wimberly, Environmental Coordinator	USDA-APHIS-Wildlife Services
Michael Hoy, District Supervisor	USDA-APHIS-Wildlife Services

5.2 LIST OF PERSONS CONSULTED

David Goad, Chief of Wildlife Management	Arkansas Game and Fish Commission

APPENDIX A

LITERATURE CITED

Aderman, A.R., and E.P. Hill. 1995. Locations and numbers of double-crested cormorants using winter roosts in the Delta region of Mississippi. Colonial Waterbirds 18 (Spec. Pub. 1):143-151.

Aguilera, E., R.L. Knight, and J.L. Cummings. 1991. An evaluation of two hazing methods for urban Canada geese. Wildl. Soc. Bull. 19:32-35.

Alderisio, K. A., and N. DeLuca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (*Larus delawarensis*) and Canada geese (*Branta Canadensis*). Applied and Environmental Microbiology. 65:5628-5630.

Alge, T. L. 1999. Airport bird threat in North America from large flocking birds, (geese) as viewed by an engine manufacturer. Proceedings of the Joint Birdstrike Committee - USA/Canada meeting, Vancouver, B.C. pp. 11-22.

Allan J. R., J. S. Kirby, and C.J. Feare. 1995. The biology of Canada geese *Branta canadensis* in relation to the management of feral populations. Wildl. Bio. 1:129-143.

Allen, R.W., and M.M. Nice. 1952. A study of the breeding biology of the Purple Martin (*Progne subis*). Am. Midl. Nat. 47: 606-665.

Allen, H. A., D. Sammons, R. Brinsfield, and R. Limpert. 1985. The effects of Canada goose grazing on winter wheat: an experimental approach. Proc. 2nd Eastern Wildl. Damage Control Conf. 2:135-141.

AVMA. 1987. Panel report on the colloquium on recognition and alleviation of animal pain and distress. Journal of the American Veterinary Medical Association. 191:1186-1189.

AVMA. 2007. AVMA guidelines on euthanasia. American Veterinary Medical Association. http://www.avma.org/issues/animal_welfare/euthanasia.pdf. Accessed on February 2, 2009.

Ankney, C. D. 1996. An embarrassment of riches: too many geese. J. Wildl. Manage. 60:217-223.

Apostolou, A. 1969. Comparative toxicology of the avicides 3-chloro-*p*-toluidine and 2-chloro-4-acetotoluidide in birds and mammals. PhD. Dissertation, University of California, Davis, USA.

Arhart, D.K. 1972. Some factors that influence the response of European starlings to aversive visual stimuli. M.S. Thesis., Oregon State University, Corvallis, Oregon.

AGFC. 2010. Hunting: Season dates and bag limits. Arkansas Game and Fish Commission website. http://www.agfc.com/hunting/Pages/HuntingSeasons.aspx. Accessed January 24, 2011.

Arkansas Natural Heritage Commission. 2010. Rare species search. Arkansas Natural Heritage Commission website. http://www.naturalheritage.com/research-data/rarespecies-search.aspx. Accessed January 24, 2011.

Atlantic Flyway Council. 1999. Atlantic Flyway resident Canada goose management plan. Canada Goose Committee, Atlantic Flyway Technical Section. 42 pp.

Aubin, T. 1990. Synthetic bird calls and their application to scaring methods. Ibis 132:290-299.

Austin, J.E., C.M. Custer, and A.D. Afton. 1998. Lesser Scaup (*Aythya affinis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/338.

Avery, M.L., and D.G. Decker. 1994. Responses of captive fish crows to eggs treated with chemical repellents. Journal of Wildlife Management 58:261-266.

Avery, M.L., J.S. Humphrey, and D.G. Decker. 1997. Feeding deterrence of anthraquinone, anthracene, and anthrone to rice-eating birds. Journal of Wildlife Management 61:1359-1365.

Avery, M.L., K.L. Keacher, and E.A. Tillman. 2006. Development of nicarbazin bait for managing rock pigeon populations. Pp 116-120 *in* R.M. Timm and J. M. O'Brien eds. Proceedings of the 22nd Vertebrate Pest Conference. University of California-Davis, Davis California 95616.

Avery, M.L., E.A. Tillman, and J.S. Humphrey. 2008. Effigies for dispersing urban crow roosts. Pp. 84-87 *in* R.M. Timm and M.B. Madon, eds. Proc. 23rd Vertebr. Pest Conf., University of California-Davis.

Avery, M. L., J. S. Humphrey, E. A. Tillman, K. O. Phares, and J. E. Hatcher. 2002. Dispersal of vulture roosts on communication towers. J. Raptor. Res. 36:44-49.

Barnes, T. G. 1991. Eastern bluebirds, nesting structure design and placement. College of Agric. Ext. Publ. FOR-52. Univ. of Kentucky, Lexington, KY, 4pp.

Beaver, B.V., W. Reed, S. Leary, B. McKiernan, F. Bain, R. Schultz, B.T. Bennett, P. Pascoe, E. Shull, L. C. Cork, R. Franis-Floyd, K.D. Amass, R. Johnson, R.H. Schmidt, W. Underwood, G.W. Thorton, and B. Kohn. 2001. 2000 Report of the AVMA Panel on Euthanasia. J. Am. Vet. Med. Assoc. 218:669-696.

Bedard, J., and G. Gauthier. 1986. Assessment of fecal output in geese. J. Appl. Ecol. 23:77-90.

Bedard, J., A. Nadeau, and M. Lepage. 1995. Double-crested cormorant culling in the St. Lawrence River Estuary. Colonial Waterbirds 18 (Spec. Pub. 1): 78-85.

Bedard, J., A. Nadeau, and M. Lepage. 1999. Double-crested cormorant culling in the St. Lawerence River Estuary: Results of a 5 year program. Pp. 147-154 *in* M.E. Tobin, ed. Symposium on Double-crested Cormorants: Population Status and Management Issues in the Midwest. USDA Tech. Bull. No. 1879.

Beeton, A. M., and L. Wells. 1957. A bronzed grackle (*Quiscalus quiscula*) feeding on live minnows. Auk 74:263-264.

Belant, J.L., and R.A. Dolbeer. 1993. Population status of nesting laughing gulls in the United States, 1977-1991. American Birds 47: 220-224.

Belant, J.L., S.K. Ickes, and T.W. Seamans. 1998. Importance of landfills to urban-nesting herring and ring-billed gulls. Landscape and Urban Planning 43:11-19.

Belant, J.L., T.W. Seamans, S.W. Gabrey, and R.A. Dolbeer. 1995. Abundance of gulls and other birds at landfills in northern Ohio. American Midland Naturalist 134: 30-40.

Belant, J.L., T.W. Seamans, L.A. Tyson, and S.K. Ickes. 1996. Repellency of methyl anthranilate to pre-exposed and naive Canada geese. Journal of Wildlife Management 60:923-928.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Stackpole Books. Harrisburg, PA. 540 pp.

Besser, J. F. 1964. Baiting starlings with DRC-1339 at a large cattle feedlot, Ogden, Utah, January 21 - February 1, 1964. U. S. Fish and Wildl. Serv., Denver Wildl. Res. Ctr., Denver, CO. Suppl. Tech. Rep. Work Unit F9.2.

Besser, J.F. 1985. A grower's guide to reducing bird damage to U.S. agricultural crops. Denver Wildl. Res. Cent., Bird Damage Res. Rep. 340.

Besser, J.F., J.W. DeGrazio, and J.L. Guarino. 1968. Costs of wintering European starlings and red-winged blackbirds at feedlots. Journal of Wildlife Management 32:179-180.

Besser, J.F., W. C. Royal, and J.W. DeGrazio. 1967. Baiting starlings with DRC-1339 at a cattle feedlot. Journal of Wildlife Management 3:48-51.

Bishop, R.C. 1987. Economic values defined. Pp 24-33 *in* D. J. Decker and G. R. Goff, eds. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, CO. 424 p.

Blackwell, B.F., R.A. Dolbeer, and L.A. Tyson. 2000. Lethal control of piscivorous birds at aquaculture facilities in the northeast United States: effects on populations. North American Journal of Aquaculture 62:300-307.

Blackwell, B.F., G.E. Bernhardt, and R.A. Dolbeer. 2002. Lasers as non-lethal avian repellents. Journal of Wildlife Management 66:250-258.

Blandespoor, H.D., and R.L. Reimink. 1991. The control of swimmer's itch in Michigan: past, present and future. Michigan Academ. XXIV, p. 7-23.

Blanton, E. M., B.U. Constantin, and G.L. Williams. 1992. Efficacy and methodology of urban pigeon control with DRC-1339. Proc. East. Wildl. Damage Cont. Conf. 5:58-62.

Blokpoel, H., and G.D. Tessier. 1986. The ring-billed gull in Ontario: a review of a new problem species. Occasional Paper Number 57. Canadian Wildlife Service. Ottawa, Ontario. 34pp.

Blokpoel, H., and G.D. Tessier. 1992. Control of ring-billed gulls and herring gulls nesting at urban and surburban industrial sites in Ontario, 1987-1990. Proc. East. Wildl. Damage Conf. 5:51-57.

Bomford, M. 1990. Ineffectiveness of a sonic device for deterring European Starlings. Wild. Soc. Bull. 18:151-156.

Bookhout, T. A. and S. B. White. 1981. Blackbird and Starling roosting dynamics: implications for animal damage control. Proc. Bird Control Semin. 8:215-221.

Booth, T.W. 1994. Bird dispersal techniques. Pp E-19-E-23 *in* S.E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. Prevention and control of wildlife damage. Cooperative Extension Service. University of Nebraska, Lincoln, Nebraska.

Boyd, F.L., and D.I. Hall. 1987. Use of DRC-1339 to control crows in three roosts in Kentucky and Arkansas. Third Eastern Wildlife Damage Control Conference 3:3-7.

Brauning, D.W., ed. 1992. Atlas of breeding birds in Pennsylvania. Univ. Pittsburgh Press, Pittsburgh, Pa. 484 pp.

Brisbin, Jr., I.L., and T.B. Mowbray. 2002. American Coot (*Fulica americana*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/697a.

Brough, T. 1969. The dispersal of starlings from woodland roosts and the use of bio-accoustics. J. Appl. Ecol. 6:403-410.

Bruce, R.D. 1985. An Up-and-Down procedure for acute toxicity testing. Fundamentals of Applied Toxicology 5:151-157.

Bruce, R.D. 1987. A confirmatory study of the up-and-down method for acute oral toxicity testing. Fundamentals of Applied Toxicology 8:97-100.

Bruleigh, R.H., D.S. Slate, R.B. Chipman, M. Barden, C. Allen, J. Janicke, and B. Noviello. 1998. Abstract: Management of gulls at landfills to reduce public health and safety concerns. The Wildlife Society, Sept. 22-26. Buffalo, NY.

Buckley, N. J. 1999. Black vulture (*Coragyps atratus*) *in* A. Poole and F. Gill, editors. The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Bull, J., and J. Farrand, Jr. 1977. The Audubon Society Field Guide to North American Birds, Eastern Region. Alfred A. Knopf, Inc., New York, NY.

Bunn, A.G., W. Klein, and K.L. Bildstein. 1995. Time-of-day effects on the numbers and behavior of non-breeding raptors seen on roadside surveys in eastern Pennsylvania. J. Field Ornithol. 66:544–552.

Burger, J. 1978. Competition between Cattle Egrets and native North American herons, egrets, and ibises. Condor 80: 15–23.

Butler, R.W. 1992. Great Blue Heron (*Ardea herodias*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/025. Accessed November 2, 2010.

Butterfield J., J.C. Coulson, S.V. Kearsey, P. Monaghan, J.H. McCoy, and G.E. Spain. 1983. The herring gull, *Larus argentatus*, as a carrier of *Salmonella*. Journal of Hygiene, Camb. 91:429-436.

California Department of Fish and Game. 1991. Final environmental document - bear hunting. Title 14 Calif. Code of Regs. Calif. Dept. of Fish and Game, State of California, April 25, 1991. 337 pp.

California Department of Pesticide Regulation. 2007. California Department of Pesticide Regulation Public Report 2007-8. http://www.cdpr.ca.gov/docs/registration/ais/publicreports/5944.pdf. Accessed November 20, 2008.

Castelli, P. M., and S. E. Sleggs. 2000. The efficacy of border collies for nuisance goose control. Wildl. Soc. Bull. 28:385-293.

CDC. 1998. Cryptosporidiosis: Fact Sheet. Nat. Center for Infect. Dis., Div. Paras. Dis. 3 pp.

CDC. 1999. Giardiasis: Fact Sheet. Nat. Center for Infect. Dis., Div. Paras. Dis. 5 pp.

CDC. 2007. Campylobacter Infections. www.cdc.gov. Accessed on December 3, 2007.

Chipman, R.B., T.L. Devault, D. Slate, K.J. Preusser, M.S. Carrara, J.W. Friers, and T.P. Algeo. 2008. Non-lethal management to reduce conflicts with winter urban crow roosts in New York: 2002 – 2007. Pp. 88-93 *in* R.M. Timm and M.B. Madon, eds. Proc. 23rd Vertebr. Pest Conf., University of California-Davis.

Clark, L., and J. Hall. 2006. Avian influenza in wild birds: status as reservoirs, and risk to humans and agriculture. Ornithological Monographs 60:3-29.

Clark, S. L., and R. L. Jarvis. 1978. Effects of winter grazing by geese on yield of ryegrass seed. Wildl. Soc. Bull. 6:84-87.

Cleary, E.C., R.A. Dolbeer, and S.E. Wright. 2005. Wildlife strikes to civil aircraft in the United States, 1990–2004. U.S. Dept. of Trans., Federal Aviation Admin., Serial Report No. 11 DOT/FAA/AS/00-6 (AAS-310). Washington DC. 53 pp.

Cole, D., D. J. V. Drum, D. E. Stallknecht, D. G. White, M. D. Lee, S. Ayers, M. Sobsey, and J. J. Maurer. 2005. Free-living Canada geese and antimicrobial resistance. Emerging Infectious Diseases. 11:935-938.

Coleman, J. S. and J. D. Fraser. 1989. Habitat use and home ranges of black and turkey vultures. Journal of Wildlife Management 53:782–792.

Colley, D. G. 1996. Waterborne Cryptosporidiosis threat addressed. Centers for Disease Control and Prevention. Atlanta, GA. http://www.cdc.gov/ncidod/EID/vol1no2/colley.htm. Accessed on December 3, 2007.

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

Conover, M.R. 1982. Evaluation of behavioral techniques to reduce wildlife damage. Proc. Wildl.-Livestock Relation. Sym. 10:332-344.

Conover, M. R. 1984. Comparative effectiveness of avitrol, exploders, and hawk-kites in reducing blackbird damage to corn. J. Wildl. Manage. 48:109-116.

