ENVIRONMENTAL ASSESSMENT

REDUCING BIRD DAMAGE

IN THE STATE OF MISSOURI

Prepared by:

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

February 2015

TABLE OF CONTENTS

LIST OF APPENDICES

ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AQDO	Aquaculture Depredation Order
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BCR	Bird Conservation Region
BDM	Bird Damage Management
CBC	Christmas Bird Count
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CSR	Code of State Regulation
EA	Environmental Assessment
ECOFRAM	Ecological Committee on FIFRA Risk Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
MA	Methyl Anthranilate
MBTA	Migratory Bird Treaty Act
MDC	Missouri Department of Conservation
MOU	Memorandum of Understanding
NAS	National Audubon Society
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NWRC	National Wildlife Research Center
PRDO	Public Resource Depredation Order
ROD	Record of Decision
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USGS	United States Geological Survey
USFWS	U.S. Fish and Wildlife Service
WAFB	Whiteman Air Force Base
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Across the United States, wildlife habitat has been substantially changed as human populations expand and land is used for human needs. These human uses and needs often compete with the needs of wildlife which increases the potential for conflicting human/wildlife interactions. This Environmental Assessment (EA) evaluates the potential environmental effects of alternatives for WS involvement in bird damage management (BDM) in Missouri.

Wildlife damage management (WDM) is the science of reducing damage or other problems associated with wildlife, and is recognized as an integral part of wildlife management (The Wildlife Society 2010). The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program is the federal agency authorized to protect American resources from damage associated with wildlife (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)). Human/wildlife conflict issues are complicated by the wide range of public responses to wildlife and wildlife damage. What may be unacceptable damage to one person may be a normal cost of living with nature to someone else. The relationship in American culture of wildlife values and wildlife damage can be summarized in this way:

WS' activities are conducted to prevent or reduce wildlife damage to agricultural, industrial and natural resources, property, livestock, and threats to public health and safety on private and public lands in cooperation with federal, state and local agencies, tribes, private organizations, and individuals. The WS program uses an integrated wildlife damage management (IWDM) approach (WS Directive 2.105[1]) in which a combination of methods may be used or recommended to reduce wildlife damage. These methods may include non-lethal techniques like alteration of cultural practices, habitat management, repellents, frightening devices, and physical exclusion to prevent or reduce damage. The reduction of wildlife damage may also require removal of individual animals, reducing the local animal populations through lethal means. In some instances, the goal may be to eradicate an invasive species. Program activities are not based on punishing offending animals but are conducted to reduce damage and risks to human and livestock health and safety, and are used as part of the WS Decision Model (Slate et al. 1992).

WS is a cooperatively funded, service-oriented program that receives requests for assistance with wildlife damage management from private and public entities, including tribes and other governmental agencies. As requested, WS cooperates with land and wildlife management agencies to reduce wildlife damage effectively and efficiently in accordance with applicable federal, state, and local laws and Memoranda of Understanding (MOUs) between WS and other agencies.

WS chose to prepare this EA to facilitate planning, interagency coordination and the streamlining of program management, and to clearly communicate with the public the analysis of individual and cumulative impacts. In addition, this EA has been prepared to evaluate and determine if there are any potentially significant or cumulative impacts from the proposed damage management program.

[1]The WS Policy Manual (http://www.aphis.usda.gov/wildlifedamage) provides guidance for WS personnel to conduct wildlife damage management activities through Program Directives. WS Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Appendix.

1.2 PURPOSE

The purpose of this EA is to evaluate cumulatively the individual projects conducted by WS in Missouri to manage damage and threats to agricultural resources, property, natural resources, and threats to humans associated with the species listed in Appendix B. This EA will assist in determining if the proposed management of bird damage could have a significant impact on the human environment based on previous activities conducted and based on the anticipation of receiving additional requests for assistance. Because the goals of WS are to conduct a coordinated program in accordance with plans and objectives developed to reduce damage, and because those goals and objectives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates those additional efforts and the analyses are intended to apply to actions that may occur in any locale and at any time within Missouri as part of a coordinated program.

This EA will evaluate the need for action to manage damage associated with birds in the state of Missouri, 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. The issues and alternatives associated with bird damage management were initially developed by WS in consultation with the USFWS and the Missouri Department of Conservation (MDC). To assist with the identification of additional issues and alternatives to managing damage associated with birds in Missouri; this EA will be made available to the public for review and comment prior to the issuance of a Decision[2].

WS previously developed an EA that addressed WS' activities to manage damage associated with birds in the state (USDA 2008; see Section 1.4). Based on the analyses in that EA, a Decision and Finding of No Significant Impact (FONSI) was signed selecting the proposed action alternative. The proposed action alternative implemented a damage management program using a variety of methods in an integrated approach (USDA 2008). Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to address bird damage 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.

1.3 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived 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.

Both sociological and biological carrying capacities must be applied when resolving 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 people directly and indirectly affected by the species and any

[2]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 NEPA and the Council of Environmental Quality regulations.

associated damage. This damage threshold determines the wildlife acceptance capacity. While the habitat might 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, people begin to implement population or damage management 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 2010). 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 poses 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 the term "*damage*" could also include a loss in aesthetic value and other situations where the actions of wildlife are no longer tolerable to an individual person.

Wildlife management is often based on balancing wildlife populations and human perceptions, in a struggle to preserve rare species, regulate species populations, oversee consumptive uses of wildlife, and conserve the environment that provides habitat for wildlife resources. Increasingly, cities, towns, parks, airports, and private properties have become sites of some of the greatest challenges for wildlife management (Adams et al. 2006). When the presence of a prolific, adaptable species is combined with human expansion, land management conflicts often develop. Birds are generally regarded as providing ecological, educational, economic, recreational, and aesthetic benefits (Decker and Goff 1987), and there is enjoyment in knowing wildlife exists and contributes to natural ecosystems (Decker et al. 2001). Birds add an aesthetic component to the environment, sometimes provide opportunities for recreational hunting, and like all wildlife, provide people with valued close contact with nature. Many people, even those people experiencing damage, consider those species of birds addressed in this EA to be a charismatic and valuable component of their environment; however, tolerance differs among individuals. Because of their prolific nature, site tenacity, longevity, size, and tolerance of human activity, many bird species are often associated with situations where damage or threats can occur. For example, free-ranging waterfowl are extremely adaptable and may use the resources provided by humans in urban landscapes for nesting, raising young, molting, feeding, and loafing.

Birds are difficult to manage because they are highly mobile, able to exploit a variety of habitat types within a given area, and cannot be permanently excluded from large areas. It is rarely desirable or possible to remove or disperse all problem birds from an area, but with a proper management scheme, the number of birds and associated problems may be reduced to a level that can be tolerated. Additionally, management of bird-related problems often exceeds the capabilities of individual people to reduce damage to tolerable levels. In Missouri, problem situations associated with birds typically involve, but are not limited to, unacceptable accumulations of feces in public-use areas, damage to agricultural and natural resources, and unacceptable safety hazards (e.g., aircraft striking birds). Those problems frequently occur on private properties, in residential communities, apartment/condominium complexes,

municipal parks, schools, hospitals, natural/habitat restoration sites, corporate and industrial sites, office complexes, roadways, airports, and other areas.

The need for action to manage damage and threats associated with birds in Missouri arises from requests for assistance[3] received by WS to reduce and prevent damage associated with birds from occurring to four major categories (USDA 2002, USFWS 2003, USFWS 2009). Those four major categories include 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 based on previous requests for assistance and assessments of the threat of bird strike hazards at airports. Table 1.1 lists WS' technical assistance projects involving bird damage or threats of bird damage to those four major resource types in Missouri from the federal fiscal year[4] (FY) 2009 through FY 2013.

Agricultural Resources

WS has addressed several issued related to birds and agriculture resources in the past few years. In the fall of 2014, WS was asked to address starling and pigeon issues at a research farm near Columbia, Missouri. Several hundred pigeons and several thousand starlings were consuming feed in the feed bunks and creating a mess with their droppings by roosting on top of and in shaded structures and in enclosed pens. The research farm was not only concerned with the consumption of feed, contamination of feed and filth of the dropping, but the quality of the research being effected by the large number of birds at the farm on a daily basics. WS was able to use shooting and avicides to reduce the number of birds at the research farm to reduce the damage the birds were causing.

Property

WS has address several issued related to birds and property for the past 19 years at Whiteman Air Force Base (WAFB) in the interest of protecting property and human health and safety. Whiteman AFB is the only permanent housing for the B-2 Spirit stealth bomber. When a B-2 is not in flight, it is housed in a climate controlled hangar to protect its sensitive materials and coatings. Today, there are 20 B-2's that remain in operation with an estimated value of $2.2 billion each. WS continues to help WAFB manage their property to discourage hazardous wildlife species to aircraft. The slightest wildlife strike with a B-2 could result in the loss of hundreds of thousands or millions of dollars to the United States Air Force in addition to the potential for loss of human life.

Human Safety

WS has addressed several issues related to the risks birds pose to the safety of humans near airports. Birds pose a direct threat to human injury and/or life by their presence within the airport environment. WS provides both technical and direct control assistance to airports throughout Missouri to decrease bird hazards within the airport environment, with hopes of decreasing bird/aircraft collisions. WS has recommended various land management practices to individual airports so that birds are not attracted to areas nearby the airport. WS has been active in using an array of non-lethal techniques to disperse and/or live trap-to-relocate birds from airport property(s). WS does use lethal take when deemed necessary to remove birds considered a direct threat to the safety of others and to further support the effectiveness of their non-lethal actions.

Technical assistance has been provided by WS to those persons requesting assistance with resolving damage or the threat of damage by providing information and recommendations on methods and techniques to reduce damage that can be conducted by the requestor without WS' direct involvement in

[3]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.

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

managing or preventing the damage. WS' technical assistance activities will be 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 Missouri. From FY 2009 through FY 2013, WS has conducted 3,643 technical assistance projects that addressed damage and threats of damage associated with those bird species addressed in this assessment (Appendix B). Many of the projects involved multiple resources and multiple species.

Table 1.2 lists those bird species and the resource types to which those bird species have caused damage in Missouri. Many of the bird species addressed in this EA can cause damage to or pose threats to a variety of resources. Most requests for assistance received by WS are related to threats associated with those bird species being struck by aircraft at or near airports. Bird strikes can cause substantial damage to aircraft requiring costly repairs. In some cases, bird strikes can lead to the catastrophic failure of the aircraft, which can threaten passenger safety. 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 or the threat of 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 swallows, 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 not only can increase the damage to the aircraft but also increases the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines.

Table 1.2 – Birds species addressed by WS in Missouri and the resource types damaged

	Resource*					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
American Avocets				X	Hawks, Broad-Winged			X	
Black birds, Red-winged	X		X	X	Hawks, Coopers			X	X
Bluebirds, Eastern			X		Hawks, Northern Harrier			X	X
Cardinals, Northern				X	Hawks, Red-Sholdered			X	X
Coot, American			X	X	Hawks, Red-tailed	X	X	X	X
Cormorants, Double-Crested	X		X	X	Hawks, Rough-legged			X	X
Cow Brids	X		X	X	Hawks, Sharp-shinned			X	X
Cranes, Sandhill				X	Hawks, Swainson's			X	X
Crows, American	X		X	X	Herons, Great Blue	X	X	X	X
Dickcissels			X	X	Herons, Green	X	X	X	X
Doves, Collared Eurasian			X		Herons, Little Blue	X			X
Doves, Mourning			X	X	Herons, Black-Crowned Night	X		X	X
Dowitchers, short-billed			X		Ibises, White Faced				X
Ducks, Bufflehead	X			X	Juncos, Dark-Eyed			X	X
Ducks, Canvasback				X	Killdeers			X	X
Ducks, Feral				X	Kingbirds			X	X
Ducks, Gadwall	X		X	X	Kingfishers, Belted	X	X		X
Ducks, Goldeneye Common				X	Kites, Mississippi			X	X
Ducks, Mallards	X		X	X	Larks, Horned			X	X
Ducks, Meranser Common				X	Longspurs, lapland			X	X
Ducks, Meranser Hooded	X			X	Martins, Purple			X	X
Ducks, Northern Pintails	X		X	X	Meadowlarks, Eastern			X	X
Ducks, Redhead				X	Mockingbirds, Northern			X	X
Ducks, Ring-necked			X	X	Nighthawks			X	

Species	Resource*				Species	Resource			
	A	N	P	H		A	N	P	H
Ducks, Ruddy			X	X	Ospreys	X			X
Ducks, Scaup			X	X	Owls, Common Barrred			X	X
Ducks, Teal	X		X	X	Owls, Common Barn				X
Ducks, American Wigeon			X	X	Owls, Great Horned	X	X	X	X
Ducks, Wood			X	X	Owls, Short-Eared			X	X
Ducks, Northern Shoveler	X		X	X	Owls, Snowy			X	X
Bald Eagles	X		X	X	Pelicans, American White			X	X
Egrets, Cattle			X	X	Pheasants, Ring Necked			X	X
Egrets, Great			X	X	Pigeons, Feral	X			X
Egrets, Snowy				X	Pine Siskin			X	
Falcons, American Kestrels			X	X	Plovers, all			X	X
Falcons, Merlin			X	X	Robins, American	X		X	X
Falcons, Peregrine			X	X	Sanderlings				X
Falcons, Prairie			X	X	Sandpipers, all			X	X
Finches House	X		X	X	Snipes, all			X	
Finches, Purple	X		X		Sparrows, all	X		X	X
Flickers, Northern			X	X	Starlings, European	X		X	X
FlyCatches, Scissor-Tailed			X	X	Swallows, all			X	X
Geese, Canada	X		X	X	Swans, (all)			X	X
Geese, Ross's				X	Swifts, (all)			X	X
Geese, Snow	X		X	X	Terns, (all)	X		X	X
Geese White-Fronted			X		Turkeys, Wild			X	X
Godwits, Marbled			X		Vultures, (all)	X		X	X
Goldfinchhes, American	X		X	X	Warblers, (all)	X		X	
Grackles			X	X	Waxwings, Cedar			X	
Grebes, Pied-Billed			X	X	Woodcock, American				X
Gulls, Black Backed			X		Woodpeckers, Downey			X	
Gulls, Bonaparte's			X	X	Woodpeckers, Red-Bellied			X	
Gulls, Franklin's			X	X	Woodpeckers, Red-Headed			X	
Gulls, Herring	X	X		X	Woodpeckers, Yellow-Bellied			X	
Gulls, Laughing			X		Yellowlegs, (all)			X	X
Gulls, Ring-Billed	X		X	X					

*A=Agriculture, N =Natural Resources, P=Property, H=Human Safety

During requests for assistance received by WS, cooperators often report or WS verifies through site visits, damage associated with various species of birds. Between FY 2009 and FY 2013, bird damage has been reported to WS or has been verified to exceed $5,724,966 (see Table 1.3). Damages have been reported or verified as occurring primarily to property and agricultural resources. Nearly $1,568,157 in damage to property has been reported to or verified by WS between FY 2009 and FY 2013 with damage to agricultural resources exceeding $2,637,439. The majority of damage that occurred was spread across several species including Canada geese, snow geese, feral pigeons and turkey vultures.

Table 1.3 – Reported or WS verified monetary damage by resource caused by birds in Missouri

Resource Type	Fiscal Year					Total
	2009	2010	2011	2012	2013	
Property	$617,620	$121,803	$322,545	$261,634	$244,555	**$1,568,157**
Agriculture	$415,350	$543,350	$394,000	$250,903	$1,033,836	**$2,637,439**
Natural Resources	$0	$0	$500	$1,800	$0	**$2,300**
Human Safety	$284,250	$119,202	$10,500	$733,000	$370,148	**$1,517,100**
Total	**$1,317,220**	**$784,355**	**$727,545**	**$1,247,337**	**$1,648,539**	**$5,724,996**

Table 1.3 only reflects damage that has been reported to or verified by WS based on requests received for assistance. Assigned monetary damage to natural resources can be difficult especially when factoring in the lost aesthetic value when natural resources are damaged by birds. Similarly, placing a monetary value on threats to human safety can be difficult. Monetary damage reported in Table 1.3 reflects damage that has occurred and that has been reported to WS, but is not reflective of all bird damage occurring in the state since not all bird damage or threats are reported to WS. Information regarding bird damage to agricultural resources, property, natural resources, and threats to human safety are discussed in the following subsections of the EA:

Need to Resolve Bird Damage to Agricultural Resources

According to the National Agricultural Statistics Service (NASS), there were approximately 28,400,000 acres devoted to agricultural production in Missouri during 2013 with a market value of agricultural products sold estimated at over $9 billion in 2012 (NASS 2014). The top two farm commodities for cash receipts were soybeans and corn, which together accounted for almost 50% of the cash receipts. The livestock inventory in Missouri during 2014 included 3.8 million head of cattle and an estimated 17 million turkeys and chickens (NASS 2014). Aquaculture sales were valued at over $10.2 million in 2012 (NASS 2014).

A variety of bird species can cause damage to agricultural resources (USDA 2008, USFWS 2003, USFWS 2009). Damage and threats of damage to agricultural resources is often associated with bird species that exhibit flocking behaviors (e.g., red-winged blackbirds, European starlings) or colonial nesting behavior (e.g., swallows, gulls). Damage occurs through direct consumption of agricultural resources, the contamination of resources from fecal droppings, or the threat of disease transmission to livestock from contact with fecal matter. As shown in Table 1.2, many of the bird species addressed have been identified as causing or posing threats to agricultural resources.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic organisms. 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 aquaculture products propagated at facilities in Missouri are catfish, trout, baitfish, crustaceans, mollusks, and ornamental fish (NASS 2014). Of those birds shown in Table 1.2 associated with damage to agriculture, of primary concern to aquaculture facilities are gulls, osprey,

herons, egrets, and to a lesser extent waterfowl, red-tailed hawks, gulls, kingfishers, double-crested cormorants, crows, and common grackles.

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 predatory birds 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.

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 regarding predation (Glahn et al. 1999). Glahn et al. (1999) 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 surveyed having birds present on aquaculture ponds. Great blue herons were found at 90% of the sites surveyed by Glahn et al. (1999). Loss of trout in ponds with herons present ranged from 9.1% to 39.4% in a Pennsylvania study with an estimated loss in production ranging from $8,000 to nearly $66,000 (Glahn et al. 1999). 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).

In addition to herons, other bird species have 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 mallards, egrets, kingfishers, osprey, red-tailed hawks, Northern harriers, owls, gulls, terns, American crows, mergansers, common grackles, and brown-headed cowbirds (Parkhurst et al. 1987).

During a survey of fisheries in 1984, osprey ranked third highest among 43 species of birds identified as foraging on fish at aquaculture facilities in the United States (Parkhurst et al. 1987). Fish comprise the primary food source of osprey (Poole et al. 2002). Parkhurst et al. (1992) found that when ospreys were present at aquaculture facilities over 60% of their mean time was devoted to foraging. The mean length of trout captured by osprey was 30.5 centimeters leading to a higher economic loss per captured fish compared to other observed species (Parkhurst et al. 1992).

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 organisms inside impoundments at aquaculture facilities and the high densities of those organisms in those impoundments, the introduction of a disease can result in substantial economic losses since the entire impoundment is likely to become infected, which can 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.

Damage and Threats to Livestock Operations

Damage to livestock operations can occur from several bird species (USDA 2008). Economic damage can occur from bird consumption of livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual 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, many requests for assistance are associated with damage occurring from bird species that congregate in large flocks at livestock operations.

Damage is often 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 barn swallows. Of primary concern to livestock operations in Missouri are European starlings, red-winged blackbirds, grackles, cowbirds, pigeons, and to a lesser extent crows and barn swallows. The flocking behavior of those species either from feeding, 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 and Otis 1981, Glahn 1983, Glahn and Otis 1986). 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 is 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 affect the health and production of livestock. The removal of this high-energy source by birds, 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.

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 can leave fecal deposits, which can be consumed by livestock. Fecal matter can also be deposited in sources of water for livestock, which increases the likelihood of disease transmission and can contaminate other surface areas where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carry infectious diseases which can be excreted in fecal matter and pose 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). Rock pigeons, starlings, and house sparrows have been identified as carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979). Weber (1979) also reported pigeons, starlings, and house sparrows as vectors of several viral, fungal, protozoal, and rickettsial diseases that are known to infect livestock and pets.

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.

Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. The birds also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be aesthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions.

Waterfowl, including mallards, snow geese, tundra swans, feral geese and ducks, are also a concern to livestock producers. Waterfowl droppings in and around livestock ponds can affect water quality and are a source of a number of different types of bacteria, creating concerns about potential disease interactions between waterfowl and livestock. The transmission of diseases through drinking water is one of the primary concerns for a safe water supply for livestock. Bacteria levels for livestock depend on the age of the animal since adults are more tolerant of bacteria than young animals (Mancl 1989). The bacteria guidelines for livestock water supplies are <1000 fecal coliforms/100 ml for adult animals and < 1 fecal coliform/100 ml for young animals (Mancl 1989). Salmonella causes shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, salmonella can kill cattle and calves.

Wild and domestic waterfowl are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997). Avian influenza circulates among those birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997). However, the potential for avian influenza to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, USDA 2005).

Certain bird species are also known to prey upon livestock, which can result in economic losses to livestock producers. Black vultures are known to prey upon newly born calves and harass adult cattle, especially during the birthing process. The NASS reported livestock owners lost 11,900 head of cattle and calves from black vultures in the United States during 2010 valued at $4.6 million (NASS 2011). While black vultures have been documented harassing expectant cattle, WS has also documented calf predation by black vultures. Black vulture predation on livestock is distinctive. Black vultures have killed pigs by pulling eyes out followed by attacks to the rectal area or directly attacking the rectal area (Lovell 1947, Lovell 1952, Lowney 1999). During a difficult delivery, black vultures will peck at the half-expunged calf and kill it.

Economic losses can also result from raptors, including bald eagles preying on sheep, goats and newly born calves as well as red-tailed hawks, feeding on domestic fowl such as chickens and waterfowl. Free-ranging fowl or fowl allowed to range outside of confinement for a period are particularly vulnerable to predation by raptors.

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 the consumption of sprouting crops (*i.e.*, loss of the crop and revenue), but also consists of trampling of emerging crops by waterfowl, damage to fruits associated with feeding, and fecal contamination. In 2013, the sale of all agriculture products sold in Missouri was over nine billion ranking Missouri 16th in the United States.

Grain sales totaled 3.9 billion dollars, followed by cattle 1.9 billion dollars and poultry 1.4 billion dollars. Damage to agricultural field crops, as reported to WS, occurs primarily from American crows, snow geese, tundra swans, starlings, blackbirds, and pigeons.