Conover, M. R. 1985. (abstract only). Management of nuisance Canada goose flocks. Proc. East. Wildl. Damage Control Conf. 2:155.

Conover, M. R. 1988. Effect of grazing by Canada geese on the winter growth of rye. J. Wildl. Manage. 52:76-80.

Conover, M. R. 1991. Herbivory by Canada geese: diet selection and effects on lawn. Ecolo. Appl. 2:231-236.

Conover, M. R. 1992. Ecological approach to managing problems caused by urban Canada geese. Proc. Vert. Pest Conf. 15:110-111.

Conover, M. R., and G. G. Chasko. 1985. Nuisance Canada geese problems in the eastern United States. Wildl. Soc. Bull. 13:228-233.

Conover, M. R., and G. S. Kania. 1991. Characteristics of feeding sites used by urban-suburban flocks of Canada geese in Connecticut. Wildl. Soc. Bull. 19:36-38.

Conover, M.R., W.C. Pitt, K.K. Kessler, T.J. Dubow, and W.A. Sanborn. 1995. Review of human injuries, illnesses and economic-based losses caused by wildlife in the United States. Wildl. Soc. Bull. 23:407-414.

Converse, K. A., and J. J. Kennelly. 1994. Evaluation of Canada goose sterilization for population control. Wildl. Soc. Bull. 22:265-269.

Cooper, J.A. 1991. Canada goose management at the Minneapolis, St. Paul International Airport. Pp. 175-183 *in* Adams, L.W. and Leedy, D.L., Eds. Wildlife Conservation in Metropolitan Environments. Proceedings of the National Symposium on Urban Wildlife, National Institute for Urban Wildlife, Columbia, Maryland.

Cooper, J. A. 1998. The potential for managing urban Canada geese by modifying habitat. Proc. Vert. Pest Conf. 18:18-25.

Cooper, J.A., and T. Keefe. 1997. Urban Canada goose management: policies and procedures. Trans. No. Am. Wildl. And Natural Resour. Conf. 62:412-430.

Courchamp F., J. L. Chapuis, and M. Pascal. 2003. Mammal invaders on islands: impact, control and control impact. Biol. Rev. 78:347-383.

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

Cramp, S., and K. E. L. Simmons. 1977. The Birds of the Western Paleartic. Oxford University Press, Oxford, United Kingdom.

Cristol, D.A. 2001. American crows cache less preferred walnuts. Animal Behaviour 62:331-336.

Cristol, D.A. 2005. Walnut-caching behavior of American crows. J. Field Ornithol. 76:27-32.

Cummings, J.L., P.A. Pochop, J.E. Davis, Jr., and H.W. Krupa. 1995. Evaluation of Rejex-It AG-36 as a Canada goose grazing repellent. Journal of Wildlife Management 59:47-50.

Cummings, J.L., S. A. Shwiff, and S.K. Tupper. 2005. Economic impacts of blackbird damage to the rice industry. Proceedings of the Wildlife Damage Management Conference 11:317-322.

Cummings, J.L., J.F. Glahn, E.A. Wilson, J.E. Davis, Jr., D.L. Bergman, and G.A. Harper. 1992. Efficacy and nontarget hazards of DRC-1339 treated rice baits used to reduce roosting populations of depredating blackbirds in Louisiana. Denver Wildlife Research Center, Bird Section Res. Rep. No. 481. 40pp.

Cunningham, D.J., E.W. Schafer, and L.K. McConnell. 1979. DRC-1339 and DRC-2698 residues in starlings: Preliminary evaluation of their effects on secondary hazard potential. Pp 31-35 *in* W.B. Jackson, S.S. Jackson, and B.A. Jackson, eds. Proceedings Eighth Bird Control Seminar. October 30 – November 1, 1979. Bowling Green State University, Bowling Green, Ohio.

Cunningham, D.J., E.W. Schafer, and L.K. McConnell. 1981. DRC-1339 and DRC-2698 residues in European Starlings: preliminary evaluation of their effects on secondary hazard potential. Proc. Bird Control Semin. 8:31-37.

Cuthbert, F.J., Wires, L.R., and McKearnan, J.E. 2002. Potential impacts of nesting double-crested cormorants on great blue herons and black-crowned night herons in the U.S. Great Lakes Region, Journal of Great Lakes Research 28:145-154.

Darden, T. 1974. Common grackles preying on fish. Wilson Bulletin 86:85-86.

Davis, Jr., W.E. 1993. Black-crowned night-heron (*Nycticorax nycticorax*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/074.

Davis, Jr., W. E., and J. A. Kushlan. 1994. Green Heron (*Butorides virescens*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/129.

Day, G.I., S.D. Schemnitz, and R.D. Taber. 1980. Capturing and marking wild animals. Pp. 61-88 *in* S. D. Schemnitz, ed.Wildlife management techniques manual. The Wildlife Society, Inc. Bethesda, MD. 686 pp.

Decino, T.J., D.J. Cunningham, and E.W. Schafer. 1966. Toxicity of DRC-1339 to European starlings. Journal of Wildlife Management 30:249-253.

Decker, D.J., and G.R. Goff. 1987. Valuing Wildlife: Economic and Social Perspectives. Westview Press. Boulder, Colorado, 424 p.

Decker, D.J., and K.G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildl. Soc. Bull. 16:53-57.

Decker, D.J., and L.C. Chase. 1997. Human dimensions of living with wildlife - a management challenge for the 21st century. Wildl. Soc. Bull. 25:788-795.

DeHaven, R.W., and J.L. Guarino. 1969. A nest box trap for European starlings. Bird Banding 40:49-50.

Dimmick, C.R., and L.K. Nicolaus. 1990. Efficiency of conditioned aversion in reducing depredation by crows. J. of Applied Ecology 27:200-209.

Dixon, W.J., and A.M. Mood. 1948. A method for obtaining and analyzing sensitive data. Journal of the American Statistical Association 43:109-126.

Dolbeer, R.A. 1991. Migration patterns of double-crested cormorants east of the Rocky Mountains. J. Field Ornithol. 62:83-93.

Dolbeer, R.A. 1994. Blackbirds: damage prevention and control methods for blackbirds. pp E-25 to E-32 *in* S. E. Hygnstrom, R. M. Timm and G. E. Larson (eds.) Prevention and Control of Wildlife Damage. Univ. Nebraska and USDA-APHIS-WS and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Dolbeer, R.A. 1997. Feathered and furry fod - a serious problem at U. S. airports. Bird Strike Briefing, National Aerospace FOD Prevention Conf., 24-26 June 1997, Seattle, WA. USDA / Wildl. Serv., National Wildl. Res. Ctr., Ohio Field Sta., 6100 Columbus Ave., Sandusky, OH 44870 USA.

Dolbeer, R.A. 1998. Population dynamics: the foundation of wildlife damage management for the 21st century. Pp. 2-11 *in* Barker, R. O. and Crabb, A. C., Eds. Eighteenth Vertebrate Pest Conference (March 2-5, 1998, Costa Mesa, California). University of California at Davis, Davis, California.

Dolbeer, R.A. 2000. Birds and aircraft: fighting for airspace in crowded skies. Proc. Vert. Pest Conf. 19:37-43.

Dolbeer, R. A., and J. L. Seubert. 2006. Canada goose populations and strikes with civil aircraft: positive trends for aviation industry. Poster Presentation for 8th Bird Strike Committee-USA/Canada meeting, St. Louis, Missouri, 21-24 August 2005.

Dolbeer, R.A., and R.A. Stehn. 1983. Population status of blackbirds and starlings in North America, 1966-81. Denver Wildl. Res. Cent., Bird Damage Res. Rep. No. 294. 61pp.

Dolbeer, R.A., and S.E. Wright. 2008. Wildlife strikes to civil aircraft in the United States, 1991 - 2007. Federal Aviation Administration. Airport Safety and Operations. Washington, DC. 34p.

Dolbeer, R.A., J.L. Belant, and L. Clark. 1993. Methyl anthranilate formulations to repel birds from water at airports and food at landfills. Proc. Great Plains Wildl. Damage Contr. Workshop. 11:42-52.

Dolbeer, R.A., D.F. Mott, and J.L. Belant. 1995. Blackbirds and European starlings killed at winter roosts from PA-14 applications, 1974-1992: Implications for regional population management. Proc. East. Wildl. Damage Control Conf.

Dolbeer, R. A., P. P. Woronecki, and R. L. Bruggers. 1986. Reflecting tapes repel blackbirds from millet, sunflowers, and sweet corn. Wildlife Society Bulletin 14:418-425.

Dolbeer, R.A., S.E. Wright, and E.C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. Wildlife Society Bulletin. 28:372-378.

Dolbeer, R.A., L. Clark, P.P. Woronecki, and T.W. Seamans. 1992. Pen tests of methyl anthranilate as a bird repellent in water. Proc. East. Wildl. Damage Control Conf. 5:112-116.

Dolbeer, R.A., T.W. Seamans, B.F. Blackwell, and J.L. Belant. 1998. Anthraquinone formulation (Flight Control) shows promise as avian feeding repellent. Journal of Wildlife Management 62:1558-1564.

Dolbeer, R.A., P.P. Woronecki, A.R. Stickley, Jr., and S.B. White. 1978. Agricultural impact of winter population of blackbirds and starlings. Wilson Bull. 90: 31-44.

Dolbeer, R.A., S.E. Wright, J. Weller, and M.J. Begier. 2009. Wildlife strikes to civil aircraft in the United States 1990-2008. Federal Aviation Administration, National Wildlife Strike Database, Serial Report Number 15.

Dove C.J., N.F. Dahlan, and M. Heacker. 2009. Forensic birdstrike identification techniques used in an accident investigation at Wiley Post Airport, Oklahoma, 2008. Human Wildlife Conflicts 3:179–185.

Eisenmann, E. 1963. Is the black vulture migratory? Wilson Bull. 75:244-249.

Eisemann, J.D., P.A. Pipas, and J.L. Cummings. 2003. Acute and chronic toxicity of compound DRC-1339 (3-chloro-4-methylaniline hydrochloride) to birds. Pp. 49-63 *in* G.M. Linz, ed. Management of North American blackbirds. National Wildlife Research Center, Fort Collins, Colorado.

EPA. 1982. Avian single-dose oral LD_{50} test, Guideline 71-1. Pp. 33-37 *in* Pesticide assessment guidelines, subdivision E, hazard evaluation wildlife and aquatic organisms. U. S. Environmental Protection Agency PB83-153908, Washington, D.C.

EPA. 1995. R.E.D. Facts — Starlicide (3-chloro-p-toluidine hydrochloride). USEPA, Prevention, Pesticides and Toxic Substances. EPA-738-F-96-003. 4 p.

EPA. 1999. ECOFRAM terrestrial draft report. Ecological Committee on FIFRA Risk Assessment Methods. U. S. Environmental Protection Agency, Washington, D. C. http://www.epa.gov/oppefed1/ecorisk/terreport.pdf.

EPA. 2005. Pesticide Fact Sheet: Nicarbazin – Conditional Registration. United States Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, DC 20460.

Eskildsen, U.K., and P.E. Vestergard-Jorgensen. 1973. On the possible transfer of trout pathogenic viruses by gulls. Rivista Italiana di Piscicultura e Ittiopatologia 8:104–105.

European Inland Fisheries Advisory Commission. 1989. Report of the EIFAC Working Party on prevention and control of bird predation in aquaculture and fisheries operations. EIFAC Tech. Pap. 51, Rome.

Fairaizl, S. D. 1992. An integrated approach to the management of urban Canada geese depredations. Verteb. Pest. Conf. 15:105-109.

Feare, C. 1984. The Starling. Oxford University Press. Oxford New York.

Feare, C., A.J. Isaacson, P.A. Sheppard, and J.M. Hogan. 1981. Attempts to reduce starling damage at dairy farms. Protection Ecol. 3:173-181.

Felsenstein, W.C., R.P. Smith, and R.E. Gosselin. 1974. Toxicological studies on the avicide 3-chloro-ptoluidine. Toxicology and Applied Pharmacology 28:110-1125.

Fenlon, D.R. 1981. Seagulls (*Larus* spp.) as vectors of salmonellae: An investigation into the range of serotypes and numbers of salmonellae in gull faeces. Journal of Hygiene, Camb. 86: 195-202.

Fledger, E. J. Jr., H. H. Prince, and W. C. Johnson. 1987. Effects of grazing by Canada geese on winter wheat yield. Wildl. Soc. Bull. 15:402-405.

Fleming, R., P. Eng, and H. Fraser. 2001. The impact of waterfowl on water quality: literature review. Ridgetown College-Univeristy of Guelph, Rigetown, Ontario Canada. Report 14 pp.

FDA. 2003. Bird poisoning of federally protected birds. Office of Criminal Investigations. Enforcement Story 2003.

Forbes, J. E. 1995. European Starlings are expensive nuisance on dairy farms. Ag. Impact. 17:4.

Ford, H.S. 1967. Winter starling control in Idaho, Nevada, Oregon. Proceedings: Third Vertebrate Pest Conference 3:104-110.

Frederick, P.C. 1997. Tricolored Heron (*Egretta tricolor*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/306.

Frederick, P.C., and D. Siegel-Causey. 2000. Anhinga (*Anhinga anhinga*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/522.

Fuller-Perrine, L.D., and M.E. Tobin. 1993. A method for applying and removing bird exclusion netting in commercial vineyards. Wildlife Society Bulletin 21:47-51.

Fussell, J.O. 1994. A Birder's Guide to Coastal North Carolina. The University of North Carolina Press, 554 pp.

Gabrey, S.W. 1997. Bird and small mammal abundance at four types of waste-management facilities in northeast Ohio. Landscape and Urban Planning 37:223-233.

Gallien, P., and M. Hartung. 1994. Escherichia coli O157:H7 as a food borne pathogen. Pp. 331-341 *in* Handbook of zoonoses. Section A: bacterial, rickettsial, chlamydial, and mycotic. G. W. Beran and J. H. Steele, eds. CRC Press. Boca Raton.

Gamble, L.R., K.M. Johnson, G. Linder, and E.A. Harrahy. 2003. The Migratory Bird Treaty Act and concerns for nontarget birds relative to spring baiting with DRC-1339. Pp. 8-12 *in* G.M. Linz, ed. Management of North American blackbirds. National Wildlife Research Center, Fort Collins, Colorado.

Geissler, P.H., and J.R. Sauer 1990. Topics in route-regression analysis. Pp. 54-57 *in* J. R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. fish and Wildlife Service, Bioloigcal Report 90(1).

Giri, S.N., D.H. Gribble, and S.A. Peoples. 1976. Distribution and binding of radioactivity in starlings after IV administration of 14C 3-chloro-p-toluidine. Federation Proceedings 35:328.

Glahn, J.F. 1982. Use of starlicide to reduce starling damage at livestock feeding operations. Proc. Great Plains Wildl. Damage Control Workshop. 5:273-277.

Glahn, J.F. 1983. Blackbird and starling depredations at Tennessee livestock farms. Proc. Bird Control Semin. 9:125-134.

Glahn, J. F., and D. L. Otis. 1981. Approach for assessing feed loss damage by European Starlings at livestock feedlots. ASTM Spec. Tech. Publ. No.752. p.38-45.

Glahn, J.F., and D.L. Otis. 1986. Factors influencing blackbird and European Starling damage at livestock feeding operations. Journal of Wildlife Management 50:15-19.

Glahn, J.F., and E.A. Wilson. 1992. Effectiveness of DRC-1339 baiting for reducing blackbird damage to sprouting rice. Proc. East. Wildl. Damage Cont. Conf. 5:117-123.

Glahn, J.F., and A.R. Stickley, Jr. 1995. Wintering double-crested cormorants in the Delta Region of Mississippi: Population levels and their impact on the catfish industry. Colonial Waterbirds 18(Special Edition 1):137-142.

Glahn, J.F., D.S. Reinhold, and C.A. Sloan. 2000*a*. Recent population trends of double-crested cormorants wintering in the Delta region of Mississippi: Responses to roost dispersal and removal under a recent depredation order. Waterbirds 23:38-44.

Glahn, J.F., E.S. Rasmussen, T. Tomsa, and K.J. Preusser. 1999*a*. Distribution and relative impact of avian predators at aquaculture facilities in the Northeastern United States. North American Journal of Aquaculture 61:340-348.

Glahn, J.F., T. Tomsa, and K.J. Preusser. 1999*b*. Impact of great blue heron predation at trout-rearing facilities in the Northeastern United States. North American Journal of Aquaculture 61:349-354.

Glahn, J.F., M.E. Tobin, and J.B. Harrel. 1999*c*. Possible effects of catfish exploitation on overwinter body condition of double-crested cormorants. Pg 107-113 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879.

Glahn, J. F., D.S. Reinhold, and P. Smith. 1999*d*. Wading bird depredations on channel catfish *Ictalurus punctatus* in northwest Mississippi. Journal of the World Aquaculture Society 30:107-114.

Glahn, J.F., S.K. Timbrook, and D.J. Twedt. 1987. Temporal use patterns of wintering European Starlings at a southeastern livestock farm: implications for damage control. Proc. East. Wildl. Damage Control Conf. 3:194-203.

Glahn, J.F., E.A. Wilson, and M.L. Avery. 1990. Evaluation of a DRC-1339 baiting program to reduce sprouting rice damage caused by spring roosting blackbirds. U. S. Department of Agriculture, Animal Damage Control, Denver Wildl. Res. Ctr., Bird Sect. Res. Rep. No. 448.

Glahn, J.F., B. Dorr, J.B. Harrel, and L. Khoo. 2002. Foraging ecology and depredation management of great blue herons at Mississippi catfish farms. Journal of Wildlife Management 66:194-201.

Glahn, J.F., G. Ellis, P. Fiornelli, and B. Dorr. 2000*b*. Evaluation of low to moderate power lasers for dispersing double-crested cormorants from their night roosts. Proceedings of the 9th Wildlife Damage Management Conference. 9:34-35.

Gorenzel, W.P., and T.P. Salmon. 1993. Tape-recorded calls disperse American crows from urban roosts. Wildlife Society Bulletin 21:334-338.

Gorenzel, W.P., and T.P. Salmon. 1995. Characteristics of American crow urban roosts in California. Journal of Wildlife Management 59:638-645.

Gorenzel, W.P., B.F. Blackwell, G.D. Simmons, T.P. Salmon, and R.A. Dolbeer. 2002. Evaluation of laser to disperse American crows, *Corvus brachyrhynchos*, from urban night roosts. Int. J. Pest Manage. 48:327-331.

Gorenzel, W.P., T.P. Salmon, G.D. Simmons, B. Barkhouse, and M.P. Quisenberry. 2000. Urban crow roosts – a nationwide phenomenon? Proc. Wildl. Damage Manage. Conf. 9:158-170.

Grabill, B. A. 1977. Reducing starling use of wood duck boxes. Wildlife Society Bulletin 5:67-70.

Graczyk, T.K., M.R. Cranfield, R. Fayer, J. Tout, and J.J. Goodale. 1997. Infectivity of *Cryptosporidium parvum* oocysts is retained upon intestinal passage through a migratory waterfowl species (Canada goose, *Branta canadnsis*). Tropical Med. International Heal. 2:341-347.

Graczyk, T.K., R. Fayer, J.M. Trout, E.J. Lewis, C.A. Farley, I. Sulaiman, and A.A. Lal. 1998. *Giardia* sp. cysts and infectious *Cryptosporidium parvum* oocysts in the feces of migratory Canada geese (*Branta canadensis*). Applied and Environmental Microbiology 64:2736-2738.

Graves, G.E., and W.F. Andelt. 1987. Prevention and control of woodpecker damage. Service in Action, Colo. St. Univ. Coop. Ex. Serv. Publ. no 6.516. Ft. Collins, Colo. 2 pp.

Hamilton, Jr., W.J. 1951. The food of nestling bronzed grackles, *Quiscalus quiscula versicolor*, in central New York. Auk 68:213-217.

Hanson, H. C. 1965. The giant Canada goose. S. Ill. Univ. Press, Carbondale. 226 pp.

Hatch, J.J. 1995. Changing populations of double-crested cormorants. Colonial Waterbirds 18(Spec. Publ. 1):8-24.

Hatch, J.J. 1996. Threats to public health from gulls (Laridae). Journal of Environmental Health Research 6:5-16.

Hatch J.J., and D.V. Weseloh. 1999. Double-crested cormorant: (*Phalacrocorax auritus*). *in* The Birds of North America, No. 441 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Hebert, C. E., J. Duffe, D. V. C. Weseloh, E. M. T. Senese, G. D. Haffner. 2005. Unique island habitats may be threatened by double-crested cormorants. Journal of Wildlife Management 69:57-65.

Heinrich, J. W., and S. R. Craven. 1990. Evaluation of three damage abatement techniques for Canada geese. Wildl. Soc. Bull. 18:405-410.

Henny, C.J. 1990. Mortality. Pages 140 - 151 In Birds of Prey. I. Newton, P. Olsen, and T. Pyrzalowski, eds. Facts on File, NY, NY. 240 pp.

Heusmann, H.W., and R. Bellville. 1978. Effects of nest removal on starling populations. Wilson Bull. 90:287-290.

Heusmann, H.W., W.W. Blandin, and R.E. Turner. 1977. Starling deterrent nesting cylinders in wood duck management. Wildlife Society Bulletin 5:14-18.

Hicks, R.E. 1979. Guano deposition in an Oklahoma crow roost. The Condor 81:247-250.

Hill, G.A., and D.J. Grimes. 1984. Seasonal study of freshwater lake and migratory waterfowl for *Campylobacter jejuni*. Canadian Journal of Microbiology 30:845-849.

Hohman, W.L., and R.T. Eberhardt. 1998. Ring-necked Duck (*Aythya collaris*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/329.

Homan H.J., L.B. Penry, and G.M. Linz. 2004. Linear modeling of blackbird populations breeding in central North America. National Sunflower Association Research Forum, Fargo, North Dakota. National Sunflower Association, http://www.sunflowernsa.com/research/research-workshop/documents/133.pdf.

Holler, N.R., and E.W. Schafer. 1982. Potential secondary hazards of Avitrol baits to sharp-shinned hawks and American kestrels. Journal of Wildlife Management 46:457-462.

Hoy, M.D., J.W. Jones, and A.E. Bivings. 1989. Economic impact and control of wading birds at Arkansas minnow ponds. Eastern Wildl. Damage Control Conf. 4:109-112.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. Waterbird Conservation for the Americas. http://www.waterbirdconservation.org/. Accessed May 12, 2010.

Hussong, D., J. M. Damare, R. J. Limpert, W. J. L. Sladen, R. M. Weiner, and R.R. Colwell. 1979. Mocrobial impact of Canada Geese (*Branta canadensis*) and whistling swans (*Cygnus columbianus columbianus*) on aquatic ecosystems. Appl. Envir. Microb. 37:14-20.

Ingold, D. J. 1994. Influence of nest site competition between European starlings and woodpeckers. Wilson Bull. 1106:227-241.

Jackson, J.A., and B.J.S. Jackson. 1995. The double-crested cormorant in the south-central United States: habitat and population changes of a feathered pariah. Colonial Waterbirds 18 (Spec. Publ. 1): 118-130.

James, D.A., and J.C. Neal. 1986. Arkansas birds: Their distribution and abundance. University of Arkansas Press, Fayetteville, Arkansas. 402 pp.

Jamieson, R. L. 1998. Tests show Canada geese are cause of polluted lake water. Seattle Pilot. July 9. Seattle, WA.

Jarvie, S., H. Blokpoel, and T. Chipperfield. 1999. A geographic information system to monitor nest distributions of double-crested cormorants and black-crowned night herons at shared colony sites near Toronto, Canada. Pp 121-129 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

Jensen, M.A. 1996. Overview of methods used to reduce gull, geese, raptor, and deer hazards to aircraft at O'Hare International Airport (abstract only). Proc. ann. Meeting Bird Strike Committee, USA.

Johnson, R.J. 1994. American Crows. Pp 33-40 *in* S. E. Hyngstrom, R. M. Timm, and G. E. Larson, eds. Prevention and control of wildlife damage. Univ. Of Nebraska, Lincoln, NE.

Johnson, S. 2005. Lighting changes and the effect on the Auburn NY crow roost. http://www.cnylinks.com/crows/. Accessed October 29, 2009.

Johnson, R.J., and J.F. Glahn. 1994. European Starlings. Pp 109 - 120 *in* S. E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and control of wildlife damage - 1994. Univ. NE Coop. Ext., Instit. o f Ag. and Nat. Res., Univ. of NE-Lincoln, USDA, APHIS, ADC, Great Plains Ag. Council Wildl. Committee.

Johnston, W. S., G. K. MacLachlan and G. F. Hopkins. 1979. The possible involvement of seagulls (*Larus* spp.) In the transmission of salmonella in dairy cattle. Veterinary Record 105:526-527.

Johnston, J.J., D.B. Hurlbut, M.L. Avery, and J.C. Rhyans. 1999. Methods for the diagnosis of acute 3-chloro-p-toluidine hydrochloride poisoning in birds and the estimation of secondary hazards to wildlife. Environ. Toxicology and Chemistry. 18:2533-2537.

Jones, F., P. Smith, and D.C. Watson. 1978. Pollution of a water supply catchment by breeding gulls and the potential environmental health implications. Journal of the Institute of Water Engineering Science 32:469-482.

Kassa, H., B. Harrington, and M.S. Bisesi. 2001. Risk of occupational exposure to *Cryptosporidium, Giardia,* and *Campylobacter* associated with the feces of giant Canada geese. Appl. Occup. And Env. Hygiene. 16:905-909.

Kear, J. 1963. The agricultural importance of goose droppings. Wildfowl. 14:72-77.

Keefe, T. 1996. Feasibility study on processing nuisance Canada geese for human consumption. Minnesota Department of Natural Resources, Section of Wildlife. 7 pp.

Kelly, J.F., E.S. Bridge, and M.J. Hamas. 2009. Belted Kingfisher (*Megaceryle alcyon*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/084.

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

Kerpez, T.A., and N.S. Smith. 1990. Competition between European starlings and native woodpeckers for nest cavities in saguaros. Auk. 107:367-375.

Kilham, L. 1989. The American crow and the common raven. Texas A&M Univ. Press, College Station.

King, D.T. 1997. American white pelicans: The latest avian problem for catfish producers. Proceedings of the Eastern Wildlife Damage Management Conference 7:31-35.

King, D.T. 2005. Interactions between the American white pelican and aquaculture in the southeastern United States: an overview. Waterbirds 28 (Special Publication 1):3-86.

King, D.T., and D.W. Anderson. 2005. Recent population status of the American white pelican: a continental perspective. Waterbirds 28 (Special Publication 1):48-54.

King, D.T., and T.C. Michot. 2002. Distribution, abundance and habitat use of American white pelicans in the Delta Region of Mississippi and along the western Gulf of Mexico coast. Waterbirds 25:410-416.

Klett, B.R., D.F. Parkhurst, and F.R. Gaines. 1998. The Kensico Watershed Study: 1993 - 1995. http://www.epa.gov/owow/watershed/Proceed/sess41-60.pdf. Accessed November 24, 2009.

Korfanty, C., W.G. Miyasaki, and J.L. Harcus. 1999. Review of the population status and management of double-crested cormorants in Ontario. Pg 131-145 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

Kreps, L.B. 1974. Feral pigeon control. Proc. Vertebr. Pest. Conf. 6:257-262.

Kruse, K. L., compiler. 2010. Central Flyway harvest and population survey data book. U.S. Fish and Wildlife Service, Denver CO.

Knittle, C.E., and J.L. Guarino. 1976. Reducing a local population of European Starlings with nest-box traps. Proc. Bird Control. Semin. 7:65-66.

Knittle, C.E., E.W. Schafer, Jr., and K.A. Fagerstone. 1990. Status of compound DRC-1339 registration. Vertebr. Pest Conf. 14:311-313.

Knutsen, G.A. 1998. Avian use of rice-baited and unbaited stubble fields during spring migration in South Dakota. M.S. Thesis, North Dakota State University, Fargo, North Dakota.

Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davison, L. Discson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. rapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC. 78 pp.

Laidlaw, M.A., H.W. Mielke, G.M. Filippelli, D.L. Johnson, and C.R. Gonzales. 2005. Seasonality and children's blood lead levels: Developing a predictive model using climatic variables and blood lead data from Indianapolis, Indiana, Syracuse, New York, and New Orleans, Louisiana (USA). Environ. Health Persp. 113:793-800.

Lemmon, C.R., G. Burgbee, and G.R. Stephens. 1994. Tree damage by nesting double-crested cormorants in Connecticut. Connecticut Warbler 14:27-30.

Lewis, H.F. 1929. The natural history of the double-crested cormorant (*Phalacrocorax auritus*). Ru-Mi-Lou Books, Ottawa, Ontario.

Link, W.A., and Sauer, J.R. 1998. Estimating population change from count data: application to the North American Breeding Bird Survey. Ecological Applications 8:258-268.

Linnell, M.A., M.R. Conover, and T.J. Ohashi. 1996. Analysis of bird strikes at a tropical airport. Journal of Wildlife Management 60:935-945.

Linz, G.M., H.J. Homan, and W.J. Bleier. 1999. Blackbird densities and sunflower damage in North Dakota and South Dakota: 1996-1998. Pp. 136-139 *in* L. Kroh, ed. Proceedings of the 21st Sunflower Research Workshop. (January 14-15, 1999, Fargo, North Dakota). National Sunflower Association, Bismarck, North Dakota.