Waterfowl can graze and trample a variety of crops, including alfalfa, barley, corn, soybeans, wheat, rye, and oats (Cleary 1994). For example, a single intense grazing event by Canada geese in fall, winter, or spring can reduce the yield of winter wheat by 16 to 30% (Fledger et al. 1987), and reduce growth of rye plants by more than 40% (Conover 1988). However, some research has reported that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985). Since 1985, agricultural practices have changed resulting in intensive wheat growing methods with much higher yields of approximately 100 bushels per acre, but these crops are unable to sustain even light grazing pressure without losing yield. Associated costs with agricultural damage involving waterfowl include costs to replant grazed crops (e.g., soybeans, corn, peanuts), implement non-lethal wildlife management practices, purchase replacement hay, and decreased yields.

Bird damage to sweet corn can also result in economic losses to producers with damage often amplified since damage to sweet corn caused by birds makes the ear of corn unmarketable since 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 and starlings (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, which the birds puncture to ingest the contents. Once punctured, the area of the ear damage 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 and common ravens are known to cause damage to sprouting corn (Mott and Stone 1973). Additionally, starlings may pull sprouting grains and feed on planted seed (Johnson and Glahn 1994). Damage to sprouting corn is likely localized and highest in areas where breeding colonies of grackles exist in close proximity to agricultural fields planted with corn (Mott and Stone 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 breeding colony.

Fruit and nut crops can be damaged by crows, robins, starlings, red-winged blackbirds, grackles and cowbirds. WS has received requests for assistance to alleviate damage to nut crops associated with 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, woodpeckers, 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). WS has a long history of assisting blueberry farmers with robin damage to their crop as well at several species of blackbirds feeding on Missouri's growing grape industry.

Damage to apples occurs from beak punctures which makes the apples unmarketable (Besser 1985). Crows and robins 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).

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, such as vultures, waterfowl, gulls, crows, swallows, grackles, cowbirds, and red-winged blackbirds. 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 waterfowl, can pose risks to human safety.

Threat of Disease Transmission

Birds can play an important role in the transmission of zoonotic diseases (i.e., animal diseases transmissible to humans) where humans may encounter fecal droppings of those birds. For example, as many as 65 different diseases transmittable to humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). Few studies are available on the occurrence and transmission of zoonotic diseases in wild birds. 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. The presence of disease causing organisms in bird feces is a result of the pathogens being present in the environment in which birds live. Birds likely acquire disease-causing organisms through ingestion of pathogens that originated in the environment. Disease-causing organisms do not originate with birds (i.e., birds do not produce disease-causing organisms), but those birds can act as reservoirs for disease causing organisms that are of concern to human safety.

Of concern, is the ability of birds to obtain disease causing organisms and transporting those organisms to other areas, especially to areas with a high amount of human activity. With the ability to fly and move from one location to another, birds can obtain a disease causing organism at one location and transfer the disease causing organism from that location to another location. Human exposure to fecal droppings through contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Birds can be closely associated with human habitation where interaction with birds or fecal droppings can occur. Many bird species often exhibit gregarious behavior, which can lead to accumulations of fecal droppings in areas where those species forage or loaf. Accumulations of feces 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 found in areas where humans may be exposed.

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, the primary reason for requesting assistance is the risk of disease transmission.

Waterfowl may affect human health through the distribution and incubation of various pathogens and through nutrient loading in water supplies. Avian botulism is produced by the bacteria *Clostridium botulinum* type C, which occurs naturally in wild bird populations across North America. Ducks are most often affected by this disease. Avian botulism is the most common disease of waterfowl. 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).

Escherichia 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). 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 the area by the public, even though the serological type of the *E. coli* is unknown. Unfortunately, linking the elevated bacterial counts to 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). For example, 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). In addition, fecal coliform bacteria counts coincided with the number of Canada geese and gulls roosting at the reservoir.

Research has shown that gulls carry various species of bacteria such as *Bacillus* spp., *Clostridium* spp., *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 can threaten the safety of municipal drinking water sources by potentially causing dangerously high levels of coliform bacteria from their fecal matter. 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.

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, Blankespoor and Reimink 1991, Graczyk et al. 1997, Saltoun et al. 2000, Kassa et al. 2001). In some cases, 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. Financial costs related to human health threats involving birds may include testing of water for *coliform* bacteria, cleaning and sanitizing public-use areas, contacting and obtaining assistance from public health officials, and implementing non-lethal and lethal methods of wildlife damage management to reduce risks. 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.

The disease issues Missouri is most concerned about include lead toxicosis, West Nile virus, avian influenza, New castle disease virus, avian botulism and cholera (per communications Kelly Straka, MDC Veterinarian). In FY14, WS tested serum samples from pigeons taken in Kansas City, Columbia and St. Louis area. Of the 74 samples tested, eight birds tested seropositive for New Castle disease.

Threat of Aircraft Striking Wildlife at Airports and Military Installations

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 transportation industry as a whole (Conover et al. 1995). In several instances, wildlife-aircraft collisions in the United States have resulted in human fatalities. 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 that collided with a flock of European starlings (Terres 1980). From 1990 through 2010, 2,940 birds have been reported as struck by aircraft in Missouri (Dolbeer et al. 2012).

When birds enter or exit a roost in large flight lines at or near airports or when present in large flocks foraging on or near an airport, those bird species represent a safety threat to aviation. Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered 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). Mourning doves also present risks when their late summer behaviors include creating large roosting and loafing flocks. Their feeding, watering, and gritting behavior on airport turf and runways further increases the risk of bird-aircraft collisions.

From 1990 through 2010, 105,947 bird strikes have been reported to the Federal Aviation Administration (FAA) in the United States (Dolbeer et al. 2011). The number of actual bird strikes is likely to be much greater since an estimated 80% of civil bird strikes may go unreported (Linnell et al. 1999, Cleary et al. 2005, Wright and Dolbeer 2005). Between 2004 and 2008, Dolbeer (2009) estimated that 39% of aircraft strikes were reported to the FAA. Generally, bird collisions occur when aircraft are near the ground during take-off and approach to the runway. From 1990 through 2010, approximately 76% of reported bird strikes to general aviation aircraft in the United States occurred when the aircraft was at an altitude of 500 feet above ground level or less. Additionally, approximately 97% occurred less than 3,500 feet above ground level (Dolbeer et al. 2012).

Gulls, pigeons/doves, raptors, and waterfowl have been 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 2010, gulls comprised 17% of the strikes, pigeons and doves comprised 15% of the total reported strikes where identification occurred, while raptors accounted for 13%, and waterfowl were identified in 7% of reported strikes (Dolbeer et al. 2012). An example of identifiable strikes reported to the National Wildlife Strike Database between FY 2009 and FY 2013 at Lambert- St. Louis International airport includes 20 red - tailed hawks, 13 mourning doves and 11 were barn swallows. At the Kansas City International Airport, between FY 2009 and FY 2013, 83 horned lark strikes and 58 barn swallow strikes occurred (FAA 2015). Between FY 2010 and FY 2013, 43 horned larks strikes have occurred at WAFB (per communication, Kevin McGrath, WS Biologist, WAFB).

Birds being struck by aircraft can cause substantial damage. Bird strikes can cause catastrophic failure of aircraft systems (e.g., ingesting birds into engines) which can cause the plane to become uncontrollable which can lead to crashes. Since 1988, more than 229 people worldwide have died in aircraft that have crashed after striking wildlife (Dolbeer et al 2012). Between 1990 and 2010, 24 people have died after commercial or private aircraft have stuck birds in the United States (Dolbeer et al. 2012). Of those 24 fatalities involving bird strikes, seven fatalities occurred after striking birds that were not identified while eight fatalities occurred after strikes involving red-tailed hawks (Dolbeer et al. 2012). A recent example occurred in Oklahoma where an aircraft struck American white pelicans (*Pelecanus erythrorhynchos*) causing the plane to crash killing all five people aboard (Dove et al. 2009). Injuries also occur from bird strikes to pilots and passengers. Between 1990 and 2010, 44 strikes involving waterfowl have resulted in injuries to 49 people while 29 strikes involving vultures resulted in injuries to 32 people (Dolbeer et al. 2012).

Additional Human Safety Concerns Associated with Birds

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people 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 people and human activity, a loss of apprehension occurs that can lead those species to exhibit threatening behavior toward people. This threatening behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can be in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although birds attacking people occurs rarely, aggressive behavior by birds does occur, especially during nest building and the rearing of eggs and chicks. Raptors can aggressively defend their nests, nesting areas, and young, and may swoop and strike at pets, children, and adults.

In addition to raptors, waterfowl can also aggressively defend their nests and nestlings during the nesting season. Waterfowl aggressively defend their nests, nesting areas, and young, and may attack or threaten pets, children, and adults. Feral waterfowl often nest in high densities in areas used by humans for recreational purposes such as industrial areas, parks, beaches, and sports fields (VerCauteren and Marks 2004). If people unknowingly approach waterfowl or their nests at those locations, injuries could occur if waterfowl react aggressively to the presence of those people or pets. Additionally, slipping hazards can be created by the buildup of feces from birds on docks, walkways, and other foot traffic areas. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.2, all of the bird species addressed in this assessment are known to cause damage to property in Missouri. 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 activities. 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. Woodpeckers also cause direct damage to property through excavating holes in buildings either for nesting purposes or to locate food which can remove insulation and allows water and other wildlife to enter the building. 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.

Birds frequently damage structures on private property and public facilities with fecal contamination. 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 uric acid from 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 hundreds of thousands of dollars of outage time for power companies. In addition to causing power outages noted above, property damage from black vultures can include tearing and consuming latex window caulking or rubber gaskets sealing window panes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and ATV seats. Black vultures and turkey vultures also cause damage to cell phone and radio towers by roosting on critical tower infrastructure.

Gulls, raptors, waterfowl, and doves are the bird groups most frequently struck by aircraft in the United States. When struck, 27% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight while 66% of the reported waterfowl strikes resulted in damage or negative effects on the flight compared to 26% of strikes involving raptors and 12% of strikes involving pigeons and doves (Dolbeer et al. 2012). Since 1990, over $150 million in damages to civil aircraft have been reported from strikes involving waterfowl (Dolbeer et al. 2012). In total, aircraft strikes involving birds have resulted in over $394 million in reported damages to civil aircraft since 1990 in the United States (Dolbeer et al. 2012).

Damage to property associated with large concentrations of roosting birds occurs primarily from accumulations of droppings and feather debris. 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 recurring presence of fecal droppings under bird roosts can lead to repeated cleaning costs for property owners.

Waterfowl may cause damage to aircraft, landscaping, piers, yards, boats, beaches, shorelines, parks, golf courses, driveways, athletic fields, ponds, lakes, rafts, porches, patios, gardens, footpaths, swimming pools, play grounds, school grounds, and cemeteries. Property damage most often involves waterfowl fecal matter that contaminates landscaping and walkways, often at golf courses and water front property. Fecal droppings and the overgrazing of vegetation can be aesthetically displeasing. Businesses may be concerned about the negative aesthetic appearance of their property caused by excessive droppings and excessive grazing, and are sensitive to comments by clients and guests. Costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, implementation of non-lethal wildlife management methods, loss of property use, loss of aesthetic value of flowers, gardens, and lawns consumed by geese, loss of customers or visitors irritated by walking in fecal droppings, repair of golf greens, and replacing grazed turf. The costs of re-establishing overgrazed lawns and cleaning waterfowl feces from sidewalks have been estimated at more than $60 per bird (Allan et al. 1995).

The attraction of landfills as a food source for gulls has been well-documented (Mudge and Fern 1982, Patton 1988, Belant et al. 1995*a*, Belant et al. 1995*b*, Gabrey 1997, Belant et al. 1998). Large numbers of gulls are attracted to 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*a*, Belant and Dolbeer 1993*b*, Belant et al. 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 the deposition of garbage on surrounding industrial and residential areas which creates a nuisance, as well as increases the risks of disease transmission.

Damage to property by birds, reported to or verified by WS in Missouri, has totaled $2,573,897 between FY 2008 and FY 2013, which is an average of $428,989 per year. In most situations, requests for assistance received by WS are associated with the accumulation of fecal droppings in areas where birds roost, loaf, and feed as well as aviation safety.

Need to Resolve Bird Damage Occurring to Natural Resources

Birds can also negatively affect 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 affect characteristics of the surrounding habitat, which can then adversely affect other wildlife species and become 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.

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 and the MDC is responsible for managing wildlife in the State of Missouri, including birds. The MDC establishes and enforces regulated hunting seasons, including the establishment of seasons that allow the take of some of the bird species addressed in this assessment.

For migratory birds, the MDC can establish hunting seasons for those species under frameworks determined by the USFWS. WS' activities to reduce and/or prevent bird damage would be coordinated with the USFWS and the MDC, which ensure WS' actions are incorporated into population objectives established by those agencies. The take of many of the bird species addressed in this EA can only occur when authorized by a depredation permit issued by the USFWS. The MDC does not offer any permits for migratory birds; therefore, the take of those bird species by WS to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS. In addition, WS' annual take of birds to alleviate damage or threats of damage would only occur at levels authorized by the USFWS as specified in depredation permits.

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

- How can WS best respond to the need to reduce bird damage in Missouri?
- Do the alternatives have significant impacts meriting an Environmental Impact Statement (EIS)?

1.5 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 Missouri, wherever such management is requested by a cooperator. This EA discusses the issues associated with conducting damage management activities to meet the need for action and evaluates different alternatives to meet that need while addressing those issues.

The methods available for use under the alternatives evaluated are provided in Appendix C. The alternatives and Appendix C also discuss how methods would be employed to manage damage and threats associated with birds. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives by WS to manage or prevent damage and threats associated with birds from occurring when permitted by the USFWS pursuant to the Migratory Bird Treaty Act (MBTA.

The 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 effects to the human environment from activities to manage bird damage.

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 Missouri when a request is received for such services by the appropriate resource 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.

Period for which this EA is Valid

If the analyses in this EA indicate an Environmental Impact Statement (EIS) is not warranted, this EA would remain valid until WS determine that new needs for action, changed conditions, new issues, or new alternatives having different potential environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and supplemented pursuant to the NEPA. The EA would be reviewed 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 were selected, no

additional analyses would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by WS in Missouri under the selected alternative, when requested.

Site Specificity

This EA analyzes the potential impacts of bird damage management based on previous activities conducted on private and public lands in Missouri where WS and the appropriate entities have entered into a MOU, cooperative service agreement, or other comparable document. This EA also addresses the potential impacts of bird damage management on areas where additional agreements may be signed in the future. Because the need for action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, 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; 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 entities whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown, but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Some of the sites where bird damage could occur can be predicted; however, 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 occurs and those issues are treated as such in this EA.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in Missouri. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS (see Chapter 3 for a description of the WS Decision Model and its application). 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 Missouri. 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 the program's mission.

Summary of Public Involvement

Issues and alternatives related to bird damage management as conducted by WS in Missouri were initially developed by WS. 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 will be 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, and by posting the EA on the APHIS website at http://www.aphis.usda.gov/wildlifedamage/nepa.

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 will 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 will be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a Decision.

1.6 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

Double-crested Cormorant Management in the United States - Final Environmental Impact Statement: The USFWS has prepared a Final EIS (FEIS) on the management of double-crested cormorants (USFWS 2003). WS was a formal cooperating agency during the preparation of the FEIS and 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).

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

Proposal to Permit Take as Provided under the Bald and Golden Eagle Protection Act - Final Environmental Assessment: Developed by the USFWS, this EA evaluated the issues and alternatives associated with the promulgation of new regulations to authorize the "*take*" of bald eagles and golden eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EA evaluated the authorization of disturbance take of eagles, the removal of eagle nests where necessary to reduce threats to human safety, and the issuance of permits authorizing the lethal take of eagles in limited circumstances, including authorizing take that is associated with, but is not the purpose of, an action (USFWS 2009). A Decision and Finding of No Significant Impact (FONSI) was made for the preferred alternative in the EA. The selected alternative in the EA established new permit regulations for the "*take*" of eagles (see 50 CFR 22.26) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27). The USFWS published a Final Rule on September 11, 2009 (74 FR 46836-46879).

Resident Canada Goose Management - Final Environmental Impact Statement: The USFWS has issued a FEIS on the management of resident Canada geese (USFWS 2005). Pertinent and current information available in the FEIS has been incorporated by reference into this Decision/FONSI. The FEIS may be obtained by contacting the Division of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, MBSP-4107, Arlington, Virginia 22203 or by downloading it from the USFWS website at http://www.fws.gov/migratorybirds/issues/cangeese/finaleis.htm.

USFWS Light Goose Management – Final Environmental Impact Statement: The USFWS has issued a FEIS, which analyzes the potential environmental impacts of management alternatives for addressing problems associated with overabundant light goose populations. The "*light*" geese referred to in the FEIS include the lesser snow goose (*Chen caerulescens caerulescens*), greater snow goose (*C. c. atlantica*), and the Ross's goose (*C. rossii*), and that nest in Arctic and sub-Arctic regions of Canada and migrate and winter throughout the United States. A ROD and Final Rule were published by the USFWS and the final rule went into effect on December 5, 2008. Information from the USFWS FEIS on light goose management (USFWS 2007) has been incorporated by reference into this EA.

***WS' Environmental Assessments*:** WS has previously developed EAs that analyzed the need for action to manage damage associated with several bird species (USDA 2008). Those EAs identified the issues associated with managing damage associated with birds and analyzed alternative approaches to meet the specific need identified in those EAs while addressing the identified issues.

Changes in the need for action and the affected environment have prompted WS and cooperating agencies to initiate this new analysis to address the need for bird damage management. 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, as well as incorporating Canada goose damage and threats. Since activities conducted under the previous EAs will be re-evaluated under this EA to address the new need for action and the associated affected environment, the previous EAs that addressed birds will be superseded by this analysis and the outcome of the Decision issued.

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

USFWS' Authority

The USFWS mission is to conserve, protect, and enhance fish and wildlife along with 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 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 T&E under the ESA. The take of migratory birds is prohibited by the MBTA. 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 orders that allow for the take of those migratory birds addressed in those orders 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 (EPA)

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

United States Food and Drug Administration (FDA)

The FDA is responsible for protecting the public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. The FDA is also responsible for advancing the public health by helping to speed innovations that make medicines and foods more effective, safer, and more affordable; and helping the public get the accurate, science-based information they need to use medicines and foods to improve their health.

Missouri Department Conservation (MDC)

The MDC and WS have signed a MOU, which establishes a cooperative relationship and outlines roles and responsibilities for resolving wildlife damage in Missouri. The mission of the MDC is *"To protect and manage the forest, fish, and wildlife resources of the state and to facilitate and provide opportunities for all citizens to use, enjoy and learn about these resources"*. Under the MOU, Wildlife Services Section (WSS) of the MOU assumes primary responsibility for responding to requests for assistance involving migratory birds and all wildlife on airports and federal lands. The MDC forwards requests for assistance associated with migratory birds, federally protected species, and wildlife hazards at airports to WS. In addition, the MDC conducts management and education programs for endangered, threatened, and nongame wildlife species in Missouri.

Missouri Department of Agriculture (MDA)

The MDA currently has a MOU with WS which establishes a cooperative relationship between the two agencies. The MOU outlines the roles and responsibilities for resolving wildlife damage in Missouri. The mission of the MDA *"To serve, promote, and protect the agricultural producers, processors, and consumers of Missouri's food, fuel, and fiber products."* Per the MOU, the MDA provides non-confidential agricultural information and statistics to WS, forwards requests for wildlife damage assistance to WS, provides notification of livestock/poultry disease threats and outbreaks to WS, and communicates information regarding wildlife damage management the agricultural community. The MDA also enforces state laws pertaining to the use and application of pesticides, including those related to the registration of pesticide products, licensing of private and commercial pesticide applicators, and licensing of pesticide businesses.

Missouri Department of Natural Resources (DNR)

The DNR currently has a MOU with WS which establishes a cooperative relationship between the two agencies and outlines the roles and responsibilities for resolving wildlife damage in Missouri. A division of the DNR, State Parks (MOSP), is the primary contact with WS. The MOSP manage Missouri's State Park system and will suffer wildlife damage from bird

Missouri Department of Health and Senior Services (DHSS)

The DHSS currently has a MOU with WS which establishes a cooperative relationship between the two agencies and outlines the roles and responsibilities for resolving wildlife damage in Missouri. The mission of the DHSS is: *"To be the leader in promoting, protecting and partnering for health"*. Per the MOU, the DHSS will consult on issues pertaining to zoonotic disease potential, assist in investigations of human disease, take cognizance of any contagious disease and shall administer all laws, orders and finding to quarantine, prevent or to control the spread of diseases.

1.8 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes authorize, regulate, or otherwise would affect WS' activities under the alternatives. 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 managing bird damage in the state are addressed below:

National Environmental Policy Act (NEPA)

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows CEQ regulations implementing the NEPA (40 CFR 1500 et seq.), 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 the CEQ through regulations in 40 CFR 1500-1508. In accordance with the CEQ and USDA regulations, APHIS guidelines concerning the implementation of NEPA procedures, as published in the Federal Register (44 CFR 50381-50384), provide guidance to the 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 USC 703-711; 40 Stat. 755), as amended

The 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 USC 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13.

The MBTA also provides the USFWS regulatory authority to protect families of migratory birds. 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. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21. All actions analyzed in this EA would be conducted in compliance with the regulations of the MBTA, as amended.

The law was further clarified to include only those birds afforded protection from take in the United States by the Migratory Bird Treaty Reform Act of 2004. Under the Reform Act, the USFWS published a list of bird species not protected under the MBTA (70 FR 12710-12716). Free-ranging or feral domestic waterfowl, mute swans, ring-necked pheasants, wild turkeys, monk parakeets, rock pigeons, European starlings, and house sparrows are not protected from take under the MBTA. A permit from the USFWS to take those species is not required.

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.

MDC Agricultural Depredation Order for Canada Geese

The MDC may issue a free permit to farmers for the lethal control of geese between March 15 and August 31 when geese are causing damage to agricultural crops, and to prevent damage to agricultural crops. The permit must be obtained prior to implementing any control program.

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 lethally 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 (Sobeck 2010). 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, boat-tailed grackles, and brown-headed cowbirds.

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

The purpose of this depredation order is to reduce the occurrence and/or minimize the risk of adverse impacts to public resources (fish, including both free-swimming and hatchery stock at federal, state, and tribal facilities, wildlife, plants, and their habitats) caused by double-crested cormorants. This depredation order authorizes the MDNR, federally recognized tribes, and state directors of WS to prevent depredation of public resources by taking without a permit any double-crested cormorant committing or about to commit such act. Under this depredation order nonlethal control methods should be utilized first when they are considered effective and practicable and not harmful to other nesting birds.

Control Order for Muscovy Ducks (50 CFR 21.54)

Muscovy ducks are native to South America, Central America, and Mexico with a small naturally occurring population in southern Texas. Muscovy ducks have also been domesticated and have been sold and kept for food and as pets in the United States. In many states, Muscovy ducks have been released or escaped captivity and have formed feral populations, especially in urban areas, that are non-migratory. The USFWS has issued a Final Rule on the status of the Muscovy duck in the United States (75 FR 9316-9322). Since naturally occurring populations of Muscovy ducks are known to inhabit parts of south

Texas, the USFWS has included the Muscovy duck on the list of bird species afforded protection under the MBTA at 50 CFR 10.13 (75 FR 9316-9322). To address damage and threats of damage associated with Muscovy ducks, the USFWS has also established a control order for Muscovy ducks under 50 CFR 21.54 (75 FR 9316-9322). Under 50 CFR 21.54, Muscovy ducks, and their nests and eggs, may be removed or destroyed without a depredation permit from the USFWS at any time in the United States, except in Hidalgo, Starr, and Zapata Counties in Texas (75 FR 9316-9322).

Bald and Golden Eagle Protection Act (16 USC 668)

Populations of bald eagles showed periods of steep declines in the lower United States during the early 1900s attributed to the loss of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail declining trends in bald eagles, Congress passed the Bald Eagle Protection Act (16 USC 668) in 1940 prohibiting the take or possession of bald eagles or their parts. The Bald Eagle Protection Act was amended in 1962 to include the golden eagle and is now referred to as the Bald and Golden Eagle Protection Act. Certain populations of bald eagles were listed as *"endangered"* under the Endangered Species Preservation Act of 1966, which was extended when the modern Endangered Species Act (ESA) was passed in 1973. The *"endangered"* status was extended to all populations of bald eagles in the lower 48 States, except populations of bald eagles in Minnesota, Wisconsin, Michigan, Washington, and Oregon, which were listed as *"threatened"* in 1978. As recovery goals for bald eagle populations began to be reached in 1995, all populations of eagles in the lower 48 States were reclassified as *"threatened"*. In 1999, the recovery goals for populations of eagles had been reached or exceeded and the eagle was proposed for removal from the ESA. The bald eagle was officially de-listed from the ESA on June 28, 2007 with the exception of the Sonora Desert bald eagle population. Although officially removed from the protection of the ESA across most of its range, the bald eagle is still afforded protection under the Bald and Golden Eagle Protection Act.

Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of bald eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "*take*" includes actions that "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb*" eagles. The regulations authorize the United States Fish and Wildlife Service to issue permits for the take of bald eagles and golden eagles on a limited basis (see 74 FR 46836-46837, 50 CFR 22.26, 50 CFR 22.27). As necessary, WS would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

Endangered Species Act (ESA)

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). 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)).

As part of the development of this EA, WS has also consulted with the USFWS concerning T&E species in Missouri in regards to proposed bird damage management activities, which will be discussed 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 under the alternatives 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 could 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 the use of those methods would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and 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 Section 106 of the NHPA would be conducted as necessary in those types of situations.

Environmental Justice - Executive Order 12898

Executive Order 12898 promotes the fair treatment of people of all races, income levels, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. 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 use of methods 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. WS would only employ and/or recommend legally available and approved methods under the alternatives 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, to develop and implement a MOU with the USFWS that shall promote the conservation of migratory bird populations. WS signed a MOU with the USFWS on August 2, 2012 as required by this Executive Order.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. 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 until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

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 employed and/or recommended by the WS' program in Missouri pursuant to the alternatives would be registered with the EPA and the PCP of the NJDEP, when applicable. All chemical methods would be employed by WS pursuant to label requirements when providing direct operational assistance under the alternatives. In addition, WS would recommend that all label requirements be adhered to when recommending the using of chemical methods while conducting technical assistance projects under the alternatives.

New Animal Drugs for Investigational Use

The 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, which allows use of the drug as a non-lethal form of capture. The use of alpha-chloralose as a method for resolving waterfowl damage and threats to human safety is discussed in Appendix C 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.

Missouri Wildlife Laws, Regulations, and Policies Regarding Bird Damage Management

The following Code of State Regulations (CSR) can be viewed at www.sos.mo.gov/adrules/csr/current/3csr/3csr.asp.

3 CSR 10-4.111 Endangered Species
PURPOSE: This rule extends special protection to endangered wildlife and lists those species considered to be threatened with extinction. (1) The importation, transportation, sale, purchase, taking or possession of any endangered species of wildlife, or hides or other parts thereof, or the sale or possession with intent to sell of any article made in whole or in part from the skin, hide or other parts of any endangered species of wildlife is prohibited; provided, that this rule shall not apply to legally acquired wildlife held under permit or held by a public zoo or museum or to articles manufactured before January 1, 1973. Endangered wildlife taken legally outside Missouri may be imported, transported or possessed, but may not be sold or purchased without written approval of the director. (2) The exportation, transportation or sale of any endangered species of plant or parts thereof, or the sale of or possession with intent to sell any product made in whole or in part from any parts of any endangered species of plant is prohibited. (3) For the purpose of this rule, endangered species of wildlife and plants shall include the following native species designated as endangered in Missouri: (A) Mammals: gray bat, Ozark big-eared bat, Indiana bat, black-tailed jackrabbit, spotted skunk. (B) Birds: northern harrier, interior least tern, Swainson's warbler, snowy egret, king rail, Bachman's sparrow, peregrine falcon, American bittern, greater prairie-chicken. (C) Reptiles: western chicken turtle, Blanding's turtle, Illinois mud turtle, yellow mud turtle, Mississippi green water snake, massasauga rattlesnake. (D) Amphibians: eastern hellbender, Ozark hellbender. (E) Fishes: lake sturgeon, pallid sturgeon, taillight shiner, Neosho madtom, spring cavefish, harlequin darter, goldstripe darter, cypress minnow, central mudminnow, crystal darter, swamp darter, Ozark cavefish, Niangua darter, Sabine shiner, mountain madtom, redfin darter, longnose darter, flathead chub, Topeka shiner, grotto sculpin. (F) Mussels: Curtis pearlymussel, Higgins' eye, pink mucket, fat pocketbook, ebonyshell, elephant ear, winged mapleleaf, sheepnose, snuffbox, scaleshell. (G) Other Invertebrates: American burying beetle, Hine's emerald dragonfly, Tumbling Creek cavesnail. (H) Plants: small whorled pogonia, Mead's milkweed, decurrent false aster, Missouri bladderpod, geocarpon, running buffalo clover, pondberry, eastern prairie fringed orchid, western prairie fringed orchid, Virginia sneezeweed. (4) To provide essential protection to endangered species, the director may establish refuges not to exceed one (1) square mile for not more than sixty (60) days.

3 CSR 10-5.435 Migratory Bird Hunting Permit
PURPOSE: This rule establishes a new migratory bird harvest information program card to be required by migratory bird hunters in addition to the prescribed hunting permit and, where applicable, the federal duck stamp and the Missouri Waterfowl Hunting Stamp. Missouri will be one of the pilot states for implementation of this national harvest information program. Required of any person sixteen (16) years of age or older in addition to the prescribed hunting permit to pursue, take, possess, and transport waterfowl, doves, snipe, woodcock, and rails, except for blue, snow, or Ross's geese during the Conservation Order in accordance with federal regulations as prescribed in 3 CSR 10-7.440. Fee: six dollars ($6).

3 CSR 10-7.440 Migratory Game Birds and Waterfowl: Seasons, Limits
PURPOSE: The Department of Conservation is authorized to select waterfowl hunting season dates and bag limits within frameworks established by the U.S. Fish and Wildlife Service. The seasons and limits selected are intended to provide optimum hunting opportunity consistent with the welfare of the species. (1) Migratory game birds and waterfowl may be taken, possessed, transported, and stored only as

provided in federal regulations and this Code. (2) The head or one (1) fully feathered wing must remain attached to all waterfowl while being transported from the field to one's home or a commercial preservation facility.

3 CSR 10-7.441 Crows: Seasons, Methods, Limits
PURPOSE: This rule establishes the open seasons, methods and limits for crow hunting. Crows may be taken in any numbers by shotgun, rifle, handguns, archery and falconry from November 1 through March 3.

3 CSR 10-9.440 Resident Falconry Permit
PURPOSE: This rule establishes a permit for residents of the state to engage in falconry. To take, possess alive, care for, and train birds of prey (raptors) and to use birds of prey to take other wildlife in accordance with 3 CSR 10-9.442 and federal falconry regulations. Fee: one hundred dollars ($100). This permit shall remain valid for three (3) years from date of issuance. A federal falconry permit will no longer be issued.

3 CSR 10-9.442 Falconry
PURPOSE: This rule establishes provisions for hunting with birds of prey. (1) Birds of prey may be taken, transported, possessed, or used to take wildlife by holders of a falconry permit, to be issued only to residents qualified by passing with a score of at least eighty percent (80%) a written examination meeting federal standards and whose facilities and equipment meet requirements specified in this rule. The barter, sale, purchase, importation, or exportation of raptors without a permit is prohibited. If a permittee allows his/her permit to lapse for a period of less than five (5) years, the permit may be reinstated at the level previously held. A permittee who allows his/her permit to lapse five (5) years or longer must pass the written examination with a score of at least eighty percent (80%), at which point the permit may be reinstated at the level previously held.

3 CSR 10-11.186 Waterfowl Hunting
PURPOSE: This rule establishes provisions for waterfowl hunting on department areas. (1) Waterfowl hunting is permitted on department areas except as further restricted in this chapter. Statewide permits, seasons, methods, and limits apply unless otherwise provided in this chapter.

Missouri Pesticide Laws

The Missouri Pesticide Program is administered through the Bureau of Pesticide Control in the Plant Industries Division of the MDA. The Bureau administers the Missouri Pesticide Use Act and Administrative Rules (281.005 - 281.180 RSMo & 2 CSR 70-25) and the Missouri Pesticide Registration Act (281.210-281.310 RSMo.).

The Missouri Pesticide Use Act establishes requirements for licensing of applicators, dealers, technicians and operators. There are also guidelines for approving applicator training programs. These programs are conducted by the University of Missouri annually. Additionally, the Use Act provides the authority for Enforcement and Inspections under the pesticide program. Many types of investigations and inspections are conducted by Bureau field personnel.

In order for WS to apply a restricted use pesticide as part of bird damage management in MO, the product must be registered with the MDA, the applicator must be licensed, and if a fee is charged, the agency possess a MO certified public operator license. Additionally, label instructions, and all other pesticide and wildlife laws and regulations must be adhered to (e.g., possession of a depredation permit from the USFWS take the protected bird species). Pesticide products are registered annually, and applicator

licenses are obtained and maintained through completion of training courses and examinations conducted through the MDA.

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 used to develop SOPs. 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 Missouri wherever 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. 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, the proposed action alternative or those actions described in the other alternatives could be conducted on private, federal, state, tribal, and municipal lands in Missouri to reduce damages and threats associated with birds to agricultural resources, natural resources, property, and threats to human safety. The analyses in this EA are intended to apply to actions taken under the selected alternative that could occur in any locale and at any time within the analysis area. This EA analyzes the potential impacts of bird damage management and addresses activities in Missouri that are currently being conducted under a MOU or cooperative service agreement with WS where activities have been and currently are being conducted. This EA also addresses the impacts of bird damage management where additional agreements may be signed in the future.

Assistance requests to resolve bird damage could occur, but are not necessarily limited to, 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: residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, schools, agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, nuclear, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, on ship fleets, military bases, or at any other sites where birds may roost, loaf, or nest. Damage management activities could be conducted at agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, grain mills, and grain handling areas (e.g., railroad yards) where birds destroy crops, feed on spilled grains, or contaminate food products for human or livestock consumption. Additionally, activities could be conducted at airports and surrounding properties where birds represent a threat to aviation safety.

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 state natural resources agency, invasive species, or unprotected wildlife species.

Most native wildlife 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 include the allowable length of hunting seasons, methods of take, and allowed take which are implemented by the MDC. Under the blackbird depredation order (50 CFR 21.43), blackbirds can be taken by any entity without a depredation permit when those species identified in the order are found committing or about to commit damage or posing a human safety threat. In addition, Muscovy ducks can also be removed in Missouri pursuant to a control order without the need for a permit. Pursuant to the MBTA, the USFWS can issue depredation permits to those entities experiencing damage associated with birds, when deemed appropriate. Free-ranging or feral domestic waterfowl, European starlings, rock pigeons, mute swans, ring-necked pheasants, wild turkeys, monk parakeets, and house sparrows are not protected from take under the MBTA and can be addressed without the need for a depredation permit from the USFWS.

When a non-federal entity (e.g., agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action to alleviate bird damage, the action is not subject to compliance with the NEPA due to the lack of federal involvement[5] in the action. Under such circumstances, the environmental baseline or status quo must be viewed as an environment that includes those resources as 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 should occur and even the particular methods that would be used, WS' involvement in the action would not affect the environmental status quo. WS' involvement would not change the environmental status quo if the requestor had conducted the action in the absence of WS' involvement in the action. Since the lethal take of birds can occur either without a permit if those species are non-native, during hunting seasons, under depredation orders, under control orders, or through the issuance of depredation permits by the USFWS and/or MDC and since most methods for resolving damage are available to both WS and to other entities, WS' decision-making ability is restricted to one of three alternatives. WS can either provide technical assistance with managing damage with no direct involvement, take the action using the specific methods as decided upon by the non-federal entity, or take no action at which point the non-federal entity could take the action anyway either without a permit, during the hunting season, under depredation orders, under control orders, or through the issuance of a depredation permit by the USFWS and/or MDC. 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.

In some situations, however, certain aspects of the human environment may actually benefit more from WS' involvement than from a decision not to assist. For example, if a cooperator believes WS has greater expertise to manage damage when compared to other entities, 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 using methods that have 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

[5]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.

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, which can increase effectiveness, humaneness, minimizes non-target take, and reduces threats to human safety from those methods. Thus, in those situations, WS' involvement may actually provide some benefit to 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 effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. Issues related to managing damage associated with birds in Missouri were developed by WS in consultation with the USFWS and the MDC. 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 alternative, are discussed in Chapter 4. The issues analyzed in detail are the following:

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

A common issue when addressing damage caused by wildlife is the potential impact of management actions on the populations of target species. Methods available to resolve damage or threats to human safety are categorized into non-lethal and lethal methods. Non-lethal methods available 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 were employed. Lethal methods would result in local population reductions in the area where damage or threats were occurring. The number of target species that could be removed from the population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, and the efficacy of methods employed. Under certain alternatives, both non-lethal and lethal methods could be recommended, as governed by federal, state, and local laws and regulations.

The analysis for magnitude of impact on the populations of those species addressed in the EA would be based on a measure of the number of individuals killed from each species in relation to that species' abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations would be based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations would be based on population trends and harvest trend data, when available. Take would be monitored by comparing the number killed with overall populations or trends in the population. All lethal take of birds by WS would occur at the requests of a cooperator seeking assistance and only after the take of those birds species has been permitted by the USFWS pursuant to the MBTA, when required.

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 (BBS)

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, usually along a road. 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 United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2014). 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, because of variable local habitat and climatic conditions. Trends can be determined using different population equations and tested to identify whether it is statistically significant.

Current estimates of population trends from BBS data are derived from hierarchical model analysis (Link and Sauer 2002, Sauer and Link 2011) and are dependent upon a variety of assumptions (Link and Sauer 1998). The statistical significance of a trend for a given species is also determined using BBS data (Sauer et al. 2014).

Christmas Bird Count (CBC)

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. Participants count the number of 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 the count can be used as an indicator of trends in the population of a particular bird species 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 2010).

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) survey conducted 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). The Partners in Flight Science Committee (2013) updated the database in the past year to reflect current population estimates.

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. The State of Missouri lies within the Eastern Tallgrass Prairie (Bird Conservation Region 22), and the Central Hardwoods (Bird Conservation Region.

Those bird species with nesting colonies in the Prairie Potholes (Bird Conservation Region 11), Prairie Hardwood Transition, Bird Conservation Region 23) and Boreal Hardwood Transition Bird Conservation

Region 12), also cause damage or pose a threat of damage in Missouri, especially during the migration periods. For example, several geese and duck species addressed in this EA do not have breeding colonies in the state; however, those species often cause damage or pose threats of damage, primarily during the migration periods. Several of the analyses in Chapter 4 of this EA will address birds with breeding populations that occur primarily in the Prairie Potholes region.

Mississippi Flyway Surveys and Monitoring

The Mississippi Flyway conducts population surveys and monitoring programs that are a critical parts of successful waterfowl management in North America. Combined, these results form the largest data set on any wildlife species group in the world. They help provide equitable hunting opportunities while ensuring the long-term health of waterfowl populations.

Survey efforts are cooperative in nature, and rely on partnerships between federal, state, and provincial agencies, as well as private organizations and hunters throughout the continent. Results from these surveys are crucial inputs for many waterfowl population models, and are used to help guide biologists in setting and evaluating harvest management and habitat management programs.

The success of these monitoring efforts—and ultimately the success of waterfowl management throughout North America – is dependent upon cooperation at all levels among the agencies and organizations that are charged with managing this important wildlife resource—and all hunters who go afield during waterfowl season.

Annual Harvest Estimates

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 by the MDC. Those species addressed in this EA that have established hunting seasons include Gadwall, American wigeons, Northern shovelers, wood ducks, Northern pintails, canvasbacks, redheads, ring-necked ducks, blue-winged teal, green-winged teal, greater scaup, lesser scaup, buffleheads, common goldeneyes, hooded mergansers, common mergansers, red-breasted mergansers, ruddy ducks, snow geese, ring-necked pheasants, Northern bobwhite, common moorhens, and American coots.

For crows, take can also occur under the blackbird depredation order established by the USFWS pursuant to the MBTA. Therefore, the take of crows can occur during annual hunting seasons and under the blackbird depredation order that allows crows to be taken to alleviate damage and to alleviate threats of damage. 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 MDC in published reports.

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 effects 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 that are extensively used by the target species. WS would also use SOPs that minimize the effects on non-target species' populations. SOPs are

further discussed in Chapter 3. Methods available for use under the alternatives are described in Appendix C.

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. As part of the scoping process to facilitate interagency cooperation, WS consulted with the USFWS pursuant to Section 7 of the ESA during the development of this EA, which is further discussed in Chapter 4.

Issue 3 - Effects of Damage Management Methods 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 effects on human safety. Risks can occur to persons employing methods and to persons coming into contact with methods. Risks can be inherent to the method itself or related to the misuse of the method.

Safety of Chemical Methods Employed

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods would include avicides, immobilizing drugs, reproductive inhibitors, and repellents. Avicides are those chemical methods used to lethally take birds. DRC-1339 is the only avicide currently being considered for use to manage damage in this assessment. In Missouri, DRC-1339 is registered for use by WS for management of damage associated with feral pigeons, red-winged blackbirds, brown-headed cowbirds, common grackles, European starlings and crows.

Several avian repellents are commercially available to disperse birds from an area or discourage birds from feeding on desired resources. Avitrol is an avian repellent available for use to manage damage associated with several bird species. For those species addressed in this assessment, Avitrol is available to manage damage associated with red-winged blackbirds, common grackles, brown-headed cowbirds, European starlings, house sparrows, feral pigeons, and crows.

Other repellents are also available with the most common ingredients being polybutene, anthraquinone, and methyl anthranilate. An additional repellent being considered for use in this assessment is mesurol, which is intended for use to discourage crows from predating on eggs of T&E species; however, mesurol is currently not registered for use in Missouri. In addition, Alpha-chloralose, a sedative, is also being considered as a method that could be employed under the alternatives to manage damage associated with waterfowl. Alpha-chloralose could be used to sedate waterfowl temporarily and lessen stress on the animal from handling and transportation from the capture site. Drugs delivered to immobilize waterfowl would occur on site with close monitoring to ensure proper care of the animal. Alpha-chloralose is fully reversible with a full recovery of sedated animals occurring.

Nicarbazin is the only reproductive inhibitor currently registered with the EPA. Current products containing nicarbazin are available for use to manage local populations of waterfowl and pigeons by reducing or eliminating the hatchability of laid eggs, Nicarbazin is registered in Missouri. Chemical methods are further discussed in Appendix C of this EA. The use of chemical methods is regulated by the EPA through the FIFRA, the MDC through the PCP, by the FDA, and by WS Directives.

Safety of Non-Chemical Methods Employed

Most methods available to alleviate damage and threats associated with birds are considered non-chemical methods. 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 C. Many of the non-chemical methods are only activated when triggered by attending personnel (e.g., cannon nets, air cannon nests, firearms, pyrotechnics, lasers), are passive live-capture methods (e.g., walk-in style live-traps, mist nets, goshawks traps, pole traps, bail chatri traps), or are passive harassment methods (e.g., effigies, exclusion, anti-perching devices, electronic distress calls).

The primary safety risk of most non-chemical methods occurs directly to the applicator or those persons assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, or pyrotechnics. Most of the non-chemical methods available to address bird damage in Missouri would be available for use under any of the alternatives and could be employed by any entity, when permitted. Risks to human safety from the use of non-chemical methods will be further evaluated as this issue relates to the alternatives in Chapter 4.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

Additional issues were identified by WS during the scoping process of this EA. Those issues were considered by WS; however, those issues will not be analyzed in detail for the reasons provided.

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 Missouri 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. 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 were made through this EA that the proposed action or the other alternatives might 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 Missouri would continue to conduct bird damage management in a very small percentage of the state land where damage is occurring or likely to occur.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife. WS operates in accordance with applicable 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 would frequently be temporary because immigration from adjacent areas or reproduction would replace the animals removed. WS operates on a small percentage of the land area of Missouri and would only target those birds identified as causing damage or posing a threat. Therefore, damage management activities conducted pursuant to any of the alternatives would not adversely affect biodiversity.

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. In addition, 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 a forest supervisor only needed to show that damage from wildlife was 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 damage management actions.

Bird Damage Management should not occur at Taxpayer Expense

An issue previously identified is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based. Funding for damage management activities would be derived from federal appropriations and through cooperative funding. Activities conducted for the management of damage and threats to human safety from birds would be funded through cooperative service agreements with individual property owners or managers. A minimal federal appropriation is allotted for the maintenance of a WS program in Missouri. The remainder of the WS program is entirely fee-based. Technical assistance is provided to requesters as part of the federally funded activities, but all direct assistance in which WS' employees perform damage management activities is funded through cooperative service 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 circumstances 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 further in Section 2.2 of this EA.

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 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 enter into an agreement with a government agency. In particular, large industrial businesses, and cities and towns may prefer to use WS because of security and safety issues.

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 C, 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 would occur primarily from the use of shotguns. However, the use of rifles could be employed to lethally take some species. Birds that were removed using rifles would occur within areas where retrieval of all bird carcasses for proper disposal would be highly likely (e.g., at roost sites). With risks of lead exposure occurring primarily from ingestion of lead 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 that may be contained within the carcass.

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 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. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot 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 further reduce the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead being deposited and the concentrations that would occur from 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.