Linz, G.M., D.A. Schaaf, R.L. Wimberly, H.J. Homan, T.L. Pugh, B.D. Peer, P. Mastrangelo, and W.J. Bleier. 2000. Efficacy and potential nontarget impacts of DRC-1339 avicide use in ripening sunflower fields: 1999 progress report. Pp. 162-169 *in* L. Kroh, ed.Proceedings of the 22nd Sunflower Research Workshop. (January 18-19, 2000, Fargo, North Dakota). National Sunflower Association, Bismarck, North Dakota.

Lipnick, R., J.A. Cotrouvo, R.N. Hill, R.D. Bruce, D.A. Stitzel, A.P. Walker, I. Chu, M. Goddard, L. Segal, J.A. Springer, and R.C. Meyers. 1995. Comparison of the Up-and-Down, conventional LD_{50}, and Fixed-Dose Acute Toxicity procedure. Food Chemistry and Toxicology 33:223-331.

Locke, L.N. 1987. Chlamydiosis. Pages 107-113 *in* M. Friend and C. J. Laitman, editors. Field Guide to Wildlife Diseases: General Field Procedures and Diseases Migratory Birds. M. Friend (ed.). U. S. Department of the Interior, Fish and Wildlife Service, Washington, D. C. Resource Publication 167. 225 pp.

Lovell, H.B. 1947. Black vultures kill young pigs in Kentucky. Auk 64:131-132.

Lovell, H.B. 1952. Black vulture depredations at Kentucky woodlands. Auk 64:48-49.

Lowney, M.S. 1993. Excluding non-migratory Canada geese with overhead wire grids. Proc. East. Wildl. Damage Cont. Conf. 6:85-88.

Lowney, M.S. 1999. Damage by black and Turkey Vultures in Virginia, 1990-1996. Wildlife Society Bulletin. 27:715-719.

Lowther, P.E. 1993. Brown-headed cowbird (*Molothrus ater*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/047. Accessed November 2, 2010.

Luechtefeld, N.W., M.J. Blaser, L.B. Reller, and W.L.L. Wang. 1980. Isolation of *Campylobacter fetus* subsp. *Jejuni* from migratory waterfowl. J. Clin. Microbiol. 12:406-408.

MacDonald, J.W., and P.D. Brown. 1974. *Salmonella* infection in wild birds in Britain. Veterinary Record 94: 21-322.

MacKinnon, B., R. Sowden, and S. Dudley, editors. 2001. Sharing the skies: an aviation guide to the management of wildlife hazards. Transport Canada, Aviation Publishing Division, AARA, 5th Floor, Tower C, 330 Sparks Street, Ottawa, Ontario, K1A 0N8, Canada. 316 pp.

Mason, J.R. 1989. Avoidance of methiocarb-poisoned apples by Red-winged Blackbirds. Journal of Wildlife Management 53:836-840.

Mason, J. R., and L. Clark. 1992. Non-lethal repellents: the development of cost-effective, practical solutions to agricultural and industrial problems. Proc. Vertebr. Pest Conf. 15:115-129.

Mason, J.R., M.A. Adams, and L. Clark. 1989. Anthranilate repellency to European starlings: chemical correlates and sensory perception. Journal of Wildlife Management 53:55-64.

Mason, J.R., A.H. Arzt, and R.F. Reidinger. 1984. Evaluation of dimethylanthranilate as a nontoxic starling repellent for feedlot settings. Proc. East. Wildl. Damage Control Conf. 1:259-263.

Mason, J.R., R.E. Stebbings and G.P. Winn. 1972. Noctules and European starlings competing for roosting holes. J. Zool. 166:467.

Matteson, R.E. 1978. Acute oral toxicity of DRC-1339 to cardinals (*Cardinalis cardinalis*). U. S. Fish and Wildlife Service, Denver Wildlife Research Center, Bird Damage Research Report 84. 3pp.

McCracken, H.F. 1972. Starling control in Sonoma County. Proc. Vertebr. Pest Conf. 5:124-126.

Mccrimmon, Jr., D.A., J.C. Ogden, and G. T. Bancroft. 2001. Great Egret (*Ardea alba*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/570. Accessed November 2, 2010.

McGilvrey, F.B., and F.M. Uhler. 1971. A starling deterrent wood duck nest box. J. Wildl. Manage. 35:793-797.

McGowan, K.J. 2001. Fish Crow (*Corvus ossifragus*) *in* The Birds of North America, No. 589 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Meanley, B. 1954. Nesting of the water-turkey in Eastern Arkansas. The Wilson Bulletin 66:81-88.

Meanley, B. 1971. Blackbirds and the southern rice crop. U.S. Fish Wildl. Serv. Resour. Publ. 100. 64pp.

MANEM Regional Waterbird Plan. 2006. Waterbird Conservation Plan: 2006-2010. http://www.manomet.org/pdf/waterbird07/waterbird_species_profiles.pdf. Accessed September 7, 2009.

Miller, J.W. 1975. Much ado about European starlings. Nat. Hist. 84:38-45.

Mills, C. 1989. Arkansas Audubon Society Newsletter. Distribution and abundance of Arkansas birds. The Summer Season, June-July 1989.

Mississippi Flyway Council. 2008. Status of Mississippi Flyway giant Canada geese, 2008. Mississippi Flyway Council Giant Canada Goose Committee.

Mississippi Flyway Council Technical Section. 1996. Mississippi Flyway Giant Canada Goose Management Plan. Unpub. plan, Giant C. Goose Comm., Miss. Flyway Council. Tech. Sect. 61 pp.

Mitterling, L.A. 1965. Bird damage on apples. Proc. Amer. Soc. Hort. Sci.87:66-72.

Monaghan, P., C.B. Shedden, C.R. Fricker, and R.W.A. Girdwood. 1985. *Salmonella* carriage by herring gulls in the Clyde area of Scotland in relation to their feeding ecology. Journal of Applied Ecology 22:669-680.

Mott., D.F. 1985. Dispersing blackbird-starling roosts with helium-filled balloons. Proc. East. Wildl. Damage Conf. 2:156-162.

Mott, D.F., and S.K. Timbrook. 1988. Alleviating nuisance Canada goose problems with acoustical stimuli. Proc. Vertebr. Pest. Conf. 13:301-305.

Mott, D.F., and C.P. Stone. 1973. Bird damage to blueberries in the United States. U.S. Bur. Sport Fisheries and Wildlife, Spec. Sci. Rept., Wildl. No. 172. 15 pp.

Mott, D.F., J.F. Glahn, P.L. Smith, D.S. Reinhold, K.J. Bruce, and C.A. Sloan. 1998. An evaluation of winter roost harassment for dispersing double-crested cormorants away from catfish production areas in Mississippi. Wildlife Society Bulletin 26:584-591.

Mowbray, T. B., F. Cooke, and B. Ganter. 2000. Snow Goose (*Chen caerulescens*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/514.

Mudge, G.P., and P.N. Ferns. 1982. The feeding ecology of five species of gulls (Aves: Larini) in the inner Bristol Channel. Journal of Zoology (London) 197:497-510.

Muller, L.I., R.J. Warren, and D.L. Evans. 1997. Theory and Practice of immunocontraception in wild animals. Wildlife Society Bulletin. 25:504-514.

NASS. 2006. Cattle Predator Loss – 2005. National Agricultural Statistics Service. Agricultural Statistics Board, United States Department of Agriculture. Washington, D.C. 16 pp.

NAS. 2002. National Audubon Society. The Christmas Bird Count Historical Results. www.audubon.org/bird/cbc. Accessed on March 22, 2010.

NAS. 2007. Snowy egret (*Egretta thula*). National Audubon Society website. http://birds.audubon.org/species/snoegr. Accessed January 24, 2011.

Nelson, H. K., and R.B. Oetting. 1998. Giant Canada Goose Flocks In The United States. Pp 483-495 *in* D.H. Rusch, M.D. Samuel, D.D. Humburg, and B.D. Sullivan, eds. Biology and management of Canada geese. Proc. Int. Canada Goose Symp., Miwaukee, Wis.

Nickell, W.P. 1967. European starlings and sparrow hawks occupy same nest box. Jack-Pine Warbler 45:55.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pp. 12-49 *in* Translocation of Wild Animals. Edited by L. Nielsen and R. D. Brown. WI Humane Society, Inc. and Ceaser Kleberg Wildlife Research Instit. 333 p.

Norton, R.L. 1986. Case of botulism in laughing gulls at a landfill in the Virgin Islands, Greater Antilles. Florida Field Naturalist 14:97-98.

Olesen, N.J., and P.E. Vestergard-Jorgensen. 1982. Can and do herons serve as vectors for Egtved virus. European Association of Fish Pathologists 2:48.

Pacha, R.E., G.W. Clark, E.A. Williams, and A.M. Carter. 1988. Migratory birds of central Washington as reservoirs of *Campylobacter jejuni*. Can. J. Micro. 34:80-82.

Parkhurst, J.A., R.P. Brooks, and D.E. Arnold. 1987. A survey of wildlife depredation and control techniques at fish-rearing facilities. Wildlife Society Bulletin 15:386-394.

Parkhurst, J.A., R.P. Brooks, D.E. Arnold. 1992. Assessment of predation at trout hatcheries in Central Pennsylvania. Wildlife Society Bulletin 20:411-419.

Parmalee, P.W., and B.G. Parmalee. 1967. Results of banding studies of black vultures in eastern North America. Condor 69:146-155.

Parsons, K.C., and T.L. Master. 2000. Snowy Egret (*Egretta thula*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/489.

Patton, S.R. 1988. Abundance of gulls at Tampa Bay landfills. Wilson Bulletin 100:431-442.

Peer, B.D., and E.K. Bollinger. 1997. Common Grackle (*Quiscalus quiscula*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/271.

Peh, K. S.-H., and N. S. Sodhi. 2002. Characteristics of nocturnal roosts of house crows in Singapore. Journal of Wildlife Management 66:1128-1133.

Peoples, S.A., and A. Apostolou. 1967. A comparison between the metabolism of DRC-1339 in rabbits and in starlings. Progress report on starling control. University of California, Davis.

Peters, F., and M. Neukirch. 1986. Transmission of some fish pathogenic viruses by the heron, *Ardea cinerea*. Journal of Fish Diseases T986, 9:539–544.

Peterson, R.T. 1980. Eastern Birds. Houghton Mifflin Co., Boston, MA.

Pimentel, D., L. Lech, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs associated with nonindigenous species in the United States. BioScience 50:53-65.

Pochop, P.A. 1998. Comparison of white mineral oil and corn oil to reduce hatchability of ring-billed gull eggs. Proc. Vertebr. Pest Conf. 18:411-413.

Pochop, P.A., J.L. Cummings, J.E. Steuber, and C.A. Yoder. 1998. Effectiveness of several oils to reduce hatchability of chicken eggs. Journal of Wildlife Management 62:395-398.

Portnoy, J.W. 1990. Gull contributions of phosphorous and nitrogen to a Cape Cod kettle pond. Hydrobiologia 202:61-69.

Powell, L. A., M. J. Conroy, G. D. Balkcom, and U. N. Caudell. 2003. Urban Canada geese in Georgia: assessing a golf course survey and a nuisance relocation program. International Canada Goose Symposium. Pp. 145-149.

Price, I.M., and J.G. Nikum. 1995. Aquaculture and birds: the context for controversy. Colonial Waterbirds 18 (Spec. Pub. 1): 33-45.

Quessey, S., and S. Messier. 1992. Prevalence of *Salmonella* spp., *Campylobacter* spp. and *Listeria* spp. in ring-billed gulls (*Larus delawarensis*). Journal of Wildlife Disease 28:526-531.

Rabenhold, P.P., and M.D. Decker. 1989. Black and Turkey Vultures expand their ranges northward. The Eyas. 12:11-15.

Raftovich, R.V., K.A. Wilkins, K.D. Richkus, S.S. Williams, and H.L. Spriggs. 2010. Migratory bird hunting activity and harvest during the 2008 and 2009 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Reilly, W.G., G.I. Forbes, G.M. Paterson, and J.C.M. Sharp. 1981. Human and animal salmonellosis in Scotland associated with environmental contamination, 1973-1979. Veterinary Record 108: 553-555.

Reinhold, D.S., and C.A. Sloan.1999. Strategies to reduce double-crested cormorant depredation at aquaculture facilities in Mississippi. Pg 99-105 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, and T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, New York.

Robbins, C.S., and E.A.T. Blom. 1996. Atlas of the Breeding Birds of Maryland and the District of Columbia. University of Pittsburgh Press, Pittsburgh, Pennsylvania.

Robinson, M. 1996. The potential for significant financial loss resulting from bird strikes in or around an airport. Proc. Bird Strike Committee Europe 22:353-367.

Rodgers, Jr., J.A., and H.T. Smith. 1995. Little Blue Heron (*Egretta caerulea*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/145.

Roffe, T.J. 1987. Avian tuberculosis. Pp. 95-99 *in* M. Friend and C. J. Laitman, eds. Field guide to wildlife diseases. 225 pp.

Rogers, J. G., Jr., and J. T. Linehan. 1977. Some aspects of grackle feeding behavior in newly planted corn. Journal of Wildlife Management 41:444-447.

Roscoe, D. E. 1999. A survey to estimate the prevalence of *Salmonella* sp., *Shigella* sp., *Yersinia* sp. bacteria and *Cryptosporidia* sp., *Giardia* sp. protozoa in resident Canada geese (*Branta canadensis*) in New Jersey. Project Report. NJ Division of Fish and Wildlife. 13 pp.

Rossbach, R. 1975. Further experiences with the electroacoustic method of driving European starlings from their sleeping areas. Emberiza 2:176-179.

Rowsell, E.V., J.A. Carnie, S.D. Wahbi, A.H. Al-Tai, and K.V. Rowsell. 1979. L-serine dehydratase and L-serine-pyruvate aminotransferase activities in different animal species. Comp. Biochem. Physiol. B Comp. Biochem. 63:543-555.

Royall, W.C. 1977. Blackbird-Starling Roost Survey. Bird Damage Research Report #52. Denver Wildlife Research Center. 54 pp.

Royall, W.C., T.J. DeCino, and J.F. Besser. 1967. Reduction of a starling population at a turkey farm. Poultry Science. Vol. XLVI No. 6. pp 1494-1495.

Rusch, D. H., R. E. Malecki, and R. E. Trost. 1995. Canada geese in North America. Pages 26-28 *in* LaRoe, E. T., G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac. Editors. Our Living Resources: A report to the nation on the distribution, abundance, and health of U. S. plants, animals, and ecosystems. USDI, National Biological Service. Washington, D.C. 530 pp.

Ryder, J.P. 1993. Ring-billed Gull (*Larus delawarensis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/033.

Saltoun, C.A., K.E. Harris, T.L. Mathisen, and R. Patterson. 2000. Hypersensitivity pneumonitis resulting from community exposure to Canada goose droppings: when an external environmental antigen becomes an indoor environmental antigen. Annal. Allergy Asth. Immun. 84:84-86.

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

Schafer, E.W., Jr. 1972. The acute oral toxicity of 369 pesticidal, pharmaceutical and other chemicals to wild birds. Toxicol. Appl. Pharmacol. 21:315-330.

Schafer, E.W., Jr. 1981. Bird control chemicals - nature, modes of action, and toxicity. Pp. 129-139 *in* CRC handbook of pest management in agriculture. Vol. 3. CRC Press, Cleveland, OH.

Schafer, E.W., Jr. 1984. Potential primary and secondary hazards of avicides. Proc. Vert. Pest Conf. 11:217-222.

Schafer, E.W., Jr. 1991. Bird control chemicals-nature, mode of action and toxicity. Pp. 599-610 *in* CRC Handbook of Pest Management in Agriculture Vol. II. CRC Press, Cleveland, OH.

Schafer, E.W., Jr., and D.J. Cunningham. 1966. Toxicity of DRC-1339 to grackles and house finches. U. S. Fish and Wildl. Serv. Denver Wildlife Research Center, Typed Rept. 1 pp.

Schafer, E.W., Jr., R.B. Brunton, and N.F. Lockyer. 1974. Hazards to animals feeding on blackbirds killed with 4-aminopyrine baits. Journal of Wildlife Management 38:424-426.

Schafer, E.W., Jr., R.B. Brunton, D.J. Cunningham, and N.F. Lockyer. 1977. The chronic toxicity of 3-chloro-4-methyl benzamine HCl to birds. Archives of Environmental Contamination and Toxicology 6:241-248.

Schmidt, R. 1989. Wildlife management and animal welfare. Trans. N.Amer. Wildl. And Nat. Res. Conf. 54:468-475.

Schmidt, R.H., and R.J. Johnson. 1984. Bird dispersal recordings: an overview. ASTM STP 817. 4:43-65.

Seamans, T.W. 2004. Response of roosting turkey vultures to a vulture effigy. Ohio Journal of Science 104:136-138.

Seamans, T.W., D.W. Hamershock, and G.E. Bernhardt. 1995. Determination of body density for twelve bird species. Ibis 137:424-428.

Seamans, M. E., J. P. Ludwig, K. Stromborg, F. E. Ludwig II, and F. E. Ludwig. 2008. Annual survival of double-crested cormorants from the Great Lakes, 1979-2006.

Shake, W.F. 1967. Starling wood duck interrelationships. M.S. Thesis. Western Illinois University, Macomb. 46 pp.

Shieldcastle, M.C., and L. Martin. 1999. Colonial waterbird nesting on west sister island national wildlife refuge and the arrival of double-crested cormorants. Pp. 115-119 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

Shirota, Y. M., and S. Masake. 1983. Eyespotted balloons are a device to scare gray European atarlings. Appl. Ent. Zool. 18:545-549.

Shultz, D. F., J. A. Cooper, and M. C. Zicus. 1988. Fall flock behavior and harvest of Canada geese. J. Wildl. Manage. 52:679-688.

Simmons, G. M., S. A. Herbein, and C. M. James. 1995. Managing nonpoint fecal coliform sources to tidal inlets. Water Resources Update. 100:64-74.

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, A. E. 1996. Movement and harvest of Mississippi Flyway Canada Geese. M.S. Thesis. Univ. of Wisc.-Madison. vi, 72 pp.

Smith, J.A. 1999. Nontarget avian use of DRC-1339 treated plots during an experimental blackbird control program in eastern South Dakota. M.S. Thesis, South Dakota State University, Brookings, South Dakota.

Smith, A.E., S.R. Craven, and P.D. Curtis. 1999. Managing Canada geese in urban environments. Jack Berryman Institute Publication 16, and Cornell University Cooperative Extension, Ithaca, N.Y. 42 pp.

Smith, K. E., J. R. Fischer, S. E. Little, J. M. Lockhart, and D. E. Stallknecht. 1997. Diseases with implication for human health. Pp 378-399 *in* Field Manual of Wildlife Diseases in the Southeastern United States. W. R. Davidson and V. F. Nettles, eds. Univ. of GA. Athens, GA.

Sovada, M.A., P.J. Pietz, K.A. Converse, D.T. King, E.K. Hofmeister, P. Scherr, and H.S. Ip. 2008. Impact of West Nile virus and other mortality factors on American white pelicans at breeding colonies in the northern plains of North America. Biological Conservation1021-1031.

Stansley, W., L. Widjeskog, and D.E. Roscoe. 1992. Lead contamination and mobility in surface water at trap and Skeet Ranges. Bull. Environ. Contam. Toxicol. 49:640-647.

Sterner, R.T., D.J. Elias, and D.R. Cerven. 1992. The pesticide reregistration process: collection of human health hazards data for 3-chloro-p-toluidine hydrochloride (DRC-1339). Pp. 62-66 *in* J. E. Borrecco and R. E. Marsh, eds., Proceedings 15th Vertebrate Pest Conference, March 3-5, 1992, Newport Beach, California.

Sterritt, R.M., and J.N. Lester. 1988. Microbiology for environmental and public health engineers. E. & F. N. Spon, pub. New York.

Stevens, G.R., and L.R. Clark. 1998. Bird repellents: development of avian-specific tear gases for resolution of human-wildlife conflicts. Inter. Biodeterioration and Biodegradation 42:153-160.

Stone, C.P., and D.F. Mott. 1973. Bird damage to ripening field corn in the United States, 1971. U.S. Bureau of Sport Fisheries and Wildlife, Wildlife Leaflet 505. 8 pp.

Stroud, R. K., and M. Friend. 1987. Salmonellosis. Pp 101-106 *in* Field Guide to Wildlife Diseases. M. Friend and D. J. Laitman editors. 225 pp.

Suebert, J. L., and R. A. Dolbeer. 2004. Status of North American Canada Goose populations in relation to strikes with civil aircraft. Bird strike committee. 13-17 Sept. 2004.

Sullivan, B.D., and J.J. Dinsmore. 1990. Factors affecting egg predation by American crows. Journal of Wildlife Management 54:433-437.

Summers, R. W. 1985. The effect of scarers on the presence of starlings (*Sturnus vulgaris*) in cherry orchards. Crop Prot. 4:522-528.

Swift, B. L. 1998. Response of resident Canada geese to chasing by trained border collies. Unpub. Report. NY Dept. of Environ. Conser. Delmar, NY. 6 pp.

Taylor, P.W. 1992. Fish-eating birds as potential vectors of *Edwardsiella ictaluri*. Journal of Aquatic Animal Health 4:240–243.

Telfair II, R.C. 1983. The Cattle Egret: a Texas focus and world view. Kleberg Studies in Natural Resources. Texas Agricultural Experiment Station, Texas A&M University, College Station,TX.

Telfair II, R.C. 2006. Cattle egret (*Bubulcus ibis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/113.

Telfair II, R.C., and T.J. Bister. 2004. Long-term breeding success of the cattle egret in Texas. Waterbirds 27:69-78.

Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. Wings Bros. New York, New York.

The Wildlife Society. 1992. Conservation policies of the Wildlife Society. The Wildlife Society. Washington, D.C. 20 p.

Thorpe, J. 1996. Fatalities and destroyed civil aircraft due to bird strikes: 1912-1995. Proc. Int. Bird Strike Conf. 23:17-31.

Tobin, M.E., P.P. Woronecki, R.A. Dolbeer, and R.L. Bruggers. 1988. Reflecting tape fails to protect ripening blueberries from bird damage. Wildlife Society Bulletin 16:300-303.

Tobin, M.E., D.T. King, B.S. Dorr, and D.S. Reinhold. 2002. The effect of roost harassment on cormorant movements and roosting in the Delta region of Mississippi. Waterbirds 25:44-51.

Twedt, D.J., and J.F. Glahn. 1982. Reducing starling depredations at livestock feeding operations through changes in management practices. Proc. Vertebr. Pest Conf. 10:159-163.

Tyson, L.A., J.L. Belant, F.J. Cuthbert, and D.V. Weseloh. 1999. Nesting populations of double-crested cormorants in the United States and Canada. Pp. 17-25 *in* M.E. Tobin, ed. Symposium on Double-crested Cormorants: Population Status and Management Issues in the Midwest, 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

USAF. 2009. Bird/Wildlife Aircraft Strike Hazard (BASH): Strike Statistics. http://www.afsc.af.mil/organizations/bash/statistics.asp. Accessed on December 13, 2010.

USDA. 1997. Animal Damage Control Program: Final Environmental Impact Statement (revised). USDA/APHIS/WS-Operational Support Staff, 4700 River Road, Unit 87, Riverdale, Maryland 20737.

USDA. 2001. Compound DRC-1339 Concentrate-Staging Areas. Tech Note. USDA/APHIS/WS. National Wildlife Research Center, Fort Collins, Colorado.

USDA. 2003. Tech Note: Spring viremia of carp. United States Department of Agriculture, Animal and Plant Protection Service, Veterinary Services. Riverdale, MD.

USDA. 2004. Environmental Assessment (EA) - Reducing double-crested cormorant damage through an integrated wildlife damage management program in the State of Arkansas. USDA/APHIS/WS, Sherwood, Arkansas.

USDA. 2009*a*. Arkansas - 2009 state agriculture overview. United States Department of Agriculture, National Agricultural Statistic Service, Arkansas Field Office, Little Rock, Arkansas.

USDA. 2009*b*. 2007 Census of Agriculture: Arkansas State and County Data. USDA, National Agricultural Statistics Service. Volume 1, Geographic Area Series, Part 4. AC-07-A-4.

USFWS. 1981. Domestic Pigeon. United States Department of Interior, United States Fish and Wildlife Service. 4 pp.

USFWS. 2000. Bird conservation region descriptions. North American Bird Conservation Initiative. U.S. NABCI Committee. 44 pp.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

USFWS. 2003. Final Environmental Impact Statement: Double-crested Cormorant Management. U.S. Dept. of the Interior, USFWS, Div. of Migratory Bird Management, 4401 N. Fairfax Drive MS 634, Arlington, VA 22203.

USFWS. 2005. Final Environmental Impact Statement: Resident Canada goose management. United States Fish and Wildlife Service, Division of Migratory Birds. Arlington, Virginia. http://www.fws.gov/migratorybirds/issues/cangeese/finaleis.htm. Accessed November 24, 2009.

USFWS. 2006. Waterfowl population status, 2006. U.S. Department of the Interior, Washington, D.C. U.S.A.

USFWS. 2007. Final Environmental Impact Statement: Light goose management. United States Fish and Wildlife Service, Division of Migratory Birds. Arlington, Virginia. Accessed on November 12, 2010.

USFWS. 2009. Environmental Assessment: Extended management of double-crested cormorants under 50 CFR 21.47 and 21.48. United States Fish and Wildlife Service, Division of Migratory Bird Management, 4401 N. Fairfax Drive, Mail Stop 4107, Arlington, VA 22203.

USFWS. 2010. Waterfowl population status, 2010. U.S. Department of the Interior, Washington, D.C. USA.

USGS. 2000. Screening for potential human pathogens in fecal material deposited by resident Canada geese on areas of public utility. Completion report. National Wildlife Health Center, Madison, WI. 28 pp.

Vauk-Hentzelt, E., W. Gunkel, and K. Klings. 1987. Microbial diseases in special consideration of Coli septicaemia *Escherichia coli* of gulls Laridae around the Isle Helgoland (German Bight). Global Trends in Wildlife Management, 18th IUGB Congress, Krakow, Poland, August, 1987. Swait Press, Krakow. Pp. 273-275.

Verbeek, N.A.M. 1977. Comparative feeding ecology of herring gulls *Larus argentatus* and lesser black-backed gulls *Larus fiscus*. Ardea 65:25-42.

Verbeek, N.A., and C. Caffrey. 2002. American crow (*Corvus brachyrhynchos*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/647.

VerCauteren, K. C., and D. R. Marks. 2004. Movements of urban Canada geese: implications for nicarbazin treatment programs. Pages 151-156 *in* T. J. Moser, R. D. Lien, K. C. VerCauteren, K. F. Abraham, D. E. Anderson, J. G. Bruggink, J. M. Coluccy, D. A. Graber, J. O. Leafloor, D. R. Luukkonen,and R. E. Trost, editors. Proceedings of the 2003 International Canada Goose Symposium. Madison, Wisconsin.

VerCauteren, K. C., M. J. Pipas, and K. L. Tope. 2000. Evaluations of nicarbazin-treated pellets for reducing the laying and viability of Canada goose eggs. Proc. Eastern Wildl. Damage Management Conf., State College, PA. 337-346.

Virginia Department of Health. 1995. Cryptosporidium: Fact Sheet. Pub. No. FS-DWSE-95-1. Richmond, VA. 3.

Von Jarchow, B.L. 1943. European starlings frustrate sparrow hawks in nesting attempt. Passenger Pigeon. 5:51.

Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Birds of New Jersey. New Jersey Audubon Society, Bernardsville, NJ. 704 pp.

Watts, B.D. 1995. Yellow-crowned Night-Heron (*Nyctanassa violacea*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/161.

Weber, W.J. 1979. Health Hazards from pigeons, European starlings, and English sparrows. Thompson Publ. Fresno, Calif. 138 pp.

Weeks, R.J., and A.R. Stickley. 1984. Histoplasmosis and its relation to bird roosts: a review. Denver Wildl. Res. Ctr. Bird Damage Rpt. No. 330. U.S. Fish and Wildl. Serv. 23 pp.

Weitzel, N.H. 1988. Nest site competition between the European starling and native breeding birds in northwestern Nevada. Condor. 90:515-517.

Welty, J. C. 1982. The life of birds. Saunders College Publishing. New York, NY. 754 pp.

Weseloh, D.V., and B. Collier. 1995. The rise of the double-crested cormorant on the Great Lakes: winning the war against contaminants. Great Lakes Fact sheet. Canadian Wildlife Service, Environment Canada and Long Point Observatory.

Weseloh, D.V., and P.J. Ewins. 1994. Characteristics of a rapidly increasing colony of double-crested cormorants (*Phalacrocorax auritus*) in Lake Ontario: population size, reproductive parameters and band recoveries. J. Great Lakes Res. 20(2):443-456.

Weseloh, D.V., P.J. Ewins, J. Struger, P. Mineau, C.A. Bishop, S. Postupalsky, and J.P. Ludwig. 1995. Double-crested Cormorants of the Great Lakes: Changes in population size, breeding distribution and reproductive output between 1913 and 1991. Colonial Waterbirds 18 (Spec. Publ.1):48-59.