Since the take of birds can occur during regulated hunting seasons, through the issuance of depredation permits, under depredation orders without the need to obtain a depredation permit, or are considered non-native with no depredation permit required for take, WS' assistance with removing birds would not be additive to the environmental status quo. WS' assistance 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 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 would be 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 could be 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.

Effects on Human Health from Consumption of Waterfowl

Of concern under this issue is the consumption of waterfowl meat donated to charitable organizations after being lethally taken by WS. Of recent concern is the potential for lead bullet fragments to be present in meat that has been processed for human consumption. In addition, the potential for the spreading of zoonotic diseases or other contaminants in waterfowl processed and donated for human consumption is a concern.

In order to address potential health concerns associated with consuming waterfowl, waterfowl donated for human consumption may be tested for exposure to substances such as organophosphate and carbamate insecticides, lead, mercury, arsenic, organochlorines, and organic chemicals prior to distribution. The entity selecting the capture/euthanize (and donation for charitable consumption) program would be responsible for all costs associated with legal and appropriate donation for human consumption. Poultry processing facilities utilized for this process would be in compliance with existing USDA regulations pertaining to the processing and handling of fowl (e.g., turkeys, chickens).

Waterfowl immobilized using alpha chloralose would not be donated for human consumption with disposal of carcasses occurring by deep burial or incineration. Waterfowl taken by any method for disease sampling or in an area where zoonotic diseases of concern are known to be prevalent and of concern to human health after consuming processed waterfowl meat would not be donated for consumption and would be disposed of by deep burial or incineration.

WS' activities to alleviate damage or threats associated with waterfowl would only occur after receiving a request for direct operational assistance. Therefore, the decision to process waterfowl for human consumption that were taken by WS would be the sole responsibility of the entity requesting assistance. WS would not process and/or donate processed waterfowl meat to charitable organizations and would not be involved with the processing and/or donation of the meat to charitable organizations.

Global Climate Change/Greenhouse Gas Emissions

The WS program activities that may result from 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 the proposed action. The proposed action would meet requirements of applicable federal laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that 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). 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 Missouri 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:

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 Missouri. 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, in cooperation with the USFWS and in consultation with the MDC, 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 after applying the WS Decision Model. 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 in 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 using available methods can be difficult to achieve once damage has been ongoing. 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 could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by birds, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The take of birds can only legally occur through the issuance of a depredation permit by the USFWS and only at levels specified in the permit, unless those bird species are afforded no protection under the MBTA or a depredation/control order has been established by the USFWS in which case no permit for take is required. When applying for a depredation permit, the requesting entity submits with the application the number of birds requested to be taken to alleviate the damage. Therefore, under this alternative, the USFWS could: 1) deny an application for a depredation permit when requested to alleviate bird damage, 2) could issue a depredation permit at the take levels requested, or 3) could issue permits at levels below those take levels requested.

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 the services of WS (i.e., direct operational assistance), or take no action.

The property owner or manager may choose to apply for their own depredation permit from the USFWS to lethally take birds, as required by the implementing regulations of the MBTA for depredation control (see 50 CFR 21.41). The USFWS requires non-lethal methods be used and shown ineffective or impractical before the USFWS will issue a depredation permit. In this situation, WS could evaluate the damage and complete a Migratory Bird Damage Report, which would include information on the extent of the damages, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate the damages.

Following USFWS review of a complete application for a depredation permit from a property owner or manager and the Migratory Bird Damage Report, a depredation permit could be issued to authorize the lethal take of a specified number of birds as part of an integrated approach. Upon receipt of a depredation permit, the property owner, manager, or appropriate subpermittee may commence the authorized activities and must submit a written report of their activities upon expiration of their permit. Permits may be renewed annually as needed to resolve damage or reduce threats to human safety. Property owners or managers could conduct management using those methods legally available. Most methods discussed in Appendix C that are available for use to manage bird damage would be available to all entities. The only methods currently available that would not be available for use by those persons experiencing bird

damage is the avicide DRC-1339, the immobilizing drug alpha-chloralose, and the repellent mesurol, which can only be used by WS.

In anticipation of damage management activities, WS would annually submit an application for a depredation permit to the USFWS estimating the maximum number of birds that could be lethally taken to alleviate damage in Missouri through direct operational assistance projects. The number of birds anticipated to be lethally taken by WS would be based on previous requests for assistance received to manage damage associated with those species of birds. Therefore, the USFWS could: 1) deny WS' application for a depredation permit, 2) issue a depredation permit for the take of birds at a level below the number requested by WS, or 3) issue a depredation permit for the number of birds requested by WS. In addition, WS could be listed as subpermittees under depredation permits issued to other entities.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. The philosophy behind integrated wildlife damage management is to implement the best combination of effective management methods in a cost-effective[6] manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. Integrated damage management may incorporate cultural practices (e.g., animal husbandry), habitat modification (e.g., exclusion, vegetation management), animal behavior modification (e.g., scaring, repellents), removal of individual offending animals (e.g., trapping, shooting, and avicides), local population reduction, or any combination of these, depending on the circumstances of the specific damage problem.

Non-lethal methods include, but are not limited to, habitat/behavior modification, nest/egg destruction, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, alpha-chloralose, reproductive inhibitors, and chemical taste repellents (see Appendix C for a complete list and description of potential methods). Lethal methods considered by WS include live-capture followed by euthanasia, DRC-1339, the recommendation of take during hunting seasons, and firearms. WS would employ cervical dislocation or carbon dioxide to euthanize target birds once those birds were live-captured using other methods. Carbon dioxide is an acceptable form of euthanasia for birds while cervical dislocation is a conditionally acceptable[7] method of euthanasia (AVMA 2013). The use of firearms could also be used to euthanize birds live-captured; however, the use of firearms for euthanasia is considered a conditionally acceptable method for wildlife (AVMA 2013).

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 that are addressed further below and in Appendix C.

Integrated Wildlife Damage Management (IWDM)

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. The philosophy behind IWDM is to implement the best combination of effective management methods in the most cost-effective manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment. IWDM may incorporate cultural practices (e.g., animal husbandry), habitat modification (e.g., exclusion), animal behavior modification (e.g., scaring), removal of individual offending animals, local population reduction,

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

[7]The AVMA (2013) 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".*

elimination of invasive species (e.g., European starlings) or any combination of these, depending on the circumstances of the specific damage problem.

Technical Assistance Recommendations

The WS program in Missouri 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.

From FY 2009 through FY 2013, WS conducted 3,643 technical assistance projects that involved bird damage to agricultural resources, property, natural resources, and threats to human safety in Missouri (see Appendix B).

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 MOU, cooperative service agreement, or other comparable document 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 resolve problems, especially if restricted-use chemicals are necessary or if the problems are complex.

To address the anticipated needs of property owners/managers with bird damages that may request WS' assistance with lethal methods to alleviate their damages, WS would submit an application for a one-year depredation permit to the USFWS estimating the maximum number of birds of each species to be lethally taken as part of an integrated approach. The USFWS would conduct an independent review of the application, and if acceptable, issue a permit as allowed under the depredation permit regulations. WS could request an amendment of their permit to increase the number of birds that could be taken to address unpredicted and emerging bird damages/conflicts. Each year, WS would submit an application for renewal of their permit, and using adaptive management principles, would adjust numbers of birds to meet anticipated needs, based upon management actions in the previous year and anticipated damages and conflicts in the next year. The USFWS would review these applications annually, and issue permits as allowed by regulations. All alterations in the number of birds to be taken would be checked against the impacts analyzed in this EA. All management actions by WS would comply with appropriate federal, state, and local laws.

Educational Efforts

Education is an important element of activities because wildlife damage management is about finding compromise 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. Cooperating agencies frequently collaborate 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. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate 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 worldwide for their expertise in wildlife damage management.

WS' Decision Making Procedures

WS' personnel use a thought process for evaluating and responding to damage complaints that is depicted by the WS Decision Model (WS Directive 2.201) and described by Slate et al. (1992) (see Figure 3.1). WS' personnel are frequently contacted after requesters have tried or considered non-lethal 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 practical for the situation would be incorporated into a damage management strategy. After this strategy had been implemented, monitoring would be conducted and evaluation would continue to assess the effectiveness of the strategy. If the strategy were effective, no further management would be needed. In terms of the WS Decision Model, most efforts to manage damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The WS Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

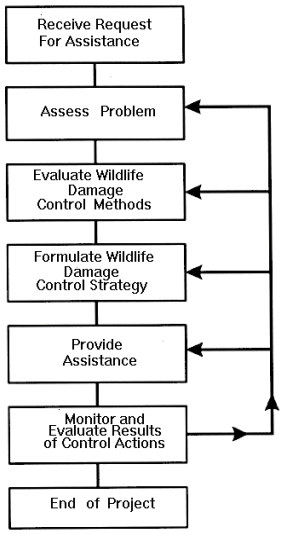


Figure 3.1 WS Decision Model as presented by Slate et al. (1992) for developing a strategy to respond to a request for assistance with human-wildlife conflicts.

Community-based Decision Making

The WS program in Missouri follows the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS could provide 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 could include 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 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.

By involving decision-makers in the process, damage management actions can be presented to allow decisions to involve those individuals that the decision-maker(s) represents. 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 presentations by WS on activities to manage damage. This process allows decisions on activities to be made based on local input.

Alternative 2 - Bird Damage Management by WS using only Non-lethal Methods

Under this alternative, WS would be restricted to only using or recommending non-lethal methods to resolve damage caused by birds in Missouri (Appendix C). Lethal methods could continue to be used under this alternative by those persons experiencing damage without involvement by WS. In situations where non-lethal methods were impractical or ineffective to alleviate damage, WS could refer requests for information regarding lethal methods to the state, local animal control agencies, or private businesses or organizations. Property owners or managers may choose to implement WS' non-lethal recommendations on their own or with the assistance of WS, implement lethal methods on their own, or request assistance (non-lethal or lethal) from a private or public entity other than WS.

Alternative 3 – No Bird Damage Management Conducted by WS

This alternative precludes any 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. All requests for assistance received by WS to resolve damage caused by birds would be referred to the USFWS, the MDC, and/or private entities. This alternative would not deny other federal, state, and/or local agencies, including private entities from conducting damage management activities directed at alleviating damage and threats associated with birds. Many of the methods listed in Appendix C would be available for use by other agencies and private entities, unless otherwise noted in the Appendix, to manage damage and threats associated with birds.

Under this alternative, property owners/managers may have difficulty obtaining permits to use lethal methods. The USFWS needs professional recommendations on individual damage situations before issuing a depredation permit for lethal removal, and the USFWS does not have the mandate or the resources to conduct damage management activities. State agencies with responsibilities for migratory birds would likely have to provide this information if depredation permits are to be issued. If the information were provided to the USFWS, following the agency's review of a complete application package for a depredation permit from a property owner or manager to lethally remove birds, the permit issuance procedures would follow that described in Alternative 1.

Despite no involvement by WS in resolving damage and threats associated with birds, those persons experiencing damage caused by birds could continue to resolve damage by employing those methods legally available since the removal of birds could occur either through the issuance of depredation permits by the USFWS; harvest during the hunting seasons, and blackbirds could be removed at any time when found committing or about to commit damage or posing a human safety threat under a depredation order; Muscovy ducks could be removed under the control order, and non-native bird species could be removed without the need for a depredation permit issued by the USFWS. All methods described in Appendix C would be available for use by those persons experiencing damage or threats except for the use of alpha-chloralose for waterfowl, DRC-1339 for blackbirds and gulls, which can only be used by WS.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives analyzed in detail, several alternatives were identified by WS and the USFWS; however, those alternatives will not receive detailed analyses in this EA 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 C be applied to all requests for assistance to reduce damage and threats to safety from birds. If the use of all non-lethal methods fails 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.

Those persons experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many non-lethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of non-lethal methods can be evaluated. The proposed action (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 this EA.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with 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. 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 alpha-chloralose, live-traps, cannon nets, rocket nets, air cannon nest bow nets, or mist nets. 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 MDC, 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 birds could only occur under the authority of the USFWS and/or MDC. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the MDC, WS could translocate birds under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). Since WS does not have the authority to translocate birds in the state unless permitted by the USFWS and/or the MDC, this alternative was not considered in detail.

The translocation of birds, that have caused 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. In addition, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (e.g., urban blackbird roosts); therefore, translocation would be unrealistic. Translocation of wildlife is also discouraged by WS policy (WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988).

Compensation for Bird Damage

The compensation alternative would require WS 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 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 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.

Technical Assistance Only

This alternative would restrict WS to only providing technical assistance (advice) on BDM. Producers, property owners, agency personnel, or others could obtain permits from the USFWS and/or the MDC as needed and could conduct bird damage management using any of the legally available non-lethal and lethal techniques. Technical assistance information is also readily available from entities other than WS such as the USFWS, universities, extension agents, FAA, and private individual and organizations. Environmental impacts of this alternative are likely to be similar to Alternative 3. Consequently, the agencies have determined that detailed analysis of this alternative would not contribute substantive new information to the understanding of environmental impacts of damage management alternatives and have chosen to not analyze this alternative in detail.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of those methods available to resolve or prevent damage. The current WS program uses many such SOPs. Those SOPs would be incorporated into activities conducted by WS when addressing bird damage and threats.

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, would be consistently used and applied when addressing bird damage.

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

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

- The presence of non-target species would be monitored before using DRC-1339 to reduce the risk of mortality of non-target species' populations.

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

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

- Management actions would be directed toward specific birds posing a threat to human safety, causing agricultural damage, causing damage to natural resources, or causing damage to property.

- Only non-toxic shot would be used when employing shotguns to lethally take birds species.

- The take of birds would only occur when authorized by the USFWS, when applicable, and only at levels authorized.

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

- WS' use of euthanasia methods would comply with WS Directive 2.505.

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

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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.

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

- Preference would be 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.

- WS' personnel would be present during the use of most live-capture methods (e.g., mist nets, cannon nets, rocket nets) to ensure birds captured would be addressed in a timely manner to minimize the stress of being restrained.

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

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

- WS' personnel would use bait, 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 live-capture methods or live-traps would be checked frequently to ensure non-target species are released immediately or are prevented from being captured.

- WS has consulted with the USFWS and the MDC to evaluate activities to resolve bird damage and threats to ensure the protection of T&E 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. Damage management activities would be conducted away from areas of high human activity. If this were not possible, then activities would be conducted during periods when human activity is low (e.g., early morning).

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

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

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

- WS' employees who use alpha chloralose participate in approved training courses concerning immobilizing drugs.

- WS would adhere to all established withdrawal times when using immobilizing drugs for the capture of waterfowl that are agreed upon by WS, the USFWS, the MDC, 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 time where the withdrawal period could overlap with the start of a harvest season, WS would euthanize the animal.

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 are not expected to be significantly impacted by any of the alternatives analyzed as none of the alternatives cause any significant ground disturbance: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, and range. Therefore, these resources will not be analyzed.

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.

Indirect Effects: These are impacts caused by an action that are later in time or farther removed in distance, but are still reasonably foreseeable.

Cumulative Effects: Cumulative effects are discussed in relationship to each of the alternatives analyzed, with emphasis on potential cumulative effects from methods employed, and including summary analyses of potential cumulative impacts to target and non-target species, including T&E species.

Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and other materials, there are no irreversible or irretrievable commitments of resources.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

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 USFWS, and the MDC.

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

Population Impact Analyses of the Alternatives

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 target bird species 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 using methods described in Appendix C to those persons requesting assistance with managing damage and threats associated with birds. WS' lethal removal is monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal is maintained below the level that would cause significant adverse impacts to the viability of native species' populations. The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below. Unless noted otherwise, the state population

estimate listed for each species analyzed below was obtained from PFSC (2014) or Flyways.us (2014). Breeding Bird Survey (BBS) population trends from 1966 to 2012 for Missouri and the region that the state falls within (Eastern Tall Grass Prairie and Central Hardwoods) are listed for each species when available (Sauer et al. 2014). WS' proposed take represents an annual and reoccurring projection. The statistical significance of a trend for a given species that is determined by the BBS data is color coded: a black percentage indicates a statistically non-significant positive or negative trend, a red percentage indicates a statistically significant negative trend, and a blue percentage indicates a statistically significant positive trend (Sauer et al. 2014).

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 or recommended 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 used non-lethal methods, WS would not likely recommend or continue to employ those particular methods since their use has already been proven ineffective in adequately resolving the damage or threat.

Many 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. 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.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods are generally regarded as having minimal impacts on overall populations of wildlife since individuals of those species are unharmed. The use of non-lethal methods would not have adverse impacts on bird populations in the state under any of the alternatives.

The use of lethal methods could 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 mammals 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 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.

WS may recommend birds be harvested during the regulated hunting and/or trapping season for those species 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 and trapping seasons and the allowed take during those seasons is the responsibility of the MDNR. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons. However, the harvest of those birds with hunting and/or trapping seasons would be occurring in addition to any take that could occur by WS under the alternatives or recommended by WS.

Generally, WS only conducts damage management on species whose population densities are high or concentrated and usually only after they have caused damage. No indirect effects were identified for this issue. The issue of the potential impacts of conducting the alternatives on the populations of those target bird species addressed in this EA is analyzed for each alternative below.

WS reporting on migratory bird take

WS receives a permit from the USFWS that allows for the take of certain migratory bird species that come into conflict with human populations every year. Not every migratory bird that is taken by WS each year is reported under this individual permit though. WS employs multiple wildlife biologists and technicians at airports throughout the state of Missouri. In addition to the permit that WS receives from the USFWS each year, each of these airports receives its own migratory bird depredation permit from the USFWS. To allow for more accurate reporting, each WS employee at these airports reports their take on that specific airports depredation permit as a subpermittee. However, the birds that are taken at these airports are reported in the WS Management Information System (MIS) along with any birds taken under the WS depredation permit. This is the reason that number of birds recorded on the WS depredation permit annual report do not mirror the numbers that are lethally removed by WS.

Turkey Vulture Biology and Population Impacts

MO population estimate: 150,000
BBS Eastern Tall Grass Prairie, 1966-2012: 6.58%
BBS Eastern Tall Grass Prairie, 2002-2012: 6.00%
BBS Central Hardwoods, 1966-2012: 3.94%
WS proposed removal as % of state population: 0.13 %
Cumulative removal as % of state population: 0.17

WS proposed take: 200
BBS Missouri, 1966-2012: 6.49%
BBS Missouri, 2002-2012: 6.25%
BBS Central Hardwoods, 2002-2012: 5.27%

Turkey vultures can be found throughout the year in Missouri and are a common migrant and summer resident statewide. They are becoming locally common in the southern half of Missouri during the winter months. Turkey vultures can live at least 20 years of age (Venable 1996) and roost in large colonies but forage individually. There are usually two chicks per clutch which are fed by the parents for 10–11 weeks (MDC 2015).

The number of turkey vultures dispersed by WS and authorized to be removed by WS and other entities addressed in is shown in Table 4.1.

Table 4.1 – Number of turkey vultures addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	1523	25	60/24
2010	1481	26	110/37
2011	1419	25	120/24
2012	1261	20	100/15
2013	1694	45	177/49
Average	**1,476**	**28**	**113/30**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:

Based on the best scientific data, WS proposed take level will have no adverse direct effects on vulture populations. The majority of the direct operational assistance conducted by WS on turkey vultures would occur in the spring, summer and fall months as most of Missouri's turkey vultures migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 Missouri.

Mourning Dove Biology and Population Impacts

MO population estimate: 2,200,000
BBS Eastern Tall Grass Prairie, 1966-2012: -0.32%
BBS Eastern Tall Grass Prairie, 2002-2012: 0.22%
BBS Central Hardwoods, 1966-2012: -0.31%
WS proposed take as % of state population: 0.09%
Cumulative removal as % of state population: 0.11%

WS proposed take: 2,000
BBS Missouri, 1966-2012: -1.41%
BBS Missouri, 2002-2012: -0.42%
BBS Central Hardwoods, 2002-2012: 0.14%

Mourning doves are migratory birds with substantial populations throughout much of North America and can be found statewide. Mourning doves are found mainly in crop fields, around farms, and in yards. New agricultural practices of crop farming, livestock grazing, forest clearing, burning, and introduction of exotic seed-bearing plants helped dove populations (MDC 2014). Mourning doves are considered migratory game birds in Missouri and have regulated hunting seasons. Doves can be harvested from September 1 to December 16. The annual preliminary harvest numbers for mourning doves is recorded every other year (Tom Kulowiec, personal communication 2014). In 2010 and 2014, 492,696 and 587,600, respectively, mourning doves were harvested. The number of mourning doves observed during the BBS had shown a general increasing trend in Missouri since 2002 although populations have experienced slight declines in the past twenty years (Sauer et al. 2014).

The number of mourning doves addressed by WS and other entities to alleviate damage is shown in Table 4.2. WS' proposed take of 2,000 birds would only account for 0.34% of the annual harvest in 2012. The highest authorized take for other entities (200 birds) in addition to the WS proposed take was used to assess the cumulative take. WS also has an active trapping and relocating program in conjunction with the MDC. Research has demonstrated that doves can be successfully trapped and relocated 30 to 60 miles away without the concern of the doves returning to the damage site (personal communication with David Borrowman, USDA WS).

Table 4.2 – Number of Mourning dove addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits		
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]	WS Relocated
2009	8,705	382	1050/411	276
2010	5,965	194	1175/161	254
2011	4,170	196	1250/269	196
2012	14,046	589	1670/528	154
2013	6,431	213	1670/446	367
Average	**7,863**	**1,574**	**1,363/363**	**249**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:

Based on the best scientific data, WS' proposed take level will have no adverse direct or indirect effects on mourning dove populations. Like other native bird species, the take of mourning doves by WS to alleviate damage will only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take and the annual harvest is not expected to create adverse cumulative

impacts. The take of mourning doves by WS would only occur at levels authorized by the USFWS, which ensures WS' take and take by all entities, including hunter harvest, would be considered to achieve the desired population management levels of doves in Missouri. WS' proposed take is only a small percentage of the annual harvest, and therefore is not expected to hinder the ability of those interested persons in harvesting mourning doves during the hunting season.

European Starling Biology and Population Impacts

MO population estimate: 1,300,000
BBS Eastern Tall Grass Prairie, 1966-2012: -0.40%
BBS Eastern Tall Grass Prairie, 2002-2012: -0.86%
BBS Central Hardwoods, 1966-2012: 0.26%
WS proposed take as % of state population: 3.85 %

WS proposed take: 50,000
BBS Missouri, 1966-2012: -0.20%
BBS Missouri, 2002-2012: -0.22%
BBS Central Hardwoods, 2002-2012: 0.06%

The European starling is an Old World passerine species introduced in the eastern U.S. in the late 1800's. The starling is found in virtually all Missouri habitats. Starlings nest in cavities and will readily evict most native hole-nesting species. In the absence of natural cavities, they will nest in almost any enclosed area such as a street light, a mail box, or an attic (Brauning 1992).

European starlings are considered a non-native species in Missouri and are afforded no protection under the MBTA. Therefore, no depredation permits from either the USFWS or the MDC are needed for the removal of starlings. The number of starlings lethally removed by non-WS entities is unknown since the reporting of starling take is not required. The number of starlings dispersed and lethally removed by WS from FY 2009 through FY 2013 can be seen in Table 4.3. Executive Order 13112 states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and 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.

Table 4.3 – Number of European starling addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	202,138	967
2010	308,090	886
2011	119,431	776
2012	364,802	8,694
2013	390,607	4,122
Average	**277,014**	**3,089**

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

Direct, Indirect, and Cumulative Effects:

Based on the best scientific data, WS' proposed take level will have no adverse direct or indirect effects on European starling populations. While non-WS take is unknown, starling populations have remained relatively stable and have historically expanded their range throughout North America. Therefore, WS does not anticipate any significant cumulative impacts to starling populations.

Great Blue Heron Biology and Population Impacts

MO population estimate: Unknown
BBS Eastern Tall Grass Prairie, 1966-2012: 3.25%
BBS Eastern Tall Grass Prairie, 2002-2012: 2.20%
BBS Central Hardwoods, 1966-2012: 3.76%
WS proposed take: 75
BBS Missouri, 1966-2012: 3.69%
BBS Missouri, 2002-2012: 5.12%
BBS Central Hardwoods, 2002-2012: 4.20%

All WS great blue heron damage management in Missouri has been conducted to reduce bird-collision hazards to aircraft. Bird strike hazards from great blue herons can occur any time of the year although usually from spring through fall. Great blue herons are relatively common and can be observed throughout Missouri and the U.S. No population data is available in Missouri for great blue herons as the MDC states there are no concerns on the stability of this population (Personal Communication Janet Haslerig 2014).

The majority of "Take by All Entities" is the removal of great blue herons at state or privately owned aquaculture facilities. Great blue herons are the number one threat at state and privately owned fish hatcheries feeding on a wide variety of fish.

Great blue herons are most often located in lakes, ponds, streams and rivers (MANEM Waterbird Conservation Plan 2006). Nesting great blue heron rookeries in Missouri occur along the large rivers and lakes areas located throughout Missouri.

Table 4.4 – Number of Great blue heron addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	415	33	435/277
2010	206	33	415/323
2011	107	12	465/368
2012	117	8	495/355
2013	109	16	725/424
Average	**191**	**20**	**507/349**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:

Based on the best scientific data, WS proposed take level will have no adverse direct effects on great blue heron populations. The majority of the direct operational assistance conducted by WS on great blue heron would occur in the spring, summer and fall month's as most of Missouri's great blue heron migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 great blue heron in Missouri.

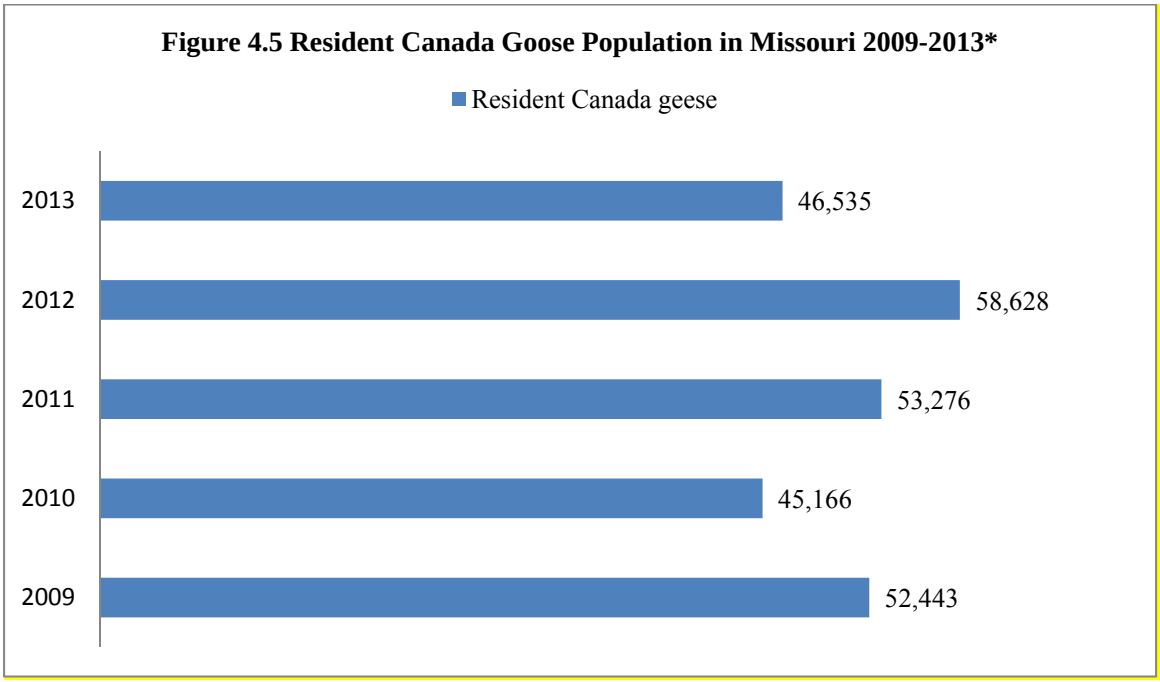
Canada Goose Biology and Population Impacts

MO resident goose population estimate: 69,445
BBS Eastern Tall Grass Prairie, 1966-2012: 17.99%
BBS Eastern Tall Grass Prairie, 2002-2012: 9.42%
BBS Central Hardwoods, 1966-2012: 16.40%
WS proposed take as % of state population: 0.72 %
Cumulative take as % of state population: 0.9%
WS proposed take: 500
BBS Missouri, 1966-2012: 14.94%
BBS Missouri, 2002-2012: 14.62%
BBS Central Hardwoods, 2002-2012: 15.90%

Canada geese are one of the most readily recognized and observable birds in Missouri. They can live approximately 20-25 years in the wild. There are two behaviorally-distinct types of Canada goose populations in Missouri: resident and migratory. Although they may appear similar, they exhibit many different behaviors that affect the management of these birds. The USFWS identifies "resident Canada geese" as those nesting within the lower 48 states and the District of Columbia in the months of March, April, May, or June, or residing within the lower 48 states and the District of Columbia in the months of April, May, June, July, or August. Migratory geese nest north of the Canadian border, migrating south beginning in October and returning back to Canada by March to begin nesting.

In the winter, resident geese may move south during cold weather. Additionally, resident geese from states further north may move into Missouri at these times. Resident geese are found throughout Missouri year-round and their populations have been estimated as low as 45,166 and as high as 58,628 between 2009 and 2013 (per communications, Doreen Mengel, 2014) (Figure 4.5). The Missouri resident Canada goose population objective is 40,000 to 60,000.

Figure 4.5 Resident Canada Goose Population in Missouri 2009-2013*



Migratory geese pass through or remain in Missouri from October through March. Mid-winter waterfowl surveys conducted by the MDC indicate that for 2014, the mid-winter goose population in Missouri totaled 212,052 migratory and resident birds. Migratory Canada geese belong to the Mississippi Flyway Population.

The majority of Canada goose damage complaints in Missouri involve damage related to reduce bird-collision hazards to aircraft. Bird strike hazards from Canada geese can occur any time of the year, although usually spring through fall.

Goose populations are managed by the USFWS and the MDC pursuant to the MBTA, Federal Regulations (50 CFR 10, 13, 20 & 21), Wildlife Code of Missouri and other federal and state laws, regulations, policies, and court rulings. Procedures, such as handling nests and eggs, capturing and

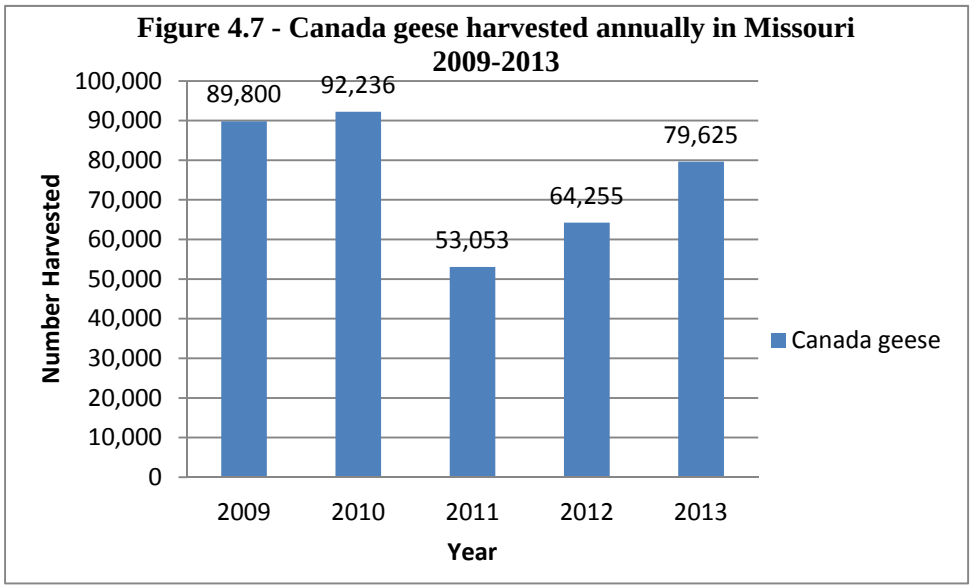
relocating birds, capturing and euthanizing birds, shooting birds to reduce damage, and any other activity that includes handling birds, their parts, and/or their nests and eggs requires compliance with these laws. A depredation permit is generally required to conduct any of these activities. Table 4.6 addresses the number of Canada geese removed under depredation permits in Missouri from FY 2009-FY 2013.

Table 4.6 – Number of Canada geese addressed in Missouri from FY 2009 through FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	79,972	151	485/68
2010	44,283	129	485/75
2011	45,369	130	670/163
2012	54,272	123	580/111
2013	53,736	93	1005/122
AVERAGE	**55,526**	**125**	**645/108**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Like many waterfowl species in Missouri, Canada geese can be harvested during a regulated hunting season that traditionally occurs from late October through January. Canada geese can also be harvested during a special "Resident Canada goose Hunting Season" that occurs during the month of October. Since migrant geese do not arrive in Missouri until November, this hunt targets the resident goose population in Missouri. Figure 4.7 depicts the total number of hunter harvested geese between 2009 and 2013 (2014 Missouri Canada Goose Survey).



Direct, Indirect, and Cumulative Effects:

The Missouri resident Canada goose population objective is 40,000 to 60,000 birds. Based on a population objective of 40,000 to 60,000 birds, up to 19,625 geese could be taken annually to reach manageable population levels. The proposed removal of 500 Canada geese by WS, when included with

the maximum number of 122 take by all entities for the last five years between 2009 and 2012, would total 622 geese. This total would not exceed the level necessary to cause a decline in Canada goose populations. WS does not typically remove geese during the migratory period; however, occasionally minimal numbers of geese are removed during this period at airports for the protection of human safety. This minimal removal is not expected to adversely affect migratory goose populations.

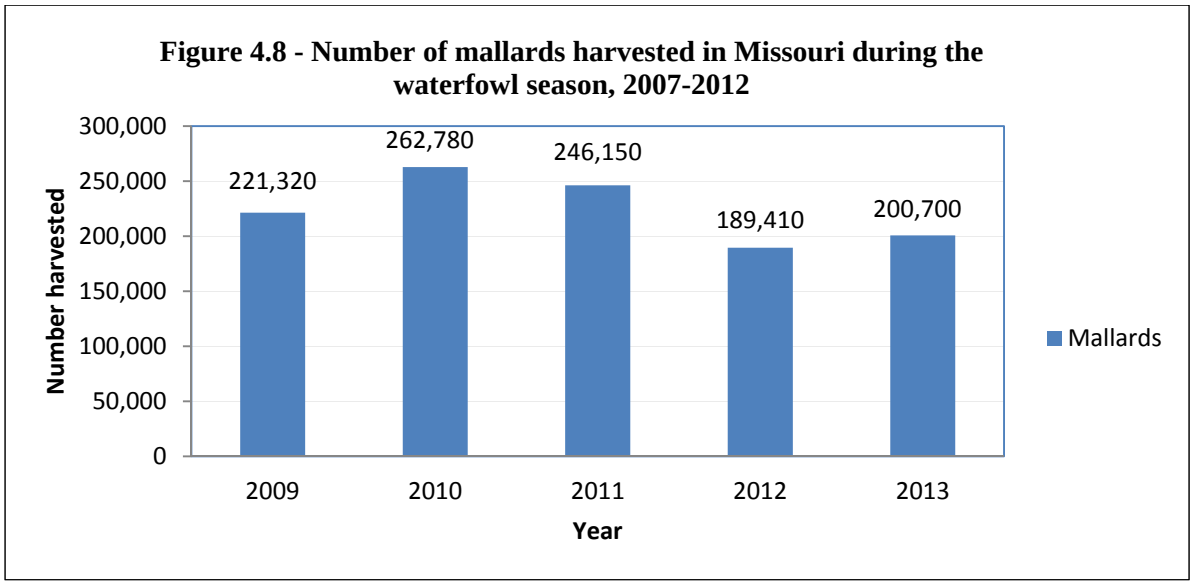
Canada goose nests are authorized to be destroyed (which may involve treatment of eggs by oiling, puncturing, or addling to inhibit reproduction) by the USFWS through the Resident Canada Goose Registration. Between 2009 and 2013, the number of goose nests destroyed in Missouri by WS annually has ranged from as low as 353 nests in 2007, to as high as 890 nests in 2010. From FY 2007 to FY 2012, 3,927 nests were removed by WS in Missouri to alleviate damage and reduce threats. The destruction/treatment of up to 6,000 Canada goose nests annually by WS would occur in localized areas where nesting takes place. As with the lethal take of geese, the take of nests must be authorized by the USFWS and the MDC. Therefore, the number of geese lethally removed and the number of nests taken by WS annually would occur at the discretion of the USFWS and the MDC. Provided that the goose population allows for an annual hunting harvest, and WS' take is a fraction of a percent of the annual harvest, the cumulative take will not adversely affect Canada goose populations. WS' take could be considered of low magnitude when compare to the number of geese observed in Missouri annually and will not hinder the ability of those interested persons to harvest geese during the hunting season.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on Canada geese populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 Canada geese in Missouri.

Mallard Biology and Population Impacts

MO population estimate: 304,709
WS proposed take: 250
BBS Eastern Tall Grass Prairie, 1966-2012: 2.02%
BBS Missouri, 1966-2012: 2.04%
BBS Eastern Tall Grass Prairie, 2002-2012: -1.58%
BBS Missouri, 2002-2012:0.83%
BBS Central Hardwoods, 1966-2012: 4.91%
BBS Central Hardwoods, 2002-2012: 3.29%
2014 WS proposed take as percentage of state population: 0.08 %
2013 Cumulative take as % of state population: 0.1%

In Missouri, mallards can be found year-round (Drilling et al. 2002). Like other waterfowl species, mallards can be harvested during a regulated season. The estimated numbers of mallards harvested from 2009 through 2013 during the annual hunting season are shown below in Figure 4.8. An average 224,072 mallards were harvested between 2009 and 2013.



As with other waterfowl species, mallards can be found in large numbers during the spring and winter migration periods. When those large flocks occur on or near airports, they can pose aircraft strike risks. Primarily at aerodromes, a total of 155 mallards have been lethally removed by WS from FY 2009 through FY 2013. Based on the number of requests received for assistance and in anticipation of additional efforts to address damage or threats of damage at additional airports and military installations, an annual take of up to 250 mallards per year could occur under the proposed action.

The USFWS has authorized the total lethal take of approximately 175 mallards annually from 2009 through 2013 (Table 4.9). If the USFWS authorized take of 200 mallards from all entities and WS lethally removed 250 mallards, the cumulative take would be 450 mallards.

Table 4.9 – Number of Mallards addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	13,186	34	155/33
2010	4,021	14	180/26
2011	7,738	36	155/36
2012	20,958	46	200/51
2013	7,576	25	180/16
Average	**10,696**	**31**	**174/32**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS proposed take level will have no adverse direct effects on mallard populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 mallards in Missouri. Additionally, WS' proposed take represents only

0.1% of the average mallard harvest in the past five years, and therefore, is not expected to diminish the opportunity for sportsmen to harvest mallards during the hunting season.

Bald Eagle Biology and Population Impacts
MO population estimate: Unknown
BBS Eastern Tall Grass Prairie, 1966-2012: 16.23%
BBS Eastern Tall Grass Prairie, 2002-2012: 22.76%

The bald eagle is a large raptor often associated with aquatic habitats across North America with breeding populations occurring primarily in Alaska and Canada; however, eagles have been documented nesting in all 48 contiguous states, except Rhode Island and Vermont (Buehler 2000). Nesting normally occurs from late March through September with eggs present in nests from late March through the end of May. Eaglets can be found in nests generally from late May through mid-September (Buehler 2000).

Although officially removed from the protection of the ESA across most of its range, the bald eagle is still afforded protection under the Bald and Golden Eagle Protection Act. In addition, the MDC lists the bald eagle as "Vulnerable" in the state either because it is rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation.

During the migration period, eagles occur throughout the United States and parts of Mexico (Buehler 2000). Under the Bald and Golden Eagle Act, activities that could result in the "take" of eagles cannot occur unless the United States Fish and Wildlife Service allow those activities to occur through the issuance of a permit. Take could occur through purposeful take (e.g., harassing an eagle from an airport using pyrotechnics to alleviate aircraft strike hazards) or non-purposeful take (e.g., unintentionally capturing an eagle in a trap). Both purposeful take and non-purposeful take require a permit from the United States Fish and Wildlife Service (see 50 CFR 22.26, 50 CFR 22.27). In those cases where purposeful take could occur or where there is a high likelihood of non-purposeful take occurring, WS would apply for a permit for those activities.

WS has received requests for assistance associated with bald eagles posing threats to safety at or near airports as well as predation to sheep and calves in Missouri. The large body size and soaring behavior of eagles can pose threats of aircraft strikes when eagles occur in close proximity to airports. Given the definition of "*disturb*" under the Act as described above, the use of harassment methods to disperse eagles posing threats at or near airports could constitute "*take*" as defined under the Act, which would require a permit from the USFWS to conduct those types of activities.

Under 50 CFR 22.26, WS and/or an airport authority could apply for a permit allowing for the harassment of eagles that pose threats to aviation safety at civil and military airports. Under this proposed action alternative, WS could employ harassment methods to disperse eagles from airports/air bases or surrounding areas when authorized and permitted by the USFWS pursuant to the Act. Therefore, if no permit is issued by the USFWS to harass eagles that are posing a threat of aircraft strikes, no activities would be conducted by WS. Activities would only be conducted by WS when a permit allowing for the harassment of eagles has been issued to WS or to an airport authority/military installation where WS is working as a subpermittee. No lethal take of eagles would occur under this proposed action alternative.

WS would abide by all measures and stipulations provided by the USFWS in permits issued for the harassment of eagles at airports to reduce aircraft strikes. The USFWS determined that the issuance of permits allowing the "*take*" of eagles as defined by the Act would not significantly impact the human environment when permits are issued for "*take*" of eagles under the guidelines allowed within the Act (USFWS 2010). Therefore, the issuance of permits to allow for the "*take*" of eagles, including permits issued to WS or other entities has been fully evaluated in a separate analysis (USFWS 2010). During FY

2013, WS harassed two bald eagles from a Missouri airport's safety zone to alleviate strike risks pursuant to a permit issued by the USFWS in accordance with the Bald and Golden Eagle Protection Act. WS was able to find a deer carcass that attracted the eagles to the airport area and after disposing of the deer carcass properly, the eagles moved away from the airport. Eagles are becoming more common in Missouri each year. From 2009 to 2013, WS dispersed eagles on 517 occasions, all from airport environments as noted in Table 4.10.

Although no population numbers are available for bald eagles in Missouri, the Missouri Department of Conservation reports there were four active nests in 2004 and 235 in 2014 (per communication, Janet Haslerig, MDC).

Table 4.10 – Number of Bald Eagles addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	6	0	0/0
2010	264	0	0/0
2011	27	0	0/0
2012	136	0	0/0
2013	84	0	0/0
Average	**103**	**0**	**0/0**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
WS' harassment efforts will have no adverse direct effects on bald eagle populations as WS will comply with permit stipulations from the USFWS. No significant adverse cumulative impacts are expected as the USFWS provides oversight to all take permits, which will sufficiently monitor eagle management efforts by all entities.

Red-tailed Hawk Biology and Population Impacts
MO population estimate: 38,000
BBS Eastern Tall Grass Prairie, 1966-2012: 2.38%
BBS Eastern Tall Grass Prairie, 2002-2012: 2.54%
BBS Central Hardwoods, 1966-2012: 2.22%
WS proposed take as % of state population: 0.2 %
Cumulative take as % of state population: 0.37%

WS proposed take: 75
BBS Missouri, 1966-2012: 1.58%
BBS Missouri, 2002-2012: 1.38%
BBS Central Hardwoods, 2002-2012: 2.66%

The red-tailed hawk is one of the most widely distributed raptor species in North America with a breeding range extending from northern Canada and Alaska southward to northern and central Mexico (Preston and Beane 2009). In Missouri, the red-tailed hawk is a year-round resident (Preston and Beane 2009). Red-tailed hawks are capable of exploiting a broad range of habitats with structures for perching and nesting, and the availability of prey items being the key factors. Populations of red-tailed hawks in North America showed increasing trends during the mid- to late-1900s likely in response to the conversion of forested areas to more open environments for agricultural production (Preston and Beane 2009).

The open grassland habitats of airports and the availability of perching structures often attract red-tailed hawks to airports where those birds can pose a risk to aviation safety. Most requests for assistance with red-tailed hawks that have been received by WS in Missouri involve threats hawks pose to aircraft. However, WS occasionally receives requests involving red-tailed hawk damage or threats of damage to agricultural resources, property, and human safety. For example, red-tailed hawks are known to capture and feed on free-ranging chickens.

From FY 2009 through FY 2013, the WS program in Missouri employed non-lethal methods to disperse an average 884 red-tailed hawks and employed live-traps to capture and translocate an average 282 red-tailed hawks from airports. Red-tailed hawks were live-captured using bal-chatri traps or Swedish Goshawk traps and translocated to an area not less than 50 miles away and released into appropriate habitat with landowner permission. In addition, red-tailed hawks captured and translocated were banded for identification purposes using USGS approved leg-bands appropriate for the species. WS is authorized to band captured raptor species with auxiliary plastic colored leg bands under a Federal Bird Banding Permit (No. 23388) issued by the U.S. Geological Survey (USGS) Bird Banding Laboratory (BBL). Under this permit, WS is authorized to band birds captured on airports only and may not band birds with existing bands or remove any existing bands from captured species. Per WS' raptor relocation protocol, which was developed to create consistency in WS' operations across Missouri airports, banded raptors that return to the same airport environment twice may be euthanized to protect aviation safety. In addition, when a red-tailed hawk is creating an immediate risk to aviation safety (e.g., perching along an active runway, flying into aircraft approach space) and after aggressive harassment has proven ineffective, lethal removal may be deemed necessary.