West, R.R., and J.F. Besser. 1976. Selection of toxic poultry pellets from cattle rations by European Starlings. Proc. Bird Control Semin. 7:242-244.

West, R.R., J.F. Besser, and J.W. DeGrazio. 1967. Starling control in livestock feeding areas. Proc. Vertebr. Pest Conf. San Francisco, CA.

Westberg, G.L. 1969. Comparative studies of the metabolism of 3-chloro-p-toluidine and 2-chloro-4-acetutoluidine in rats and chickens and methodology for the determination of 3-chloro-p-toluidine and metabolites in animal tissues. M.S. Thesis, University of California-Davis.

White, D.H., L.E. Hayes, and P.B. Bush. 1989. Case histories of wild birds killed intentionally with famphur in Georgia and West Virginia. Jounal of Wild. Diseases. 25:144-188.

Whitford, P. C. 2003. Use of alarm/alert call playback and human harassment to end Canada goose problems at an Ohio business park. Pp 245-255 *in* K. A. Fagerstone and G.W. Wtimer, eds. Proceedings of the 10th Wildlife Damage Management Conference.

Whoriskey, F.G., and G.J. Fitzgerald. 1985. The effects of bird predation on an estuarine stickleback (Pisces: Gasterosteidae) community. Can. J. Zool. 63:301-307.

Wiese, J.H. 1979. A study of the reproductive biology of herons, egrets, and ibis nesting on Pea Patch Island, Delaware. Delmarva Power and Light Co., Manomet Bird Observatory, Manomet, MA.

Wilbur, S.R. 1983. The status of vultures in the western hemisphere. Pp 113-123 *in* S.R. Wilbur and J.A. Jackson, eds. Vulture biology and management. University of California Press. Berkeley.

Williams, R.E. 1983. Integrated management of wintering blackbirds and their economic impact at south Texas feedlots. Ph.D. Dissertation, Tex. A&M Univ., College Station. 282 pp.

Williams, D.E., and R.M. Corrigan. 1994. Pigeons (Rock Doves). pp E-87 to E-96 *in* S. E. Hygnstrom, R. M. Timm and G. E. Larson (eds.) Prevention and Control of Wildlife Damage. Univ. Nebraska and USDA-APHIS-WS and Great Plains Agric. Council Wildl. Comm., Lincoln, Nebr.

Williams, B.M., D.W. Richards, D.P. Stephens, and T. Griffiths. 1977. The transmission of *S. livingstone* to cattle by the herring gull (*Larus argentatus*). Veterinary Record 100:450-451.

Wilmer, T.J. 1987. Competition between European starlings and kestrels for nest boxes: a review. Raptor Res. Rep. No. 6 p. 156-159.

Wires, L.R., and Cuthbert, F.J. 2001. Prioritization of waterbird colony sites for conservation in the U.S. Great Lakes. Final Report to USFWS.

Wires, L.R., F.J. Cuthbert, D.R. Trexel, and A.R. Joshi. 2001. Status of the Double-crested Cormorant (*Phalacrocorax auritus*) in North America. Final Report to USFWS.

Wobeser, G., and C.J. Brand. 1982. Chlamydiosis in 2 biologists investigating disease occurrences in wild waterfowl. Wildlife Society Bulletin 10170-172.

World Health Organization. 1998. Toxicological evaluation of certain veterinary drug residues in foods. World Health Organization, International Programme on Chemical Safety. http://www.inchem.org/documents/jecfa/jecmono/v041je10.htm. Accessed November 20, 2008.

Woronecki, P.P., R.A. Dolbeer, and T.W. Seamans. 1990. Use of alpha-chloralose to remove waterfowl from nuisance and damage situations. Proc. Vertbr. Pest Conf. 14:343-349.

Wright, E.N. 1973. Experiments to control starling damage at intensive animal husbandry units. Bull. OEPP. 9:85-89.

Wright, S. 2010. Some significant wildlife strikes to civil aircraft in the United States, January 1990-November 2009, United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Sandusky, OH. 120 pp.

Wright, S.E., and R.A. Dolbeer. 2005. Percentage of wildlife strikes reported and species identified under a voluntary system. *In* Proceedings of Bird Strike Committee USA/Canada meeting, Vancouver, B.C. Canada.

Yasukawa, K., and W.A. Searcy. 1995. Red-winged Blackbird (*Agelaius phoeniceus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/184. Accessed November 2, 2010.

Yoder, C.A., L.A. Miller, and K.S. Bynum. 2005. Comparison of nicarbazin absorption in chickens, mallards, and Canada geese. Poultry Science 84:1491–1494.

Zimpfer, N.L., W.E. Rhodes, E.D. Silverman, G.S. Zimmerman, and M.D. Kone. 2010. Trends in duck breeding populations, 1955 – 2010. United States Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, Maryland.

Zottoli, S.J. 1976. Fishing behavior of the Common Grackle. Auk 93:640-642.

Zucchi, J., and J. H. Bergman. 1975. Long-term habituation to species-specific alarm calls in a song-bird *Fringilla coelebs.* Experientia 31:817-818.

APPENDIX B

BIRD DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE OR RECOMMENDATION BY THE WS PROGRAM IN ARKANSAS

NON-LETHAL METHODS - NONCHEMICAL

Agricultural producer and property owner practices consist primarily of non-lethal preventive methods such as cultural methods and habitat modification. Cultural methods and other management techniques are implemented by the agricultural producer or property owners/managers. Resource owners/managers may be encouraged to use those methods, based on the level of risk, need, and professional judgment on their effectiveness and practicality. Those methods include:

Cultural methods may include altering planting dates so that crops are not young and more vulnerable to damage when the damage-causing species are present, or the planting of crops that are less attractive or less vulnerable to such species. At feedlots or dairies, cultural methods generally involve modifications to the level of care or attention given to livestock which may vary depending on the age and size of the livestock. Animal husbandry practices include but are not limited to techniques such as night feeding, indoor feeding, closing barn doors, removal of spilled grain or standing water, and use of bird proof feeders (Johnson and Glahn 1994).

Environmental/Habitat modification can be an integral part of bird damage management. Wildlife production and/or presence are directly related to the type, quality, and quantity of suitable habitat. Therefore, habitat can be managed to reduce or eliminate the production or attraction of certain bird species or to repel certain birds. In most cases, the resource or property owner is responsible for implementing habitat modifications, and WS only provides advice on the type of modifications that have the best chance of achieving the desired effect. Habitat management is most often a primary component of bird damage management strategies at or near airports to reduce bird aircraft strike problems by eliminating bird nesting, roosting, loafing, or feeding sites. Generally, many bird problems on airport properties can be minimized through management of vegetation and water from areas adjacent to aircraft runways. Habitat management is often necessary to minimize damage caused by crows, blackbirds, and starlings that form large roosts during late autumn and winter. Bird activity can be greatly reduced at roost sites by removing all the trees or selectively thinning the stand.

Habitat alteration can be the planting of vegetation unpalatable to wildlife or altering the physical habitat (Conover and Kania 1991, Conover 1992). For example, Conover (1991) found that even hungry Canada geese refused to eat some ground covers such as common periwinkle (*Vinca minor*), English ivy (*Hedera helix*) and Japanese pachysandra (*Pachysandra terminalis*). Planting less preferred plants or grasses to discourage geese from a specific area could work more effectively if good alternative feeding sites are nearby (Conover 1985). However, the manipulation of turf grass varieties in urban/suburban, heavy use situations such as parks, athletic fields and golf courses is often not feasible. Varieties of turf grass that grow well and can withstand regular mowing and regular/heavy human use include: Kentucky blue grass, red fescue, perennial bent grass, perennial rye grass and white clover. All of these grasses are appealing to most waterfowl. The turf grass varieties that are not appealing to geese such as tall fescue, orchard grass, and timothy do not withstand regular mowing and/or regular/heavy human use.

Animal behavior modification refers to tactics that alter the behavior of wildlife to reduce damage. Animal behavior modification may involve use of scare tactics or fencing to deter or repel animals that cause loss or damage (Twedt and Glahn 1982). Some but not all methods that are included by this

category are bird-proof barriers, electronic guards, propane exploders, pyrotechnics, distress calls and sound producing devices, chemical frightening agents, repellents, scare crows, mylar tape, lasers, and eye-spot balloons.

Those techniques are generally only practical for small areas. Scaring devices such as distress calls, helium filled eye spot balloons, raptor effigies and silhouettes, mirrors, and moving disks can be effective but usually for only a short time before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Conover 1982, Shirota and Masake 1983, Schmidt and Johnson 1984, Mott 1985, Graves and Andelt 1987, Bomford 1990). Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988).

Bird proof barriers can be effective but are often cost-prohibitive, particularly because of the aerial mobility of birds which requires overhead barriers as well as peripheral fencing or netting. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993).

Overhead wire grids can deter bird use of specific areas where they are causing a nuisance (Johnson 1994). The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. Netting can be used to exclude birds from a specific area by the placement of bird proof netting over and around the specific resource to be protected. Exclusion may be impractical in most settings (*e.g.*, commercial agriculture); however, it can be practical in small areas (*e.g.*, personal gardens) or for high-value crops (*e.g.*, grapes) (Johnson 1994). Although this alternative would provide short-term relief from damage, it may not completely deter birds from feeding, loafing, staging, or roosting at that site. A few people would find exclusionary devices such as netting unsightly and a lowering of the aesthetic value of the neighborhood when used over personal gardens.

Waterfowl may be excluded from ponds using overhead wire grids (Fairaizl 1992, Lowney 1993). Overhead wire grids have been demonstrated to be most applicable on ponds of two acres or less, but wire grids may be considered aesthetically unappealing to some people. Wire grids render a pond unusable for boating, swimming, fishing, and other recreational activities. Installation costs are about $1,000 per surface acre for materials. The expense of maintaining wire grids may be burdensome for some people.

Electric Fence is generally limited to rural settings, due to the possibility/likelihood of interaction with people and pets. Limits of this application arise where there are multiple landowners along the wetland, pond, or lake, the size of the area, and its proximity to bodies of water used by waterfowl. Perceptions from Minnesota on the effectiveness of electric fences were high (Cooper and Keefe 1997). While electric fencing may be effective in repelling waterfowl in some urban settings, its use is often prohibited in many municipalities for human safety reasons. Problems that typically reduce the effectiveness of electric fences include; vegetation on fence, flight capable birds, fencing knocked down by other animals (*e.g.*, white-tailed deer and dogs), and poor power.

Barrier Fence consists of the construction or placement of physical barriers but has limited application for most bird species, except waterfowl. Barriers can be temporary or permanent structures. Lawn furniture/ornaments, vehicles, boats, snow fencing, plastic hazard fencing, metal wire fencing, and multiple strand fencing have all been used to limit the movement of Canada geese. The application of this method is limited to areas that can be completely enclosed and do not allow waterfowl to land inside enclosures. Similar to most abatement techniques, this method has been most effective when dealing with small numbers of breeding geese and their flightless young along wetlands and/or waterways. Unfortunately, there have been situations where barrier fencing designed to inhibit goose nesting has entrapped young and resulted in starvation (Cooper 1998). The preference for geese to walk or swim, rather than fly, during this time period contributes to the success of barrier fences. Birds that are capable

of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing.

Surface Coverings are most often used on small bodies of water to exclude waterfowl. Plastic balls approximately five inches in diameter can be used to cover the surface of a pond. A "*ball blanket*" renders a pond unusable for boating, swimming, fishing, and other recreational activities. This method can be cost prohibitive.

Harassment/Hazing reduces damage or threats of damage in those instances when the affected birds move to a more acceptable area. Birds hazed from one area where they are causing damage frequently move to another area where they cause damage (Brough 1969, Conover 1984, Summers 1985, Swift 1998). Smith et al. (1999) noted that others have reported similar results, stating: "*biologists are finding that some techniques (e.g., habitat modifications or scare devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and waterfowl become more accustomed to human activity*". Whitford (2003) used a combination of noise harassment, dogs, nest displacement, and visual harassment to chase geese from an urban park during the nesting season. Birds responded by dispersing and continued harassment with alarm calls prevented recolonization of the site during the nesting season. Generally speaking, birds tend to habituate to hazing techniques (Zucchi and Bergman 1975, Summers 1985, Aubin 1990). In some locations and circumstances, hazing is a useful component of a bird damage management program.

Auditory scaring devices such as propane exploders, pyrotechnics, electronic guards, scare crows, and audio distress/predator vocalizations are effective in many situations for dispersing damage-causing bird species. Those devices are sometimes effective but usually only for a short period of time before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Shirota and Masake 1983, Schmidt and Johnson 1984, Mott 1985, Bomford 1990). Williams (1983) reported an approximate 50% reduction in blackbirds at two south Texas feedlots as a result of pyrotechnics and propane cannon use. However, they are often not practical in dairy or feedlot situations because of the disturbance to livestock, although livestock can generally be expected to habituate to the noise. Birds, too, quickly learn to ignore scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics.

Distress calls are used to imitate the vocalization of birds in distress. Aguilera et al. (1991) found distress calls ineffective in causing migratory and resident geese to abandon a pond. Although, Mott and Timbrook (1988) reported distress calls as effective at repelling resident geese 100 meters from the distress unit, the birds would return shortly after the calls stopped. The repellency effect was enhanced when pyrotechnics were used with the distress calls. In some situations, the level of volume required for this method to be effective in urban/suburban areas would be prohibited by local noise ordinances. A similar device, which electronically generates sound, has proven ineffective at repelling migrant waterfowl (Heinrich and Craven 1990).

Pyrotechnics (screamer shells, bird bombs, and 12-gauge cracker shells) have been used to repel many species of birds (Booth 1994). Aguilera et al. (1991) found 15mm screamer shells effective at reducing resident and migrant Canada geese use of areas in Colorado. However, Mott and Timbrook (1988) and Aguilera et al. (1991) doubted the efficacy of harassment and believed that moving the geese simply redistributed the problem to other locations.

Fairaizl (1992) and Conomy et al. (1998) found the effectiveness of pyrotechnics highly variable among different flocks of waterfowl. Some flocks in urban areas required continuous harassment throughout the day with frequent discharges of pyrotechnics. The waterfowl usually returned within hours. A minority of resident Canada goose flocks in Virginia showed no response to pyrotechnics (Fairaizl 1992). Some flocks of Canada geese in Virginia showed a quick response to pyrotechnics during winter months,

suggesting migrant geese made up some or all of the flock (Fairaizl 1992). Shultz et al. (1988) reported fidelity of resident Canada geese to feeding and loafing areas is strong, even when heavy hunting pressure is ongoing. Mott and Timbrook (1988) concluded that the efficacy of harassment with pyrotechnics is partially dependent on availability of alternative loafing and feeding areas. Although one of the more effective methods of frightening geese away, more often than not pyrotechnics simply move geese to other areas. There are also safety and legal implications regarding their use. Discharge of pyrotechnics is inappropriate and prohibited in some urban/suburban areas of Arkansas. Pyrotechnic projectiles can start fires, ricochet off buildings, pose traffic hazards, and trigger dogs to bark incessantly, annoy and possibly injure people. Use of pyrotechnics in certain municipalities would be constrained by local firearm discharge and noise ordinances.