Direct, Indirect, and Cumulative Effects:
Under the proposed action alternative, WS would continue to employ live-trapping for capturing red-tailed hawks and would continue to band and translocate hawks more than 50 miles from capture sites. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, mainly at civil and military airports, up to 400 red-tailed hawks could be live-captured and translocated annually.

Although the live-capture and translocation of red-tailed hawks would be a non-lethal method of reducing damage or threats of damage, red-tailed hawks could be translocated during their nesting season which could potentially lower nesting success. Since 2009, 161 red-tailed hawks were captured for relocation between March 15 and July 15 in Missouri which represents 11% of the relocated hawks that were removed during the nesting season. Eggs are generally observed in nests of red-tailed hawks as early as mid to late March (Preston and Beane 2009). Nestlings are generally present in nests from late-May through early-July (Preston and Beane 2009). Incubation of eggs can occur by either the male or female; however, incubation occurs primarily by the female while the male contributes a shorter amount of time to incubation each day (Preston and Beane 2009). Both the male and female red-tailed hawks feed the young once hatched; however, the female actually feeds the young more often while the male does more of the hunting (Preston and Beane 2009).

Although reduced nesting success could occur by removing one of the adult pairs of red-tailed hawks during the nesting season, available information indicates the successful raising of young could occur if only one adult was left to tend to the young. Given the statistically significant increase in the red-tailed hawk population and the low percentage of hawks removed during the nesting season, no adverse indirect effects to the statewide population are expected to occur by any resulting reduced nesting success.

WS could also continue to be requested to employ lethal methods under the proposed action alternative to address damage or threats of damage associated with red-tailed hawks. Similar to the other raptor species addressed under the proposed action alternative, lethal take would only occur when birds were identified

as being an immediate threat to human safety and/or property or after relocated hawks returned twice to the same airport environment.

Based on previous requests received by WS, as well as anticipated requests, up to 75 red-tailed hawks could be lethally removed by WS to alleviate damage. This level of take is considered to be of low magnitude and unlikely to result in any cumulative adverse impacts. Furthermore, the increasing population trend indicates that prior removal and relocation of red-tailed hawks has had no adverse effects on statewide populations. The permitting of the take by the USFWS ensures WS' take would occur within allowable harvest levels of red-tailed hawks.

Table 4.11 – Number of Red-tailed hawk addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits		
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]	WS Relocated
2009	1867	35	185/24	370
2010	613	26	200/37	346
2011	542	43	134/57	310
2012	569	67	83/55	205
2013	830	57	182/51	177
Average	**884**	**46**	**157/45**	**284**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Based on the best scientific data, WS proposed take level will have no adverse direct effects on red-tailed hawk populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 red-tailed hawks in Missouri.

American Kestrel Biology and Population Impacts

MO population estimate: 30,000
BBS Eastern Tall Grass Prairie, 1966-2012: 0.64%
BBS Eastern Tall Grass Prairie, 2002-2012: -0.05%
BBS Central Hardwoods, 1966-2012: 0.05%
WS proposed take as % of state population: 0.34 %
2013 Cumulative take as % of state population: 0.53%

WS proposed take: 100
BBS Missouri, 1966-2012: 2.30%
BBS Missouri, 2002-2012: 5.32%
BBS Central Hardwoods, 2002-2012: -.008%

American kestrels are the smallest and most common North American falcon. Their range includes most of North America, except the far northern portions of Alaska and Canada (Smallwood and Bird 2002). Kestrels are capable of breeding as yearlings as is the case in about 80% of individuals. Average clutch size is most often four to five eggs, with an estimated 67% reproductive success (at least one fledgling) across their range.

Kestrels can be found throughout the year in Missouri and are considered to be an uncommon summer resident with a fairly widespread distribution (MDC 2015). Kestrels are considered fairly common during the spring migration periods and are a common migrant through the fall.

Most requests for assistance received by WS associated with kestrels occur at civil and military airports where those individuals are posing threats to aviation safety. WS has addressed those requests for assistance primarily with non-lethal dispersal methods and through live-capture and translocation of individual kestrels. As shown in Figure 4.12, WS has addressed relatively few numbers of kestrels since 2009.

Table 4.12 – Number of American Kestrels addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits		
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]	WS Relocated
2009	121	7	135/4	14
2010	60	10	55/8	32
2011	114	7	55/7	19
2012	94	16	55/17	20
2013	90	16	80/16	23
Average	**96**	**11**	**76/82**	**22**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Requests for assistance associated with kestrels primarily originate from airports and military installations where kestrels pose an aircraft strike risk. Based on the requests for assistance received previously and in anticipation of receiving additional requests for assistance to manage threats posed by kestrels at airports, up to 100 kestrels could be taken and or live-captured and translocated under the proposed action.

Although the live-capture and translocating of kestrels would be a non-lethal method of reducing damage or threats of damage, kestrels could be translocated during their nesting season which could lower nesting success. Since 2009, however, only 27 kestrels have been removed between March 15 and July 15 which represents 25% of the total kestrels captured from FY 2009 to FY 2013. Eggs are generally observed in nests of kestrels beginning at the very end of March through mid-June, with the peak period occurring from early-April through mid-May (Smallwood and Bird 2002). Nestlings are generally present in nests from early-May through late-August with the peak occurring from the end of May through the end of July (Smallwood and Bird 2002).

Although reduced nesting success could occur by removing one of the adult pairs of kestrels, available information indicates the successful raising of young could occur if only one adult was left to tend to the young. The degree of success would likely be related to the sex of the adult removed, the developmental stage of the eggs or nestlings, availability of food sources, and the time of year the removal of one of the adult pairs occurred. Provided that most of WS' relocation actions occur outside of the nesting season, and the kestrel's ability to successfully raise broods with only one parent, no indirect adverse effects are expected to occur to the statewide kestrel population from relocation activities.

As with other raptor species, WS would continue to employ primarily non-lethal methods to address damage and threats of damage. However, lethal removal could be conducted when immediate threats to human safety occur, such as when banded kestrels have returned to the same airport twice after translocation or when habituation to non-lethal methods occurs. Based on previous requests for assistance received by WS, and in anticipation of receiving additional requests, the total lethal removal of kestrels by WS would not exceed 100 kestrels annually. According to the USFWS, 52 kestrels were taken by all entities in the state between 2009 and 2013. However, the USFWS authorized the take of

135 kestrels by all entities in Missouri during 2009. The WS proposed take of 100 birds represents 0.34% of the estimated population based (PFSC 2014). Provided that most of WS take occurs during the winter season, and little to no other take is expected by other entities based on historical evidence, no cumulative adverse effects are expected to occur to the statewide or regional kestrel population.

The take of kestrels, including live-capture and translocation, can only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. Therefore, all take, including take by WS, is authorized by the USFWS and occurs at their discretion. The take of American kestrels would only occur at levels authorized by the USFWS which ensures cumulative take is considered as part of population management objectives for American kestrel in Missouri.

Killdeer Biology and Population Impacts

MO population estimate: Unknown
WS proposed take: 350
BBS Eastern Tall Grass Prairie, 1966-2012: 2.32%
BBS Missouri, 1966-2012: 1.60%
BBS Eastern Tall Grass Prairie, 2002-2012: 1.72%
BBS Missouri, 2002-2012: 0.98%
BBS Central Hardwoods, 1966-2012: 0.25%
BBS Central Hardwoods, 2002-2012: -1.55%

The killdeer is by far the most wide-spread and familiar of North American plovers because of its habitat, its tolerance of humans, its easily observed parental care, and its distinct vocalizations. The killdeer is probably more common today than at any time in its history as a result of habitat changes brought on by humans. It breeds in Missouri and generally migrates during the winter months but some populations may reside in southern Missouri, and thus can be found year-round (Jackson and Jackson 2000).

No current population estimates are available for the number of killdeer residing in Missouri. Based on broad-scale surveys, the United States Shorebird Conservation Plan estimated the population of killdeer in the United States to be approximately 2,000,000 birds in 2001 (Brown et al. 2001).

From FY 2009 through FY 2013, WS has lethally taken a total of 798 killdeer at airports to reduce damages and threats of damage associated with aviation safety. The highest level of killdeer take by WS occurred in FY 2013 when 308 killdeer were lethally removed. WS has also employed non-lethal methods to harass 5,580 killdeer at airports from FY 2009 through FY 2013.

Table 4.13 – Number of Killdeer addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	1239	78	400/81
2010	1401	105	260/116
2011	921	54	300/58
2012	777	253	520/268
2013	1242	308	690/290
Average	**1,116**	**160**	**76/10**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:

Requests for assistance associated with killdeer occur primarily at airports. WS would continue to assist airport personnel in identifying habitat and other attractants to killdeer on airport property. Killdeer

would continue to be addressed using primarily non-lethal harassment and dispersal methods. The removal of 350 killdeer would represent 0.018% of the national population. Based on the best scientific data, WS proposed removal level will have no adverse direct effects on killdeer populations. If habitat modification and non-lethal harassment methods occur within airport property to minimize the attraction of killdeer on the property, then there could be an indirect impact on the nesting and/or breeding success of individuals that originally nested on the airport property; this localized indirect impact would be minimal and therefore would not cause significant effects on the state killdeer populations. The potential authorized removal from all non-WS entities combined with WS proposed removal is also not expected to create adverse cumulative impacts. All removal of killdeer would occur within the levels permitted by the USFWS and MDC pursuant to the MBTA.

Ring-billed Gull Biology and Population Impacts

MO population estimate: Unknown
BBS Eastern Tall Grass Prairie, 1966-2012: 13.57%
BBS Eastern Tall Grass Prairie, 2002-2012: 19.12%
WS proposed take: 200
CBC 2014: 11,381

The breeding population of ring-billed gulls is divided into 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, Pollet et al. 2012). 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 through 1990. The number of ring-billed gulls nesting on Lake Erie increased by 161% from 1976 through 2009 (Morris et al. 2011). Wires et al. (2010) estimates the ring-billed gull population in North America at 1.7 million breeding individuals. No breeding populations of ring-billed gulls are known to occur in Missouri. The number of gulls present in the state increases during the migration periods and during the winter.

Across all BBS routes in the United States, the number of ring-billed gulls observed has shown an increasing trend estimated at 1.5% since 1966 (Sauer et al. 2014). The number of ring-billed gulls observed in Missouri during the CBC has shown a steady increase since 1966, with a substantial increase in the past ten years. The number of gulls observed in the past five years of the survey has Averaged 9,541 (National Audubon Society 2010).

Requests for direct operational assistance received by WS occur primarily at airports where those gulls pose aircraft strike hazards; however, WS could also receive requests for assistance associated with gulls feeding on aquaculture stock and causing damage at waste facilities. During times of migration (as evidenced by observations during the CBC), numbers of ring-billed gulls can be highly variable. It is not uncommon to see an influx of thousands of gulls at airports or waste management facilities during these periods.

Ring-billed gulls are protected under the MBTA. However, take can occur pursuant to the MBTA through depredation permits issued by the USFWS. WS' take of gulls occurs under permits issued to WS or under permits issued to cooperators where WS is acting as an agent on the permit. The USFWS authorized take of ring-billed gulls in Missouri issued to all entities is shown in Table 4.15. Based on the number of ring-billed gulls lethally taken from FY 2009 through FY 2013 and a reasonable anticipation of an increase in the number of requests for assistance, WS could lethally take up to 200 ring-billed gulls in Missouri as part of an integrated damage management program.

Table 4.14 – Number of ring-billed gulls addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	1,479	9	90/18
2010	1,026	31	50/30
2011	472	23	60/28
2012	442	22	30/22
2013	1,748	21	30/21
Average	**1,033**	**21**	**43/24**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
An estimate of the number of ring-billed gulls present in the state during the migration periods is currently unavailable. The only information currently available to evaluate the magnitude of WS' proposed take of up to 200 gulls annually is the number observed in the state during the CBC. Data from the CBC provides an indication of long-term trends in the number of birds observed wintering in the state and is not representative of estimates for wintering bird populations. However, the analysis will use this information to evaluate the magnitude of lethal take that could occur by WS. The number of gulls observed in the state during the CBC would be a minimum estimate given the survey parameters of the CBC and that it covers a small portion of the state.

If WS removed 200 ring-billed gulls, WS' take would represent 2.1% of the Average number of ring-billed gulls observed in the past five years during the CBC. The USFWS authorized other entities in the state to remove up to 90 gulls in the past five years. If other entities removed 90 gulls and the take by WS reached 200 gulls, the cumulative take would represent 3.0% of the five year Average.

WS' lethal take of gulls would occur under permits issued to WS by the USFWS or under permits issued to cooperators where WS was acting as an agent on the permit. The permitting of take by the USFWS would ensure the cumulative take of ring-billed gulls occurs within allowable take levels to achieve desired population objectives for the species; therefore, the take of gulls by WS would only occur at levels permitted by the USFWS through the issuance of depredation permits.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on ring-billed gulls populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts.

Franklin's Gull Biology and Population Impacts
MO population estimate: Unknown WS proposed take: 100
BBS Central BBS Region, 1966-2012: -2.16%
BBS Central BBS Region, 2002-2012: 0.83%

Franklin's gulls depend on prairie marshes for breeding and entire colonies may shift sites from year to year depending upon water conditions. These colony movements make it extremely difficult to monitor the population. Surveys which use routes at fixed locations, such as the U.S. Geological Survey's Breeding Bird Survey, are particularly unreliable for this species (Burger and Gochfeld 2009). The Franklin's gull population in North America is estimated at over one million birds (Beyersbergen et al. 2009). Franklin's gulls do not nest in Missouri but pass through the state during migration. The pattern in WS' Franklin gull take reflects this movement through the state. In FY2010, WS lethally removed a

high of 67 Franklin's gulls during damage management projects. WS also harassed 2,105 Franklin's gulls in the same year. All of the Franklin's gull take and harassment occurred during two short time periods in the spring and fall. Thirty of the gulls were removed in a 20-day period between April 23 and May 13, 2010, and 37 of the gulls were removed in a 7-day period between October 16 and October 23. All 67 gulls were removed on airports.

Franklin's gulls are protected under the MBTA and take can occur pursuant to the MBTA through depredation permits issued by the USFWS. WS' take of gulls occurs under permits issued to WS or under permits issued to cooperators where WS is acting as an agent on the permit. The USFWS-authorized take of Franklin's gulls in Missouri issued to all entities is shown in Table 4.15.

Table 4.15 – Number of Franklin's gulls addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	139	4	0/0
2010	2,105	67	37/37
2011	300	46	50/12
2012	230	10	0/0
2013	541	7	10/5
Average	**663**	**27**	**19/11**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Based on the number of Franklin's gulls lethally taken from FY 2009 through FY 2013 and a reasonable anticipation of an increase in the number of requests for assistance, WS could lethally take up to 100 Franklin's gulls in Missouri as part of an integrated damage management program. WS anticipates an increase in the need to address damage and threats associated with Franklin's gulls at airports.

Direct, Indirect, and Cumulative Effects:
WS' proposed take would represent 0.01% of Beyersbergen's North American populations estimate. Based on the best scientific data, WS proposed take level will have no adverse direct effects on Franklin's gull populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 Franklin's gulls in Missouri.

Rock Pigeon Biology and Population Impacts
MO population estimate: 170,000 WS proposed take: 15,000
BBS Eastern Tall Grass Prairie, 1966-2012: -3.06% BBS Missouri, 1966-2012: -2.90%
BBS Eastern Tall Grass Prairie, 2002-2012: -2.44% BBS Missouri, 2002-2012: -3.30%
BBS Central Hardwoods, 1966-2012: -2.36%
BBS Central Hardwoods, 2002-2012: -1.98%
WS proposed take as % of state population: 8.82%

Pigeons are closely associated with humans as human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994). Thus, they are commonly found around city buildings, bridges, parks, farm yards, grain elevators, feed mills, and other man-made 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).

Since pigeons are a non-native species and are, therefore, afforded no protection under the MBTA, the take of pigeons to alleviate damage or to reduce threats can occur without the need for a depredation permit from the USFWS. WS' take of pigeons from FY 2009 through FY 2013 to alleviate damage and threats of damage on airports when requested is shown in Table 4.16.

Table 4.16 – Number of rock pigeons addressed by WS on airports from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	300	4,496
2010	167	3,455
2011	1,710	4,429
2012	3,580	3,750
2013	755	4,555
Average	**1,304**	**4,137**

[1] Data reported by federal fiscal year

Direct, Indirect, and Cumulative Effects:

Due to the gregarious behavior of pigeons (i.e., forming large flocks) and in anticipation of the number of requests for assistance by WS to alleviate damage and threats to increase, WS could annually take up to 15,000 pigeons. Based on a population estimated at 170,000 pigeons, take of up to 15,000 pigeons by WS would represent 8.82% 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 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. WS' proposed take is of a low magnitude compared with the statewide population; however, any take of invasive species can be considered a positive impact to the environment.

Based on the best scientific data, WS' proposed take level will have no adverse direct or indirect effects on pigeon populations. While non-WS take is unknown, pigeon populations have remained viable and have historically expanded their range throughout North America. Therefore, WS does not anticipate any significant cumulative impacts to pigeon populations.

Blackbird Status

The blackbird group in North America includes 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, American crows, red-winged blackbirds, brown-headed cowbirds, and common grackles are the species most commonly involved with causing damage or posing threats of damage in Missouri. The USFWS has established a Federal Depredation Order (50 CFR 21.43) for blackbirds (Sobeck 2010). Therefore, no federal permit is required to remove blackbirds, cowbirds, grackles, crows and magpies if they are 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. The USFWS could impose restrictions on depredation harvest as needed to assure cumulative take does not adversely affect the continued viability of crow populations, which should also assure that

cumulative impacts on crow populations would have no significant impact on the quality of the human environment.

Red-winged Blackbird Biology and Population Impacts

MO population estimate: 3,600,000
BBS Eastern Tall Grass Prairie, 1966-2012: -0.82%
BBS Eastern Tall Grass Prairie, 2002-2012: -2.09%
BBS Central Hardwoods, 1966-2012: -1.45%
BBS Central Hardwoods, 2002-2012: -3.01%
WS proposed take as % of state population: 13.89 %

WS proposed take: 500,000
BBS Missouri, 1966-2012: -1.13%
BBS Missouri, 2002-2012: -1.49%

Perhaps the most abundant bird in North America, the red-winged blackbird is highly adaptable to habitat change caused by humans and can be found in Missouri throughout the year (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). In Missouri, red-winged blackbirds are estimated to have a population estimated at 3,600,000 birds (PFSC 2014).

To alleviate damage and threats of damage, the WS program in Missouri has dispersed 677,661 red-winged blackbirds using non-lethal methods, primarily to alleviate damage occurring at and near airports between FY 2009 through FY 2013. A total of 665 red-winged blackbirds have been lethally removed (see Table 4.18). Based on previous requests for assistance received and in anticipation of receiving additional requests for assistance, up to 500,000 red-winged blackbirds could be taken by WS annually. Damage and threats are primarily associated with human safety at airports and military installations, as well as in agricultural settings. The difference in the actual take between FY09 to FY 13 of a total of 665 birds, and the proposed take of 500,000 birds is the anticipated additional need to address red-winged black bird damage to rice and other crops in southeast Missouri.

Table 4.17 – Number of red-winged blackbirds addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	51,060	121
2010	74,076	274
2011	512,615	97
2012	17,437	117
2013	22,473	56
Average	**135,532**	**133**

[1] Data reported by federal fiscal year

If up to 500,000 red-winged blackbirds were taken annually by WS, the take would represent 13.89% of the estimated population. The NWRC has been conducting research on blackbirds in the rice producing areas of the country including Missouri. The research area encompasses a portion of Missouri known as the "bootheel" in southeast Missouri that is part of the Mississippi Alluvial Plain. There are currently no existing BBS routes in this portion of Missouri.

NWRC estimates the number of blackbirds in rice fields from September to October just before harvest. The size of blackbird groups observed in Missouri rice fields during 2003-2005 ranged from 20,000 to 3,000,000 birds per site (Average 1,246,000). NWRC estimates that, each year, just before harvest, there are conservatively over 4 million blackbirds roosting in rice fields in this portion of Missouri. Estimated Average species composition in this area was 65% red-winged blackbirds, 25% brown-headed cowbirds and 10% common grackles. NWRC also has data on large blackbird roosts that have been in small towns in the region (Table 4.18). In the Missouri rice region, there have been winter roost numbers as high as 6,000,000 blackbirds in one location. The number of blackbirds in these roosts could go much higher depending on the type of winter, availability of food, and migration trends (J. Cummings, NWRC, pers. comm., NWRC unpublished data). To determine blackbird movement patterns, NWRC used aerial mass marking to mark 1,300,000 and 3,200,000 blackbirds in Missouri rice fields just prior to harvest (October) in 2004 and 2005, respectively. In 2004 and 2005, 71% and 90% of the recaptures were collected in Missouri during the following winters. Birds were also collected from Illinois, Tennessee, Arkansas and Louisiana. Arkansas and Louisiana were the only other states where marked birds were collected. This is a strong argument that winter blackbird baiting not only helps the towns with winter roosts, but will also benefit the farmer in the next growing season.

Table 4.18. Urban winter blackbird roosts observed in small towns in the rice growing region of Missouri and Arkansas

Year	Month	Location	Number of Birds	Species Composition
2002	January	Sikeston, MO	6,000,000	55% Red-winged Blackbirds, 20% Common Grackles, 20% Brown-headed Cowbirds, 5% Starlings
2003	January	Sikeston, MO	2,000,000	65% Red-winged Blackbirds, 20% Common Grackles, 10% Brown-headed Cowbirds, 5% Starlings
2005	January	Malden, MO	4,000,000	50% Red-winged Blackbirds, 27% Common Grackles, 20% Brown-headed Cowbirds, 3% Starlings
2005	January	Sedgwick north, AR	1,500,000	90% Red-winged Blackbirds, 10% Brown-headed Cowbirds
2005	January	Sedgwick east, AR	4,500,000	95% Red-winged Blackbirds, 5% Brown-headed Cowbirds
2006	February	New Madrid, MO	200,000	60% Red-winged Blackbirds, 10% Common Grackles, 20% Brown-headed Cowbirds, 10% Starlings
2006	January	Kennett, MO	1,000,000	60% Red-winged Blackbirds, 10% Common Grackles, 20% Brown-headed Cowbirds, 10% Starlings
2006	February	Gibson, AR	7,000,000	85% Red-winged Blackbirds, 10% Brown-headed Cowbirds, 5% Common Grackles

Direct, Indirect, and Cumulative Effects:

Given the density-dependent relationships in a blackbird population (i.e. decreased mortality and increased fecundity of surviving birds) a high number of blackbirds would likely have to be killed in order to impact the regional breeding population. Modeling by Dolbeer et al. (1995) indicated that killing 3.6% of the wintering blackbird population had no effect on breeding populations the following spring. Dolbeer et al. (1976) constructed a population model which indicated that a reduction of 14.8% of the

wintering blackbird population would reduce the spring breeding population by 20% and that a 56.2% reduction in the wintering blackbird population would reduce spring breeding populations by only 33%.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on red-winged blackbird populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 red-winged blackbirds in Missouri.