Propane cannons produce a noise that is intended to represent a firearm discharge. Cannons are attached to a propane tank and regulated to discharge at certain intervals. Propane cannons are generally inappropriate for urban/suburban areas due to the repeated loud explosions, which many people would consider a serious and unacceptable nuisance and potential health threat (hearing damage). Although a propane cannon can be an effective dispersal tool for migrant birds in agricultural settings, birds in urban areas are more tolerant of noise and habituate to propane cannons relatively quickly.

Recreational paintball equipment may be used to supplement other harassment methods. Paintballs consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. A paintball marker (or gun) uses compressed CO_2 to propel paintballs an average of 280 feet per second, though they are not very accurate. The discharge of the paintball marker combined with the sound of paintballs hitting the ground or splashing in water may be effective in dispersing Canada geese, especially when combined with other harassment techniques. Though paintballs break easily and velocity rapidly decreases with distance, firing at close range is discouraged to avoid harming geese. As with pyrotechnics, use of paintballs may be restricted in some areas by local ordinances

Visual scaring techniques such as use of Mylar tape (highly reflective surface produces flashes of light that startles birds), eye-spot balloons (the large eyes supposedly give birds a visual cue that a large predator is present), flags, effigies (scarecrows), sometimes are effective in reducing bird damage. Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et.al. 1986, Tobin et.al. 1988). Birds quickly learn to ignore visual and other scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics.

Scarecrows and effigies depicting alligators, humans, floating swans, and dead birds have been employed, with limited success for short time periods in small areas. An integrated approach (swan and predator effigies, distress calls and non-lethal chemical repellents) was found to be ineffective at scaring or repelling nuisance waterfowl (Conover and Chasko 1985). While Heinrich and Craven (1990) reported that using scarecrows reduced migrant Canada goose use of agricultural fields in rural areas, their effectiveness in scaring geese from urban/suburban areas is severely limited because geese are not afraid of humans as a result of nearly constant contact with people. In general, scarecrows are most effective when they are moved frequently, alternated with other methods, and are well maintained. However, scarecrows tend to lose effectiveness over time and become less effective as goose populations increase (Smith et al. 1999).

Dogs can be effective at harassing waterfowl and keeping them off of turf and beaches (Conover and Chasko 1985, Castelli and Sleggs 2000). Around water, this technique appears most effective when the body of water to be patrolled is less than two acres in size (Swift 1998). Although dogs can be effective in keeping waterfowl off of individual properties, they do not contribute to a solution for the larger problem of overabundant goose populations (Castelli and Sleggs 2000). Swift (1998) and numerous

individuals in New Jersey have reported that when harassment with dogs ceases, the number of geese returns to pre-treatment numbers. WS has recommended and encouraged the use of dogs where appropriate.

Lasers are a non-lethal technique recently evaluated by the NWRC (Glahn et al. 2000*b*, Blackwell et al. 2002). For best results and to disperse numerous birds from a roost, the laser is most effectively used in periods of low light, such as after sunset and before sunrise. In the daytime, the laser can also be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser is much diminished. Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing pigeons and mallard with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002). As with other bird damage management tools lasers are most effective when used as part of an integrated management program.

Live traps (although live traps are non-lethal, birds may be euthanized upon capture). In most situations live trapped birds are subsequently euthanized. Relocation to other areas following live capture would not generally be effective because problem bird species are highly mobile and can easily return to damage sites from long distances; habitats in other areas are generally already occupied; and relocation would most likely result in bird damage problems at the new location. Translocation of wildlife is also discouraged by WS' policy (WS Directive 2.501) because of stress to the relocated animal, poor survival rates, and difficulties in adapting to new locations or habitats. Live traps include:

Decoy traps are used by WS for preventive and corrective damage management. Decoy traps are similar in design to the Australian Crow Trap as reported by McCracken (1972) and Johnson and Glahn (1994). Live decoy birds of the same species that are being targeted are usually placed in the trap with sufficient food and water to assure their survival. Perches are configured in the trap to allow birds to roost above the ground and in a more natural position. Feeding behavior and calls of the decoy birds attract other birds which enter and become trapped themselves. Active decoy traps are monitored daily, every other day, or as appropriate, to remove and euthanize excess birds and to replenish bait and water. Decoy traps and other cage/live traps, as applied and used by WS, pose no danger to pets or the public and if a pet is accidentally captured in such traps, it can be released unharmed.

Foot-hold traps are used by WS for preventative and corrective damage management. Trapping with foot-hold traps can be effective in areas where a small resident crow population is present (Johnson 1994). No. 0 or 1 foot-hold traps with padded jaws would be used to trap individual birds in areas habitually used by crows. Traps would be monitored frequently and trapped birds euthanized by methods approved by the AVMA or a veterinarian.

Nest box traps may be used by WS for corrective damage management and are effective in capturing local breeding and post breeding European Starlings and other targeted secondary cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976).

Mist nets are more commonly used for capturing small-sized birds such as House Sparrows but can be used to capture larger birds such as ducks and ring-neck pheasants or even smaller nuisance hawks and owls. It was introduced in to the United States in the 1950's from Asia and the Mediterranean where it was used to capture birds for the market (Day et al. 1980). The mist net is a fine black silk or nylon net usually 3 to 10 feet wide and 25 to 35 feet long. Net mesh size determines which birds can be caught and overlapping pockets in the net cause birds to entangle themselves when they fly into the net.

Cannon nets are normally used for larger birds such as pigeons and use mortar projectiles to propel a net up and over birds which have been baited to a particular site.

Nest destruction is the removal of nesting materials during the construction phase of the nesting cycle. Nest destruction is generally only applied when dealing with a single bird or very few birds. This method is used to discourage birds from constructing nests in areas which may create nuisances for home and business owners. Heusmann and Bellville (1978) reported that nest removal was an effective but time-consuming method because problem bird species are highly mobile and can easily return to damage sites from long distances, or because of high populations. This method poses no imminent danger to pets or the public.

Egg addling/destruction is a method of suppressing reproduction in local nuisance bird populations by destroying egg embryos prior to hatching. Egg addling is conducted by vigorously shaking an egg numerous times which causes detachment of the embryo from the egg sac. Egg destruction can be accomplished in several different ways, but the most commonly used methods are manually gathering eggs and breaking them, or by oiling or spraying the eggs with a liquid which covers the entire egg and prevents the egg from obtaining oxygen (see *Egg oiling* below). Although WS does not commonly use egg addling or destruction, it is a valuable damage management tool and has proven effective in some applications.

Lure crops/alternate foods is often recommended when damage cannot be avoided by careful crop selection or modified planting schedules, lure crops can sometimes be used to mitigate the loss potential. Lure crops are planted or left for consumption by wildlife as an alternative food source. This approach provides relief for critical crops by sacrificing less important or specifically planted fields. Establishing lure crops is sometimes expensive, requires considerable time and planning to implement, and may attract other unwanted species to the area.

Translocation of live-captured birds could occur when requested and authorized by the USFWS and the AGFC. Birds are live captured through the use of non-chemical (panel nets, rocket nets, drive traps, net guns, dip nets, by hand, etc.) or chemical (alpha-chloralose) methods. Upon capture, birds could be transferred to waterfowl crates or other holding containers for translocation to suitable habitat away from the capture site.

Smith (1996) reported that groups of juvenile geese translocated from urban to rural settings can effectively eliminate these geese from urban areas, retain them at the release site, include them in the sport harvest, and expose them to higher natural mortality. Smith (1996) also reported that multiple survival models indicated that survival estimates of relocated juveniles were half of those of urban captured and released birds. Ultimately, the translocation of resident geese from metropolitan communities can assist in the reduction of overabundant populations (Cooper and Keefe 1997), and has been accepted by the general public as a method of reducing goose populations to socially acceptable levels (Fairaizl 1992, Powell et al. 2003). In areas where interest in hunting is high, the potential exists for moving nuisance birds to more rural areas to supplement huntable populations. In addition, the removal of geese posing or likely to pose a hazard to air safety at airports has been demonstrated to reduce the population of local geese and decrease the number of flights through the airport operations airspace, resulting in increased air safety at the Minneapolis-St. Paul International Airport (Cooper 1991).

Translocation of resident geese has the potential to spread disease into populations of other and/or migrating waterfowl. As stated in the USFWS resident Canada goose management FEIS (2005), the American Association of Wildlife Veterinarians (undated) "…*discourages the practice of relocating nuisance or excess urban ducks, geese and swans to other parks or wildlife areas as a means of local*

population control." Bird would only be translocated by WS when requested by the USFWS and/or the AGFC and only after a property owner or manager has agreed to receive those birds.

NON-LETHAL METHODS - CHEMICAL

Avitrol is a chemical frightening agent (repellent) that is effective in a single dose when mixed with untreated baits, normally in a 1:9 ratio. Avitrol, however, is not completely non-lethal in that a small portion of the birds are generally killed (Johnson and Glahn 1994). Prebaiting is usually necessary to achieve effective bait acceptance by the target species. This chemical is registered for use on pigeons, crows, blackbirds, starlings, and House Sparrows in various situations. Avitrol treated bait is placed in an area where the targeted birds are feeding. When a treated particle is consumed affected bird begins to broadcast distress vocalizations and display abnormal flying behavior, thereby frightening the remaining flock away.

Avitrol is a restricted use pesticide that can only be sold to certified applicators and is available in several bait formulations where only a small portion of the individual grains carry the chemical. It can be used during anytime of the year, but is used most often during winter and spring. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its availability for intake by organisms from water, is non-accumulative in tissues and rapidly metabolized by many species (Schafer 1991).

Avitrol is acutely toxic to avian and mammalian species, however, blackbirds are more sensitive to the chemical and there is little evidence of chronic toxicity. Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning and during field use only magpies and crows appear to have been affected (Schafer 1991). However, a laboratory study by Schafer et al. (1974) showed that magpies exposed to two to 3.2 times the published LD_{50} in contaminated prey for 20 days were not adversely affected and three American kestrels that were fed contaminated blackbirds for seven to 45 days were not adversely affected. Some hazards may occur to predatory species consuming unabsorbed chemical in the GI tract of affected or dead birds (Schafer 1981, Holler and Shafer 1982). A formal Risk Assessment found no probable risk is expected for pets and the public, based on low concentrations and low hazards quotient value for non-target indicator species tested on this compound (USDA 1997).

Methyl anthranilate (artificial grape flavoring used in foods and soft drinks for human consumption) could be used or recommended by WS as a bird repellent. Methyl anthranilate (MA) (artificial grape flavoring food additive) has been shown to be a promising repellent for many bird species, including waterfowl (Dolbeer et al. 1993). Cummings et al. (1995) found effectiveness of MA declined significantly after 7 days. Belant et al. (1996) found MA ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. MA is also under investigation as a potential bird taste repellent. MA may become available for use as a livestock feed additive (Mason et al. 1984, Mason et al. 1989). It is registered for applications to turf or to surface water areas used by unwanted birds. The material has been shown to be nontoxic to bees (LD_{50} > 25 micrograms/bee[11]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[12]), and of relatively low toxicity to fish and other invertebrates.

[11] An LD_{50} is the dosage in milligrams of material per kilogram of body weight, or, in this case in micrograms per individual bee, required to cause death in 50% of a test population of a species.
[12] An LC_{50} is the dosage in milligrams of material per liter of air required to cause death in 50% of a test population of a species through inhalation.

Methyl anthranilate is naturally occurring in concord grapes and in the blossoms of several species of flowers and is used as a food additive and perfume ingredient (Dolbeer et al. 1992). It has been listed as "*Generally Recognized as Safe*" by the FDA (Dolbeer et al. 1992).

Water surface and turf applications of MA are generally considered expensive. For example, the least intensive application rate required by label directions is 20 lbs. of product (8 lbs. active ingredient) per acre of surface water at a cost of about $64/lb. with retreating required every 3-4 weeks. Cost of treating turf areas would be similar on a per acre basis. Also, MA completely degrades in about 3 days when applied to water which indicates the repellent effect is short-lived.

Another potentially more cost effective method of MA application is by use of a fog-producing machine. The fog drifts over the area to be treated and is irritating to the birds while being non-irritating to any humans that might be exposed. Fogging applications must generally be repeated 3-5 times after the initial treatment before the birds abandon a treatment site. Applied at a rate of about 0.25 lb/acre of water surface, the cost is considerably less than when using the turf or water treatment methods.

MA is also being investigated as a livestock feed additive to reduce or prevent feed consumption by birds. Such chemicals undergo rigorous testing and research to prove safety, effectiveness, and low environmental risks before they would be registered by EPA or the FDA.

Rejex-It (fogger) is a chemical, non-lethal technique which is registered with the EPA for dispersing birds. Rejex-It TP 40 has a supplemental label allowing the use of Rejex-It in thermal or mechanical fog generators. The label allows the use of Rejex-It TP 40 fog to repel birds from roosting areas and other areas. The active ingredient in Rejex-It is methyl anthranilate. Inactive ingredients in Rejex-It TP40 include limonene, a human irritant. Limonene is added to Rejex-It TP 40 to make it float on water. Fogging is not recommended for urban/suburban areas because of cloud drift and chemical sensitivity of the public. The public would be concerned with odor sensitivity and allergic reaction to methyl anthranilate.

Rejex-It TP 40 fogger has variable effectiveness on birds and is thought to work best on passerines and waterfowl. Stevens and Clark (1998) found starlings were irritated by exposure to methyl anthranilate as an aerosol and did not habituate to the aerosol. Additionally, birds may habituate to fogging. Belant et al. (1996) found Canada geese habituated or developed tolerance for methyl anthranilate when applied to turf. The use of a fog may repel other desirable birds and it leaves a strong grape odor which may persist for several days. Finally, Stevens and Clark (1998) cautioned that an irritation response in the laboratory does not directly translate into an avoidance response in the field.

Mesurol was recently registered by WS to repel crows and ravens from bird nests of T&E species. It could be used by WS only as a bird repellent to deter predation by crows on eggs of threatened or endangered species. Dimmick and Nicolaus (1990) showed breeding pairs of crows could be conditioned with aversive chemicals to avoid eggs. However, Avery and Decker (1994) observed increased consumption of eggs treated with higher doses of Mesurol by Fish Crows. Sullivan and Dinsmore (1990) reported bird nests greater than 700 meters from crow nests were relatively safe from crow predation, thus nests beyond 700 meters from active crow nests may not need to be treated.

WS would treat eggs similar in appearance as those eggs of the species needing protection. The active ingredient is injected into eggs which are placed in artificial nests or upon elevated platforms. Upon ingestion, birds develop post-ingestional malaise (Mason 1989) and crows develop an aversion to consuming similar looking eggs (Dimmick and Nicolaus 1990). Repeated exposures may be necessary to develop and maintain aversion to threatened or endangered species eggs as the learning curve for crows can take from 23 days to 3 months (Dimmick and Nicolaus 1990, Avery and Decker 1994).

Treated areas will be posted with warning signs at access points to exclude people from endangered or threatened species nesting areas. Treated eggs are not placed in locations where threatened or endangered species may eat the treated eggs. Mesurol is highly toxic to birds and mammals and toxic to fish. It is also highly toxic to honey bees.

Polybutene is contained in a number of tactile repellent products are on the market which reportedly deters birds from roosting on certain structural surfaces by presenting a tacky or sticky surface that the birds avoid. However, experimental data in support of this claim are sparse (Mason and Clark 1992). The repellency of tactile products is generally short-lived because of dust, and they sometimes cause aesthetic problems and expensive clean-up costs by running down the sides of buildings in hot weather.

Anthraquinone is a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism, has shown effectiveness in protecting rice seed from red-winged blackbirds and boat-tailed grackles (Avery et al. 1997). It has also shown effectiveness as a foraging repellent against Canada goose grazing on turf and as a seed repellent against brown-headed cowbirds (Dolbeer et al. 1998).

Particulate feed additives have been investigated for their bird-repellent characteristics. In pen trials, European Starlings rejected grain to which charcoal particles were adhered. If further research finds this method to be effective and economical in field application, it might become available as a bird repellent on livestock feed. Charcoal feed additives have been explored for use in reducing methane production in livestock and should have no adverse effects on livestock, on meat or milk production, or on human consumers of meat or dairy products.

Tactile repellents are on the market which reportedly deters birds from roosting on certain structural surfaces by presenting a tacky or sticky surface that the birds avoid. However, experimental data in support of this claim are sparse (Mason and Clark 1992). The repellency of tactile products is generally short-lived because of dust, and they sometimes cause aesthetic problems and expensive clean-up costs by running down the sides of buildings in hot weather.

Alpha-chloralose is a central nervous system depressant used as an immobilizing agent to capture and remove pigeons, waterfowl and other birds. It is labor intensive and in some cases, may not be cost effective (Wright 1973, Feare et al. 1981). Alpha-chloralose is typically delivered in a well contained bait in small quantities with minimal hazards to pets and humans; single bread or corn baits are fed directly to the target birds. WS' personnel are present at the site of application during baiting to retrieve the immobilized birds. Unconsumed baits are removed from the site following each treatment. Alpha-chloralose was eliminated from more detailed analysis in USDA (1997) based on critical element screening; therefore, environmental fate properties of this compound were not rigorously assessed. However, the solubility and mobility are believed to be moderate and environmental persistence is believed to be low. Bioaccumulation in plants and animal tissue is believed to be low. Alpha-chloralose is used in other countries as an avian and mammalian toxicant. The compound is slowly metabolized, with recovery occurring a few hours after administration (Schafer 1991). The dose used for immobilization is designed to be about two to 30 times lower than the LD_{50}. Mammalian data indicate higher LD_{50} values than birds. Toxicity to aquatic organisms is unknown (Woronecki et al. 1990) but the compound is not generally soluble in water and therefore should remain unavailable to aquatic organisms. Factors supporting the determination of this low potential included the lack of exposure to pets, non-target species and the public, and the low toxicity of the active ingredient. Other supporting rationale for this determination included relatively low total annual use and a limited number of potential exposure pathways. The agent is currently approved for use by WS as an Investigative New Animal Drug by the FDA rather than a pesticide.

Egg oiling is a method for suppressing reproduction of nuisance birds by spraying a small quantity of food grade vegetable oil or mineral oil on eggs in nests. The oil prevents exchange of gases and causes asphyxiation of developing embryos and has been found to be 96-100% effective in reducing hatchability (Pochop 1998, Pochop et al. 1998). The method has an advantage over nest or egg destruction in that the incubating birds generally continue incubation and do not re-nest. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under FIFRA. To be most effective, the oil should be applied anytime between the fifth day after the laying of the last egg in a nest and at least five days before anticipated hatching. This method is extremely target specific and is less labor intensive than egg addling.

Sterilization has been attempted with Canada geese. Although Canada geese have been successfully sterilized to prevent production of young, this method is only effective if the female does not form a bond with a different male. In addition, vasectomies can only prevent the production of the mated pair. The ability to identify breeding pairs for isolation and to capture a male bird for vasectomization becomes increasingly difficult as the number of birds increase (Converse and Kennelly 1994). Geese have a long life span once they survive their first year (Cramp and Simmons 1977, Allan et al. 1995); leg-band recovery data indicate that some waterfowl live longer than 20 years. The sterilization of resident geese would not reduce the damage caused by the overabundance of the goose population since the population would remain relatively stable. Keefe (1996) estimated sterilization of a Canada goose to cost over $100 per bird. Additionally, a permit from the USFWS would be required to sterilize waterfowl or other migratory birds. Currently, aside from the scientific collecting permit, there is no permit mechanism available for operational reproductive control of waterfowl (C. Dwyer, USFWS pers. comm. 2010).

Nicarbazin (NCZ) is an EPA registered reproductive inhibitor containing that can be used to reduce egg production and viability in Canada geese and rock pigeons. NCZ is registered for use at site specific locations in highly populated urban areas. The user of this chemical product must adhere to all EPA use restrictions. VerCauteren et al. (2000) examined the use of NCZ to reduce Canada goose egg production and viability, and found that NCZ did experimentally reduce egg viability, but that there were difficulties in delivery methods and acceptance of treated feed. NCZ is not currently registered for use in Arkansas.

Nicarbazin is a complex of two compounds, 4,4'-dinitrocarbanilide (DNC) and 4,6-dimethyl-2-pyrimidinol (HDP) which interferes with the formation of the vitelline membrane that separates the egg yolk and egg white which prevents the development of an embryo inside the egg (EPA 2005). The active component of nicarbazin is the DNC compound with the HDP compound aiding in absorption of DNC into the bloodstream (EPA 2005). Nicarbazin was first developed to treat coccidiosis[13] outbreaks in broiler chickens and has been approved as a veterinary drug by the FDA since 1955 for use in chicken feed to prevent the protozoal disease coccidiosis (EPA 2005).

LETHAL METHODS - MECHANICAL

Shooting is more effective as a dispersal technique than as a way to reduce bird densities when large numbers of birds are present. Normally shooting is conducted with shotguns, rifles or air rifles. Shooting is a very individual specific method and is normally used to remove a single offending bird. However, at times, a few birds could be shot from a flock to make the remainder of the birds more wary and to help reinforce non-lethal methods. Shooting can be relatively expensive because of the staff hours sometimes required (USDA 1997). It is selective for target species and may be used in conjunction with the use of spotlights, decoys, and calling. Shooting with shotguns, air rifles, or rim and center fire rifles is

[13]Coccidiosis is a fungal pathogen known to infect birds and livestock causing diarrhea, dehydration, and can prevent proper growth of livestock. For more information on coccidiosis, see the EA (USDA 2000).

sometimes used to manage bird damage problems when lethal methods are determined to be appropriate. The birds are killed as quickly and humanely as possible. All firearm safety precautions are followed by WS when conducting bird damage management activities and all laws and regulations governing the lawful use of firearms are strictly complied with.

Firearm use is very sensitive and a public concern because of safety issues relating to the public and misuse. To ensure safe use and awareness, WS' employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program (WS Directive 2.615). WS' employees, who carry firearms as a condition of employment, are required to sign a form certifying that they meet the criteria as stated in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

Sport hunting is sometimes recommended by WS as a viable damage management method when the target species can be legally hunted. A valid hunting license and other licenses or permits may be required by the AGFC and USFWS for certain species. This method provides sport and food for hunters and requires no cost to the landowner. Sport hunting is occasionally recommended if it can be conducted safely for crow damage management around crops or other resources.

Cervical dislocation is sometimes used to euthanize birds which are captured in live traps. The bird is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. The AVMA approves this technique as a humane method of euthanasia and states that cervical dislocation when properly executed is a humane technique for euthanasia of poultry and other small birds (Beaver et al. 2001). Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (Beaver et al. 2001).

Snap traps are modified rat snap traps used to remove individual birds, and other cavity using birds. The trap treadle is baited with peanut butter or other food attractants and attached near the damage area caused by the offending bird. These traps pose no imminent danger to pets or the public, and are usually located in positions inaccessible to people and most non-avian animals. They are very selective because they are usually set in the defended territory of the target birds.

LETHAL METHODS - CHEMICAL

All chemicals used by WS are registered as required by the FIFRA (administered by the EPA and the AAD. WS' personnel that use restricted-use chemical methods are certified as pesticide applicators by the State of Arkansas and are required to adhere to all certification requirements set forth in FIFRA and Arkansas pesticide control laws and regulations. Chemicals are only used on private, public, or tribal property sites with authorization from the property owner/manager.

Carbon Dioxide (CO_2) is sometimes used to euthanize birds which are captured in live traps. Live birds are placed in a container such as a plastic 5-gallon bucket or chamber and sealed shut. CO_2 gas is released into the bucket or chamber and birds quickly die after inhaling the gas. This method is approved as a euthanizing agent by the AVMA (Beaver et al. 2001). CO_2 gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is also the gas released by dry ice. The use of CO_2 by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

DRC-1339 is an avicide used to lethally take blackbirds, starlings, gulls, and pigeons. For more than 30 years, DRC-1339 has proven to be an effective method of starling, blackbird, gull, and pigeon control at feedlots, dairies, airports, and in urban areas (West et al. 1967, Besser et al. 1967, Decino et al. 1966).

Studies continue to document the effectiveness of DRC-1339 in resolving blackbird/starling problems at feedlots (West and Besser 1976, Glahn 1982, Glahn et al. 1987), dispersing crow roosts in urban/suburban areas (Boyd and Hall 1987), and Blanton et al. (1992) reports that DRC-1339 appears to be a very effective, selective, and safe means of urban pigeon population reduction. Glahn and Wilson (1992) noted that baiting with DRC-1339 is a cost-effective method of reducing damage by blackbirds to sprouting rice.

DRC-1339 is a slow acting avicide that is registered with the EPA for reducing damage from several species of birds, including blackbirds, starlings, pigeons, crows, ravens, magpies, and gulls. DRC-1339 was developed as an avicide because of its differential toxicity to mammals. DRC-1339 is highly toxic to sensitive species but only slightly toxic to non-sensitive birds, predatory birds, and mammals (Schafer 1981, Schafer 1991, Johnston et al. 1999). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/bird to cause death (Royall et al. 1967). Most bird species that are responsible for damage, including starlings, blackbirds, pigeons, crows, magpies, and ravens are highly sensitive to DRC-1339. Many other bird species such as raptors (Schafer 1981), sparrows, and eagles are classified as non-sensitive. Numerous studies show that DRC-1339 poses minimal risk of primary poisoning to non-target and T&E species (USDA 1997). Secondary poisoning has not been observed with DRC-1339 treated baits, except crows eating gut contents of pigeons (Kreps 1974). During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1981). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds and starlings killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost nonexistent (Schafer 1981, Schafer 1991, Johnston et al. 1999).

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. DRC-1339 tightly binds to soil and has low mobility. The half life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (*i.e.*, degradation chemicals) have low toxicity. Aquatic and invertebrate toxicity is low (USDA 1997). Appendix P of USDA (1997) contains a thorough risk assessment of DRC-1339 and the reader is referred to that source for a more complete discussion. That assessment concluded that no adverse effects are expected from use of DRC-1339. DRC-1339 has several EPA Registration Labels depending on the application or species involved in the bird damage management project.

APPENDIX C

THREATENED AND ENDANGERED SPECIES THAT ARE FEDERALLY LISTED IN THE STATE OF ARKANSAS

Listings and occurrences for Arkansas

Notes:

- This report shows the listed species associated in some way with this state.
- This list does not include experimental populations and similarity of appearance listings.
- This list includes non-nesting sea turtles and whales in State/Territory coastal waters.
- This list includes species or populations under the sole jurisdiction of the National Marine Fisheries Service.

Summary of Animals listings

Animal species listed in this state and that occur in this state

Status	Species
E	Bat, gray (*Myotis grisescens*)
E	Bat, Indiana (*Myotis sodalis*)
E	Bat, Ozark big-eared (*Corynorhinus (=Plecotus) townsendii ingens*)
E	Beetle, American burying (*Nicrophorus americanus*)
T	Cavefish, Ozark (*Amblyopsis rosae*)
E	Crayfish, cave (*Cambarus aculabrum*)
E	Crayfish, cave (*Cambarus zophonastes*)
T	Darter, leopard (*Percina pantherina*)
T	fatmucket, Arkansas (*Lampsilis powellii*)
E	Mucket, pink (pearlymussel) (*Lampsilis abrupta*)
E	Mussel, scaleshell (*Leptodea leptodon*)
E	Panther, Florida (*Puma (=Felis) concolor coryi*)
E	Pearlymussel, Curtis (*Epioblasma florentina curtisii*)
E	Pocketbook, fat (*Potamilus capax*)
E	Pocketbook, Ouachita rock (*Arkansia wheeleri*)
E	Pocketbook, speckled (*Lampsilis streckeri*)
T	Shagreen, Magazine Mountain (*Mesodon magazinensis*)
T	Shiner, Arkansas River Arkansas R. Basin (*Notropis girardi*)
E	Sturgeon, pallid (*Scaphirhynchus albus*)
E	Tern, least interior pop. (*Sterna antillarum*)
E	Woodpecker, red-cockaded (*Picoides borealis*)

Animal species listed in this state that do not occur in this state

Status	Species
E	Wolf, gray Lower 48 States, except MN and where EXPN. Mexico. (*Canis lupus*)

Animal listed species occurring in this state that are not listed in this state

Status	Species
E	Blossom, turgid (pearlymussel) Entire Range; Except where listed as Experimental Populations (*Epioblasma turgidula*)
E	Mapleleaf, winged Entire; except where listed as experimental populations (*Quadrula fragosa*)
E	Woodpecker, ivory-billed entire (*Campephilus principalis*)

Summary of Plant listings

Plant species listed in this state and that occur in this state

Status	Species
T	bladderpod, Missouri (*Physaria filiformis*)
E	Clover, running buffalo (*Trifolium stoloniferum*)
E	Harperella (*Ptilimnium nodosum*)
T	*Geocarpon minimum* (No common name)
T	Orchid, eastern prairie fringed (*Platanthera leucophaea*)
E	Pondberry (*Lindera melissifolia*)