Common Grackle Biology and Population Impacts

MO population estimate: 1,800,000
BBS Eastern Tall Grass Prairie, 1966-2012: -1.25%
BBS Eastern Tall Grass Prairie, 2002-2012: -2.58%
BBS Central Hardwoods, 1966-2012: -3.16%
BBS Central Hardwoods, 2002-2012: -3.47%
WS proposed take as % of state population: 13.89 %

WS proposed take: 250,000
BBS Missouri, 1966-2012: -4.33%
BBS Missouri, 2002-2012: -4.92%

Another blackbird species commonly found in mixed species flocks is the common grackle. Common grackles are a semi-colonial nesting species often associated with human activities (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). Common grackles can be found throughout the year in Missouri with an estimated population calculated at 1,800,000 birds (PFSC 2014).

Like other blackbird species, the take of common grackles can occur under the previously referenced Federal 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. Therefore, the number of common grackles taken annually by other entities is currently unknown. To alleviate damage and threats of damage, the WS program in Missouri has dispersed 17,715 common grackles using non-lethal methods, primarily to alleviate damage occurring at and near airports from FY 2009 through FY 2013. A total of 311 common grackles were lethally removed during this time period (see Table 4.19). Based on previous requests for assistance received and in anticipation of receiving additional requests for assistance, up to 250,000 common grackles could be taken by WS annually. Damage and threats are primarily associated with human safety at and near airports and military installations, as well as in agricultural settings.

Table 4.19 – Number of common grackles addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	887	46
2010	3,974	12
2011	7,560	88
2012	4,651	95
2013	643	70
Average	**3,543**	**62**

[1] Data reported by federal fiscal year

Direct, Indirect, and Cumulative Effects:

If up to 250,000 common grackles are taken annually by WS, the take would represent 13.89% of the estimated population. Based on the best scientific data, WS proposed take level will have no adverse direct effects on common grackle populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 common grackles in Missouri.

Brown-headed Cowbird Biology and Population Impacts

MO population estimate: 3,200,000
WS proposed take: 500,000
BBS Eastern Tall Grass Prairie, 1966-2012: -0.48%
BBS Missouri, 1966-2012: -1.29%
BBS Eastern Tall Grass Prairie, 2002-2012: -0.19%
BBS Missouri, 2002-2012: -1.34%
BBS Central Hardwoods, 1966-2012: -0.97%
BBS Central Hardwoods, 2002-2012: -0.88%
WS proposed take as % of state population: 15.63 %

Brown-headed cowbirds are another species of the blackbird family commonly found in mixed species flocks during migration periods. Brown-headed cowbirds can be found during all seasons in Missouri and are a common summer resident (Lowther 1993). 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 take of brown-headed cowbirds can occur under the Federal Blackbird Depredation Order which allows blackbirds, including cowbirds, to be taken when committing damage or about to commit damage without the need for a depredation permit. Therefore, the number of cowbirds taken annually by other entities is currently unknown. To alleviate damage and threats of damage, the WS program in Missouri has dispersed 63,950 brown-headed cowbirds using non-lethal methods, primarily to alleviate damage occurring at and near airports from FY 2009 through FY 2013. A total of 8,319 cowbirds have been lethally removed during this time period (see Table 4.20). Based on previous requests for assistance received, and in anticipation of receiving additional requests for assistance, up to 500,000 brown-headed cowbirds could be lethally taken in the Missouri by WS annually. Damage threats are primarily associated with human health and safety requests on airports, as well as agricultural damage occurring.

Table 4.20 – Number of brown-headed cowbirds addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	23,981	3,074
2010	7,937	1,446
2011	21,375	3,471
2012	7,800	226
2013	2,757	102
Average	**12,790**	**1,664**

[1] Data reported by federal fiscal year

Direct, Indirect, and Cumulative Effects:

Based on the statewide population, take of up to 500,000 birds by WS to alleviate damage or threats of damage would represent 15.63% of the estimated population. Although cowbirds can cause damage or pose threats of damage, some take of cowbirds by WS would be the result of addressing flocks of mixed species of starlings and blackbirds. Given the relative abundance of brown-headed cowbirds, long-term

increasing population trends, and that WS' starling/blackbird damage management activities would only be conducted at a limited number of sites involving a very small portion of the area in the state, we conclude that the proposed action will not adversely impact the state, regional or national brown-headed cowbird population.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on brown-headed cowbird populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 brown-headed cowbirds in Missouri.

American White Pelicans Biology and Population Impacts

MO population estimate: unknown
WS proposed take: 100
BBS United States, 1966-2012: 6.24%
BBS Central Region, 1966-2012: 7.45%
BBS United States, 2002-2012: 12.95%
BBS Central Region, 2002-2012: 9.82%

WS provides assistance for several airports in Missouri including full time protection to the Air National Guard at the Rosecrans Memorial Airport in St. Joseph, MO. Rosecrans lies alongside the Missouri River and is surrounded by a partially filled oxbow lake. In the past several years, American white pelicans have occupied the oxbow lake and surrounding area during the fall migration for a few days each year. Recently in the fall of 2012, 800 to 1,000 pelicans occupied Rosecrans for three weeks causing serious safety issues with aircraft and human health and safety related to aircraft movements. One pelican strike during the fall migration of 2012 caused $130,000 dollars in damage to a C-130 cargo aircraft. The pelicans had very little response to harassment methods and would only move off of the airfield when lethal control was applied. An increased take was required by WS in order to keep pelicans away from landing and departing aircraft.

For the period of FY 2009-2013, WS dispersed between 3 to 11,774 American white pelicans per year and killed 6 and 57 in 2011 and 2013, respectively during damage management activities. No other take has been documented in Missouri.

Table 4.21 – Number of American pelican addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	Authorized Removal by All Entities[2,3]
2009	3	0/0
2010	204	0/0
2011	1,689	6/6
2012	1,478	0/0
2013	11,774	57/75
Average	**3,030**	**13/16**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Although there is no BBS data for pelican observations in Missouri, the data does show statistically significant increasing trends in the United States and Central BBS region and across the nation. The latest documented population estimate was published in 2005 by D. Tommy King and Daniel W. Anderson in Waterbirds (King D. T. and D. W. Anderson 2005). This publication documents109,000 breeding individuals in 55 colonies from 1979-81 in North America. From 1998 to 2001, King reported 67,030 nest from 42 colonies totaling 134,000 breeding pelicans in North America. When comparing surveys of

20 breeding colonies from 1979-81 to 1998-2001, King reports the number of American white pelican nests doubled.

Direct, Indirect, and Cumulative Effects:
Based upon the extended stay of American pelicans in 2012 compared to previous years, WS estimates that no more than 100 American white pelicans would be killed by WS annually. WS' proposed take falls within the authorized limit permitted by the USFWS which provides oversight for impacts from cumulative and regional take. Given that WS BDM activities are only conducted in a very small portion of the state, the proposed take represents only 0.07% of the national population, and no other take has been documents of American white pelicans in Missouri, the proposed level of pelican damage management will not adversely impact the state, regional or national American white pelican populations.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on American pelican populations. The majority of the direct operational assistance conducted by WS on American pelican would occur in the spring and fall as most of Missouri's American pelican only pass through during migration. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 American pelicans in Missouri.

American Crow Biology and Population Impacts

MO population estimate: 740,000
BBS Eastern Tall Grass Prairie, 1966-2012: 0.39%
BBS Eastern Tall Grass Prairie, 2002-2012: -1.64%
BBS Central Hardwoods, 1966-2012: 0.30%
BBS Central Hardwoods, 2002-2012: -0.14%
WS proposed take as % of state population: 0.07 %

WS proposed take: 500
BBS Missouri, 1966-2012: 0.94%
BBS Missouri, 2002-2012: -0.10%

American crows are highly adaptable and will live in any open place that offers a few trees to perch in and a reliable source of food. Crows regularly use both natural and human-created habitats, including farmlands, pastures, landfills, city parks, golf courses, cemeteries, yards, vacant lots, highway turnarounds, feedlots, and the shores of rivers, streams, and marshes. Crows tend to avoid unbroken expanses of forest, but do show up at forest campgrounds and travel into forests along roads and rivers (Verbeek and Caffrey 2002). American crows are one of the most recognizable birds in Missouri.

Large flocks of crows tend to concentrate in some areas where abundant food and roosting sites are available. 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 up to 6-12 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.

Table 4.22 – Number of American crow addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal[1]
2009	34,871	6
2010	28,488	10
2011	48,335	10
2012	14,736	44
2013	160,735	45
Average	**57,433**	**23**

[1] Data reported by federal fiscal year

Direct, Indirect, and Cumulative Effects:
Between FY 2009 and FY 2013, WS has dispersed 287,165 American crows and lethally removed a total of 115 crows in Missouri. Crow populations remain viable enough to support an annual hunting season and a Federal Blackbird Depredation Order. Based on the above information and WS' limited lethal take of crows in Missouri, WS should have minimal effects on local, statewide, regional or continental American crow populations.

Based on the best scientific data, WS proposed take level will have no adverse direct effects American crow populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 American crows in Missouri.

Horned Lark Biology and Population Impacts
MO population estimate: 400,000 WS proposed take: 350
BBS Eastern Tall Grass Prairie, 1966-2012: -2.23% BBS Missouri, 1966-2012: -3.33%
BBS Eastern Tall Grass Prairie, 2002-2012: -2.74% BBS Missouri, 2002-2012: -3.63%
BBS Central Hardwoods, 1966-2012: -1.98%
BBS Central Hardwoods, 2002-2012: -0.85%
WS proposed take as % of state population: 0.09 %
Cumulative removal as % of state population: 0.14%

All of WS' horned lark damage management activities have involved and are likely to continue to involve the reduction of risks to aircraft from bird collisions. Although horned larks are relatively small birds, weighing 1 – 1.7 ounces (28-48 g), they form large winter flocks which can be hazardous to aircraft. Because of the high speeds attained by military aircraft and the special materials used to build military aircraft, collision with even one small bird can cause substantial damage.

Direct, Indirect, and Cumulative Effects:
Because of the increasing local counts of horned larks at the primary local area where WS would work, WS anticipates a maximum annual take of 350 larks under this alternative. Given that the take of horned larks only occurs at a limited number of sites in the state, horned larks have a widespread distribution in North America, the low proportion of the population that would be taken under permits from the USFWS and that WS data indicate the local population appears to be increasing at the site where most take occurs, we conclude that this alternative would have a low level of impact on the state, regional and national horned lark population and will not contribute substantially to current population trends.

Table 4.23 – Number of horned larks addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal[3] by All Entities[2,3]
2009	1,223	59	350/57
2010	2,326	165	360/182
2011	3,450	158	260/26
2012	731	48	400/225
2013	3,163	306	255/175
Average	**2,179**	**147**	**325/133**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Based on the best scientific data, WS proposed take level will have no adverse direct effects on horned lark populations. The majority of the direct operational assistance conducted by WS on horned larks would occur in the spring, summer and fall month's as most of Missouri's horned larks migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 horned larks in Missouri.

Eastern Meadowlark Biology and Population Impacts
MO population estimate: 2,200,000 WS proposed take: 200
BBS Eastern Tall Grass Prairie, 1966-2012: -2.57% BBS Missouri, 1966-2012: -2.32%
BBS Eastern Tall Grass Prairie, 2002-2012: -2.60% BBS Missouri, 2002-2012: -2.69%
BBS Central Hardwoods, 1966-2012: -2.48%
BBS Central Hardwoods, 2002-2012: -2.89%
WS proposed take as % of state population: 0.009 %
Cumulative removal as % of state population: 0.012%

Eastern meadowlarks are relatively common and are often seen in fields and on fences in the Eastern U.S. All WS harassment and take of Eastern meadowlarks has been conducted for the prevention of bird strikes at airports. Despite decreasing population trends, BBS relative abundance estimates indicate that Eastern meadowlarks are among the ten most abundant bird species in the state.

Preferred habitats of Eastern meadowlarks include grasslands, prairies, lightly grazed pastures, mixed-grass hayfields, and fallow areas with a low percentage of forbs and less than one-third shrub cover. Dense grasses between 10-20 inches tall (medium height) seem to be used most for nesting. Eastern meadowlarks may use cropland as well, although nesting is limited by the absence of grass cover. Ideal habitats have ample perches within the site along the perimeter. Fence posts, tall forbs, shrubs, trees, and even utility wires can serve as perches. Eastern meadowlarks are area-sensitive birds, requiring at least 15-20 acres of unbroken grassland habitat for nesting.

From FY 2009 through FY 2013, a total of 4,620 Eastern meadowlarks were dispersed by WS using non-lethal methods (Table 4.24). In anticipation of damage associated with Eastern meadowlarks and the number of Eastern meadowlarks addressed previously to alleviate those threats, WS anticipates that up to 200 Eastern meadowlarks could be taken annually.

Table 4.24 – Number of Eastern meadowlarks addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	1,432	144	320/2
2010	1,342	120	300/127
2011	1,176	66	300/60
2012	453	121	300/116
2013	217	21	200/17
Average	**924**	**94**	**284/64**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Although take could occur by other entities when authorized by the USFWS through the issuance of a depredation permit, the take of Eastern meadowlarks would not likely reach a magnitude where adverse effects to Eastern meadowlarks populations would occur from take to alleviate damage or threats. The permitting of the take by the USFWS through the issuance of depredation permits pursuant to the MBTA ensures cumulative take of Eastern meadowlarks would be considered as part of population management objectives for this species.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on Eastern meadowlarks populations. The majority of the direct operational assistance conducted by WS on Eastern meadowlarks would occur in the spring, summer and fall month's as most of Missouri's Eastern meadowlarks migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 Eastern Meadowlarks in Missouri.

Barn Swallow Biology and Population Impacts
MO population estimate: 1,300,000
BBS Eastern Tall Grass Prairie, 1966-2012: -0.11%
BBS Eastern Tall Grass Prairie, 2002-2012: 0.89%
BBS Central Hardwoods, 1966-2012: -0.98%
BBS Central Hardwoods, 2002-2012: -0.56%
WS proposed take as % of state population: 0.04 %
Cumulative removal as % of state population: 0.58

WS proposed take: 500 and 500 nests
BBS Missouri, 1966-2012: -0.61%
BBS Missouri, 2002-2012: 0.05%

Barn swallows are found throughout Missouri and are considered the most common swallow in the state. They are common in open rural areas within the state and are known to nest in barns and other building, under bridges, in culverts, and along the entrance of caves (Buckelew Jr. and Hall 1994). The number of barn swallows addressed by WS and other entities is shown in Table 4.25. The majority of requests for assistance with barn swallows occur at airports and military installations, where the presence of swallows can pose risks to aviation safety.

Table 4.25 – Number of barn swallow addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	1,619	64	210/14
2010	4,373	154	200/104
2011	3,218	131	250119
2012	950	104	220/97
2013	1,561	48	540/252
Average	**2,344**	**100**	**284/117**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Like other native bird species, the take of barn swallows by WS to alleviate damage would only occur when permitted by the USFWS, pursuant to the MBTA, through the issuance of depredation permits. Therefore, the take of barn swallows by WS would only occur at levels authorized by the USFWS, which ensures cumulative take by all entities is considered prior to any action being conducted.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on barn swallow populations. The majority of the direct operational assistance conducted by WS on barn swallows would occur in the spring, summer and fall month's as most of Missouri's swallows migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 barn swallows in Missouri.

Cliff Swallow Biology and Population Impacts
MO population estimate: 200,000
BBS Eastern Tall Grass Prairie, 1966-2012: 13.71%
BBS Eastern Tall Grass Prairie, 2002-2012: 18.51%
BBS Central Hardwoods, 1966-2012: 20.76%
BBS Central Hardwoods, 2002-2012: 23.15%
WS proposed take as % of state population: 0.25 %
Cumulative removal as % of state population: 0.25%

WS proposed take: 500 and 500 nests
BBS Missouri, 1966-2012: 22.06%
BBS Missouri, 2002-2012: 20.89%

The majority of requests for assistance with cliff swallows occur at airports and military installations, where the presence of swallows can pose risks to aviation safety. The number of cliff swallows addressed by WS and other entities is shown in Table 4.27.

In 2014, WS received two requests to assist with cliff swallows. The large power plant in Missouri requested assistance to reduce the presence and potential damage due to the presence of cliff swallows. For several years, cliff swallows have nested in areas in and near large air flow vents that are used to cool the turbine building. The nuclear plant has been told by the Nuclear Regulatory Commission that the nests create a potential hazard and need to be removed. WS is in the process of making a structural recommendation as well as providing recommendations to reduce the number of birds at the site. In 2014, the plant implemented maintenance procedures that include washing the problem areas every other day to prevent birds from utilizing these locations for nesting.

The second request for assistance came from the state highway department. They requested assistance for the help in applying for depredation permits and management plans to allow for the maintenance and

replacement of bridges during the swallow nesting season. Bridge maintenance and replacement occurs during the spring, summer and fall each year. Many times this work is delayed due to migratory bird nesting activity under bridges. WS worked with the highway department to implement a "no nest policy" on bridges after March 15. This policy required construction crews to wash bridges that were scheduled for repairs during the swallow nesting season every other day to prevent the birds from building nests on the site. Depredation permits were also issued to each bridge site to allow for the removal of any nests that were not discovered by construction crews before the nest was completed. On one occasion in 2014, the highway department requested WS to assist with removing nests from a bridge that was planned for deck replacement the following week.

Table 4.26 – Number of cliff swallow addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Authorized Removal/Take by All Entities[2,3]
2009	600	1	60/1
2010	0	6	20/6
2011	0	0	20/0
2012	0	20	0/0
2013	65	2	0/0
Average	**133**	**5.8**	**20/1**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Like other native bird species, the take of cliff swallows by WS to alleviate damage would only occur when permitted by the USFWS, pursuant to the MBTA, through the issuance of depredation permits. Therefore, the take of cliff swallows by WS would only occur at levels authorized by the USFWS, which ensures cumulative take by all entities is considered prior to any action being conducted.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on cliff swallows populations. The majority of the direct operational assistance conducted by WS on cliff swallows would occur in the spring, summer and fall month's as most of Missouri's cliff swallows migrate during the winter. Additionally, the potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. 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 cliff swallows in Missouri.

House Sparrow Biology and Population Impacts
MO population estimate: 1,800,000
BBS Eastern Tall Grass Prairie, 1966-2012: -3.93%
BBS Eastern Tall Grass Prairie, 2002-2012: -3.35%
BBS Central Hardwoods, 1966-2012: -4.50%
BBS Central Hardwoods, 2002-2012: -2.79%
WS proposed take as % of state population: 0.28 %

WS proposed take: 5,000 and 500 nests
BBS Missouri, 1966-2012: -5.82%
BBS Missouri, 2002-2012: -3.36%

House sparrows were introduced to North America from England in 1850 and have spread throughout the continent (Fitzwater 1994). Nesting locations often occur in areas of human activities and are considered "*...fairly gregarious at all times of year*" with nesting occurring in small colonies or clumped distribution (Lowther and Cink 2006). Large flocks of sparrows can also be found in the winter as birds forage and roost together. Because of their negative effects on and competition with native bird species, house

sparrows are considered by many wildlife biologists, orinthologists, and naturalists to be an undesirable component of North American ecosystems. Since house sparrows are an introduced, rather than native species, they are not protected by the MBTA, and take of house sparrows does not require depredation permits issued by either the USFWS. Executive Order 13112 states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and 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.

Direct, Indirect, and Cumulative Effects:

From FY 2009 through FY 2013, WS lethally removed an Average of twenty house sparrows per year (see Table 4.27) to alleviate damage and threats of damage, primarily associated with aviation safety and agriculture. Since house sparrows are afforded no protection under the MBTA, depredation permits are not needed for the take of these birds and the reporting of take is not required. Therefore, the number of sparrows lethally removed by other entities is unknown.

Table 4.27 – Number of house sparrows addressed by WS from FY 2009 through FY 2013

Year	Dispersed by WS[1]	WS Removal
2009	2	97
2010	0	43
2011	17	17
2012	0	50
2013	132	110
Average	**30.2**	**63**

[1] Data reported by federal fiscal year

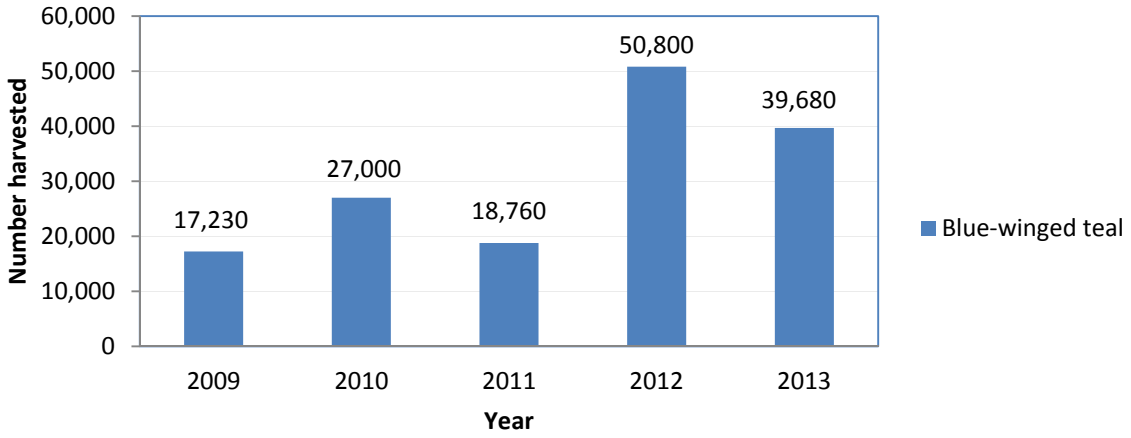
The annual take of house sparrows by other entities is currently not known. Since house sparrows are a non-native species that often competes with native birds for food and habitat, any take could be viewed as providing some benefit to the native environment in Missouri. WS' take of house sparrows to reduce damage and threats would be in compliance with Executive Order 13112.

Blue-winged teal Biology and Population Impacts

MO population estimate: Unknown
BBS Eastern Tall Grass Prairie, 1966-2012: -0.74%
BBS Eastern Tall Grass Prairie, 2002-2012: 9.55%
WS proposed take: 100
BBS Missouri, 1966-2012: -20.91%
BBS Missouri, 2002-2012: -18.11%

In Missouri, blue-winged teal can be found during the spring and fall migrations. Like other waterfowl species, blue-winged teal can be harvested during a regulated season. The estimated numbers of teal harvested from 2009 through 2013 during the annual hunting season are shown below in Figure 4.28. An estimated 153,470 blue-winged teal were harvested from 2009 to 2013.

Figure 4.28 - Number of blue-winged teal harvested in Missouri during the waterfowl season, 2009-2013



In addition to the take of blue-winged teal during the hunting season, a total of 50 blue-winged teal have been lethally removed by WS from FY 2009 through FY 2013. Based on the number of requests received for assistance previously and in anticipation of additional efforts to address damage or threats of damage, primarily at additional airports and military installations, an annual take of up to 100 blue-winged teal could occur under the proposed action. As with other waterfowl species, blue-winged teal can be found in large numbers during the winter and during the migration periods. When those large flocks occur on or near airports, they can pose aircraft strike risks.

Table 4.29 – Number of blue-winged teal addressed in Missouri from FY 2009 to FY 2013

Year	Dispersed by WS[1]	Depredation Permits	
		WS Removal[1,3]	Authorized Removal by All Entities[2,3]
2009	1,470	4	30/3
2010	1,809	5	10/4
2011	1,201	5	20/2
2012	1,133	15	108
2013	1,997	21	40/15
Average	**1,522**	**10**	**22/6**

[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

***Direct, Indirect, and Cumulative Effects*:**
Take of 100 blue-winged teal would represent 0.25% of the 39,677 blue-winged teal harvested during the 2013 waterfowl harvest season (Raftovich et al. 2014). Based on the best scientific data, WS proposed take level will have no adverse direct effects on blue-winged teal populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. Additionally, WS' removal will not inhibit the opportunity for sportsmen to harvest teal during the hunting season. 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 blue-winged teal in Missouri.

Snowy Owl Biology and Population Impacts
Snowy owls breed in open terrain of the artic barrens from the Aleutian Islands along the northern edge of Alaska, throughout the Canadian Arctic Islands and from northern Yukon, northeastern Manitoba, northern Quebec, and northern Labrador (Parmelee 1992). They can be found in similar open habitats during their winter migrations. During the winter migrations, snowy owls can be found across Canada, Alaska, and the northern edge of the United States (Parmelee 1992). The open habitats of airports provide ideal wintering areas for snowy owls. Their low-flying behavior, along with their large size and body mass, (Parmelee 1992) makes them a significant hazard for a damaging strike (Dolbeer et al. 2013). The number of snowy owls observed during the CBC across all areas surveyed in the United States has shown a variable trend over the past 20 years (NAS 2010). There are no breeding or year-round populations of snowy owls within Missouri, and population trend data is limited and long-term data is lacking (Parmelee 1992).

Between 1990 and 2012, there have been 84 reported civil aircraft strikes involving snowy owls in the U.S. (Dolbeer et al. 2013). Unfortunately, snowy owls generally become easily habituated to harassment measures and quickly become non-responsive, moving only a short distance or not at all. Thus, additional methods for wildlife hazard management may be necessary. As part of an integrated approach to reducing threats, WS would first employ non-lethal methods (e.g., pyrotechnics, aversive noise, trap/relocate) to disperse or move snowy owls when appropriate and safe. If snowy owls are deemed an immediate threat to aviation safety (e.g., flying along an active runway) or if repeated non-lethal methods have failed, WS may need to implement lethal removal options.

Direct, Indirect, and Cumulative Effects:
Based on surveys at Missouri airports and recent influxes of owls arriving at airports, WS anticipates banding and relocating less than 10 snowy owls annually. Lethal removal of snowy owls will only be allowed by permit and permission from the Wildlife Service's Regional Office. WS anticipates removing no more than five snowy owls each year. It is important to note that no snowy owls have ever been removed at a Missouri airport. The live-capture and translocation of owls to appropriate habitat would not adversely affect populations since the owls would be unharmed. Permitting by the USFWS ensure that cumulative impacts are within allowable take levels.

Additional Target Species
Target species, in addition to those species analyzed above, have been lethally taken in small numbers by WS and have included no more than 20 individuals and/or no more than 20 nests of the following species: common loons, pied-billed grebes, herring gulls, brown pelicans, snowy egrets, little blue herons, cattle egrets, great egrets, green herons, black-crowned night herons, snow geese, gadwall, American wigeons, Northern shovelers, wood ducks, Northern pintails, canvasbacks, redheads, ring-necked ducks, green-winged teal, greater scaup, lesser scaup, buffleheads, common goldeneyes, hooded mergansers, common mergansers, red-breasted mergansers, ruddy ducks, ring-necked pheasants, Northern bobwhites, common moorhens, wild turkeys, American coots, greater yellowlegs, lesser yellowlegs, least sandpipers, common snipes, Wilson's snipes, field sparrow, savanna sparrows, upland sandpipers, American woodcocks, lapland longspurs, purple martins, Northern mockingbirds, nighthawks, common terns, least terns, chimney swifts, belted kingfishers, monk parakeets, red-bellied woodpeckers, downy woodpeckers, hairy woodpeckers, Northern flickers, house finches, purple finches, scissor-tailed flycatchers, Eastern kingbirds, blue jays, bank swallows, American robins, gray catbirds, sandhill cranes, Eurasian collared doves, Coopers hawks, Northern harriers, ospreys, barred owls, great horned owls, short-eared owls, rough-legged hawks, sharp-shinned hawks, Swainson's hawks, black vultures, and snow buntings.

Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, no more than 20 individuals and 20 nests (and eggs) of any of those species could be taken annually by WS. None of those bird species are expected to be taken by WS at any level that would

adversely affect populations of those species. Most of those birds listed are afforded protection under the MBTA and take is only allowed through the issuance of a depredation permit and only at those levels stipulated in the permit. Therefore, those birds would be taken in accordance with applicable state and federal laws and regulations authorizing take of migratory birds and their nests and eggs, including the USFWS. The USFWS, as the agency with management responsibility for migratory birds, could impose restrictions on depredation take as needed to assure cumulative take does not adversely affect the continued viability of populations. This would assure that cumulative impacts on these bird populations would have no significant adverse impact on the quality of the human environment.

Gadwall, American wigeons, Northern shovelers, wood ducks, Northern pintails, canvasbacks, redheads, ring-necked ducks, blue-winged teal, green-winged teal, greater scaup, lesser scaup, buffleheads, common goldeneyes, hooded mergansers, common mergansers, red-breasted mergansers, ruddy ducks, snow geese, ring-necked pheasants, Northern bobwhite, common moorhens, and American coots maintain sufficient population densities to allow for annual harvest seasons. The proposed take of up to 20 individuals of those species, including up to 20 nests, under the proposed action would be a minor component of the annual take of those species during the regulated hunting seasons.

Some of the species of birds addressed in this EA are listed as threatened, endangered, or species of concern by the MDC. Take of these species would only occur with approval by the USFWS and consultation with the MDC. The complete list of the state-listed wildlife in Missouri can be found in Appendix E. None of those species are federally-listed by the USFWS and/or the National Marine Fisheries Service pursuant to the ESA. However, the complete list of federally protected species found in Missouri is listed in Appendix C.

Summary

Evaluation of WS' activities relative to wildlife populations indicated that program activities will likely have no cumulative adverse effects on populations in Missouri. WS' actions would be occurring simultaneously, over time, with other natural processes and human-generated changes that are currently taking place. Those activities include, but are not limited to:

- Natural mortality of wildlife
- Human-induced mortality through private damage management activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in population densities

All those factors play a role in the dynamics of wildlife 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. WS' actions to minimize or eliminate damage are constrained as to scope, duration and intensity, for the purpose of minimizing or avoiding impacts to the environment. WS evaluates damage occurring, including other affected elements and the dynamics of the damaging species; determines appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process 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.

Wildlife Disease Surveillance and Monitoring

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk

assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups.[8] Current information on disease distribution and knowledge of the mixing of birds in migratory flyways has been used to develop a prioritized sampling approach based on the major North American flyways. Surveillance data from all of those areas would be incorporated into national risk assessments, preparedness and response planning to reduce the adverse impacts of a disease outbreak in wild birds, poultry, or humans.

To provide the most useful information and a uniform structure for surveillance, five strategies for collecting samples in birds have been proposed (USDA 2005). Those strategies include:

Investigation of Illness/Death in Birds: A systematic investigation of illness and death in wild birds may be conducted to determine the cause of the illness or the cause of death in birds. This strategy offers the best and earliest probability of detection if a disease is introduced by migratory birds into the United States. Illness and death involving wildlife are often detected by, or reported to natural resource agencies and entities. This strategy capitalizes on existing situations of birds without additional birds being handled or killed.

Surveillance in Live Wild Birds: This strategy involves sampling live-captured, apparently healthy birds to detect the presence of a disease. Bird species that represent the highest risk of being exposed to, or infected with, the disease because of their migratory movement patterns (USDA 2005), or birds that may be in contact with species from areas with reported outbreaks would be targeted. Where possible, this sampling effort would be coordinated with local projects that already plan on capturing and handling the desired bird species. Coordinating sampling with ongoing projects currently being conducted by state and federal agencies, universities, and others maximizes use of resources and minimizes the need for additional bird capture and handling.

Surveillance in Hunter-harvested Birds: Check stations for waterfowl hunting or other harvestable bird species provide an opportunity to sample dead birds to determine the presence of a disease, and supplement data collected during surveillance of live wild birds. Sampling of hunter-killed birds would focus on hunted species that are most likely to be exposed to a disease; have relatively direct migratory pathways from those areas to the United States; commingle in Alaska staging areas with species that could bring the virus from other parts of the world;

Sentinel Species: Waterfowl, gamefowl, and poultry flocks reared in backyard facilities may prove to be valuable for early detection and used as for surveillance of diseases. Sentinel duck flocks may also be placed in wetland environments where they are potentially exposed to and infected with disease agents as they commingle with wild birds.

Environmental Sampling: Many avian diseases are released by waterfowl through the intestinal tract and can be detected in both feces and the water in which the birds swim, defecate, and feed. This is the principal means of virus spread to new birds and potentially to poultry, livestock, and humans. Analysis of water and fecal material from certain habitats can provide evidence of diseases circulating in wild bird populations, the specific types of diseases, and pathogenicity. Monitoring of water and/or fecal samples gathered from habitat is a reasonably cost effective, technologically achievable means to assess risks to humans, livestock, and other wildlife.

[8]Data collected by organizations/agencies conducting research and monitoring will provide a broad species and geographic surveillance effort.

Direct, Indirect, and Cumulative Effects:
Under the disease sampling strategies listed above that could be implemented to detect or monitor avian diseases in the United States, WS' implementation of those sampling strategies would not adversely affect avian populations in the state. Sampling strategies that could be employed involve sampling live-captured birds that could be released on site after sampling occurs. The sampling (e.g., drawing blooding, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse effects since those birds are released unharmed on site. In addition, sampling of sick, dying, or hunter harvested birds would not result in the additive lethal take of birds that would not have already occurred in the absence of a disease sampling program. Therefore, the sampling of birds for diseases would not adversely affect the populations of any of the birds addressed in this EA nor would result in any take of birds that would not have already occurred in the absence of disease sampling (e.g., hunter harvest).

Alternative 2 - Bird Damage Management by WS using only Non-lethal Methods

Under this alternative, WS would not use lethal methods to resolve bird damage problems. Although some unintentional mortality might result from the use of bird capture devices like mist nets, these incidents are likely to be rare and would have negligible impacts on target species populations. Individuals, agencies and organizations would still be able to obtain permits for lethal bird removal from the USFWS. Efforts to reduce or prevent damage and risks to livestock and/or human health and safety risks would likely be higher than with Alternative 1. If BDM is conducted by individuals with limited training or experience, it is possible that additional birds may be taken in the course of attempts to resolve damage problems.

Direct, Indirect, and Cumulative Effects:
Depending upon the experience, training and methods available to the individuals conducting the BDM, potential adverse direct and indirect impacts on target bird populations would likely be the same or greater than with Alternative 1. However, for the same reasons shown under Alternative 1, it is unlikely that significant adverse direct or indirect effects would occur to target species' by implementation of this alternative. Direct and indirect impacts and potential risks of illegal toxicant use would be greater under this alternative than Alternative 1. DRC-1339 and Alpha-chloralose are currently only available for use by WS employees and would not be available under this alternative, although Starlicide, a product similar to DRC-1339 would be available for use by licensed pesticide applicators. It is possible that frustration caused by the inability to reduce damage by the public would lead to illegal use of toxicants which could increase adverse direct, indirect, or cumulative effects, however to an unknown degree. Because WS would be able to provide assistance with non-lethal BDM, risks of adverse cumulative impacts from actions by non-WS entities are lower than with Alternative 3.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct bird damage management activities. WS would have no direct involvement with any aspect of addressing damage caused by birds and would provide no technical assistance. No removal of birds by WS would occur. Birds could continue to be lethally removed to resolve damage and/or threats occurring either through depredation permits issued by the USFWS, under the blackbird and cormorant depredation orders, under the control order for Muscovy ducks, during the regulated hunting seasons, or in the case of non-native species, removal could occur anytime using legally available methods. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Direct, Indirect, and Cumulative Effects:
Local bird populations could decline, stay the same, or increase depending on actions taken by those persons experiencing bird damage. The direct and indirect effects on bird populations would be variable

and unknown. 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 direct or indirect impacts similar to the proposed action.

Since birds would still be removed under this alternative, the potential direct, indirect, and cumulative effects on the populations of those bird species would be similar among all the alternatives for this issue. WS' involvement would not be additive to removal 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, and therefore the cumulative impact on those bird species could be similar to Alternative 1.

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

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 effects to non-targets occur 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.

WS personnel 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-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety. From FY 2009 through FY 2013, the WS program in Missouri unintentionally killed one American crow, two mourning doves, one common grackle, one coopers hawk, one great blue heron and one Northern mockingbird. In addition, 27 mourning doves were released from cage traps, one Coopers hawk was released from a decoy trap, and three Eastern meadowlarks were released from a raptor trap and released unharmed.

Direct, Indirect, and Cumulative Effects:
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 removal of unintended species. Those occurrences are rare and should not affect the overall populations of any species under the proposed action. WS' removal of non-target species during activities to reduce damage or threats to human safety associated with birds is expected to be extremely low to non-existent. WS would monitor the removal of non-target species to ensure program activities or methodologies used in bird damage management do not create direct effects on non-target populations. 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 MDC any non-target removal to ensure removal 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.

Non-lethal methods have the potential to cause adverse direct effects to non-targets primarily through exclusion, harassment, and dispersal. 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 dispersed from an area while employing non-lethal dispersal techniques. However, like target species, the potential direct impacts on non-target species are expected to be temporary with target and non-target species often returning after the cessation of dispersal methods. Non-lethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (e.g., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal methods are generally regarded as having minimal direct impacts on overall populations of wildlife since individuals of those species are unharmed. 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, if the area is large enough, adverse indirect effects on non-target species may occur, but these are expected to be minimal. The use of non-lethal methods would not have significant adverse impacts on non-target populations under any of the alternatives.

Other non-lethal methods available for use under this alternative include live traps, nets, nest/egg destruction, translocation, and repellents. Live traps (e.g., cage traps, walk-in traps, decoy traps) and nets restrain wildlife once captured and are considered live-capture methods. Live traps have the potential to capture non-target species. Trap and net placement in areas where target species are active and the use of target-specific attractants would likely minimize the capture of non-targets. If traps and nets are attended to appropriately, most non-targets captured can be released on site unharmed. Therefore, no direct effects are expected on non-targets.

Only those repellents registered with the EPA pursuant to the FIFRA and registered for use in the state would be recommended and used by WS under this alternative. Therefore, the use and recommendation of repellents would not have negative direct or indirect effects 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. Methyl anthranilate has been used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants like aloe. Anthraquinone can be 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. 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 create adverse direct effects on non-targets based on restrictions on baiting locations.

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 effects to non-targets would be expected from the use of alpha chloralose.

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 shooting and DRC-1339. In addition, birds could be euthanized once live-captured by other methods. Available methods and the application of those methods to resolve bird damage is further discussed in Appendix C.

The use of firearms is essentially selective for target species since animals are identified prior to application; therefore, no adverse direct or indirect effects to non-targets would be 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 direct or indirect effects 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.

During the migration period, eagles occur throughout the United States and parts of Mexico (Buehler 2000). Under the Bald and Golden Eagle Act, activities that could result in the "take" of eagles cannot occur unless the United States Fish and Wildlife Service allow those activities to occur through the issuance of a permit. Take could occur through purposeful take (e.g., harassing an eagle from an airport using pyrotechnics to alleviate aircraft strike hazards) or non-purposeful take (e.g., unintentionally capturing an eagle in a trap). Both purposeful take and non-purposeful take require a permit from the United States Fish and Wildlife Service (see 50 CFR 22.26, 50 CFR 22.27). In those cases where purposeful take could occur or where there is a high likelihood of non-purposeful take occurring, WS would apply for a permit for those activities.

However, routine activities conducted by WS' personnel under the proposed action alternative could occur in areas where bald eagles were present, which could disrupt the current behavior of an eagle or eagles that were nearby during those activities. As discussed previously, "take" as defined by the Bald and Golden Eagle Protection Act, include those actions that "disturb" eagles. Disturb has been defined under 50 CFR 22.3 as those actions that cause or are likely to cause injury to an eagle, a decrease in productivity, or nest abandonment by substantially interfering with their normal breeding, feeding, or sheltering behavior.

WS has reviewed those methods available under the proposed action alternative and the use patterns of those methods. The routine measures that WS conducts would not meet the definition of disturb requiring a permit for the non-purposeful take of bald eagles. The USFWS states, "Eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before an eagle pair nesting in a given area. For instance, if eagles build a nest near your existing home, cabin, or place of business you do not need a permit" (USFWS 2012). Therefore, activities that are species specific and are not of a duration and intensity that would result in disturbance as defined by the Act would not result in non-purposeful take. Activities, such as walking to a site, discharging a firearm, or riding an ATV along a trail, generally represent short-term disturbances to sites where those activities take place. WS would conduct activities that were located near eagle nests using the National Bald Eagle Management Guidelines (USFWS 2007). The categories that would encompass most of these activities are Category D (Off-road vehicle use), Category F (Non-motorized recreation and human entry), and Category H (Blasting and other loud, intermittent noises). These categories generally call for a buffer of 330 to 660 feet for category D and F, and a ½-mile buffer for category H. WS would take active measures to avoid

disturbance of bald eagle nests by following the National Bald Eagle Management Guidelines. However, other routine activities conducted by WS do not meet the definition of "disturb" as defined under 50 CFR 22.3. Those methods and activities would not cause injuries to eagles and would not substantially interfere with the normal breeding, feeding, or sheltering behavior of bald eagles.

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 limit the likelihood that non-target species would consume treated bait since some bait types are not preferred by non-target species.

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 treated bait to be present only when birds are conditioned to be present at the site and provides a higher likelihood that treated bait would be consumed by the target species, which makes it unavailable to non-targets. In addition, many bird species 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. Any treated bait remaining at the location after target birds had finished feeding would be removed to avoid attracting non-targets. WS would retrieve all dead birds to the extent possible following treatment with DRC-1339.

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, Jr. 1972) and low toxicity to most mammals, sparrows, and finches (Schafer, Jr. and Cunningham 1966, Apostolou 1969, Schafer, Jr. 1972, Schafer, Jr. 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})[9] 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, 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 (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 derive acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine

[9] 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.

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 the 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 that 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.

DRC-1339 is rapidly metabolized and excreted and does not bioaccumulate, which probably accounts for its low secondary hazard profile (Schafer, Jr. 1991). For example, cats, owls, and magpies would be at risk only after exclusively eating DRC-1339-poisoned starlings for 30 continuous days (Cunningham et al. 1979). No probable risk is expected to American kestrels based on the low hazard quotient value for marsh hawks used as a surrogate species (Schafer, Jr. 1970). 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. 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 (EPA 1995). Therefore, WS does not expect any adverse indirect effects on non-target species through chemical contamination from soil or water supplies.

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.

Summary

WS does not anticipate any adverse cumulative impacts on non-target species from the implementation of the proposed bird damage management methods. Based on the methods available to resolve bird damage and/or threats, WS does not anticipate the number of non-targets removed to reach a magnitude where declines in those species' populations would occur. Therefore, removal under the proposed action of non-targets will not create adverse cumulative effects on non-target species. DRC-1339 and alpha chloralose are currently only available for use by WS employees; therefore, no adverse cumulative impacts are expected from the use of these chemicals due to no additional contribution of these chemicals into the environment from non-WS entities. Starlicide, a product similar to DRC-1339, would be available for use by licensed pesticide applicators. However, no adverse cumulative impacts are expected because Starlicide has a similar hazard profile to DRC-1339.

The proposed bird damage management could benefit many other wildlife species that are impacted by predation or competition for resources. For example, crows are generally very aggressive nesting area colonizers and will force other species from prime nesting areas. American crows often feed on the eggs, nestlings, and fledglings of other bird species. 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 minimization measures. 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 Missouri as determined by the USFWS was obtained and reviewed during the development of this EA. Appendix D contains the list of species currently listed in the state along with common and scientific names. Based on a review of those T&E species, WS has determined that activities conducted pursuant to the proposed action would have "No Effect" on those species listed or their critical habitats.

State Listed Species – The current list of species designated as endangered, threatened, or special concern by the state, as determined by the MDC, was obtained and reviewed during the development of the EA (see Appendix E). Based on the review of species listed, WS has determined that the proposed activities would not likely adversely affect those species currently listed by the state. Cumulative impacts would be insignificant on non-targets from any of the alternatives discussed.

The only potential T&E species risks from goshawk traps would be to state and federally-listed birds, particularly raptors and shorebirds. In general, WS will avoid using these devices in areas where state or federally listed species are known to occur. Additionally, these devices are only used when WS personnel are in attendance at the site and closely monitoring the capture devices. WS personnel are trained in the identification of state and federally listed birds that could be caught in these devices, and they will remove/deactivate the devices if state or federally listed birds are observed in the area where the device is in use. WS may subsequently switch to a capture device that does not pose a risk to the state or federally listed bird and/or switch time or location of activities to avoid capturing a T&E species. Therefore, we conclude that the inclusion of these methods in WS' BDM program will not adversely affect state listed species.

Alternative 2 - Bird Damage Management by WS using only Non-lethal Methods

Under this alternative, risks to non-target species from WS actions would likely be limited to the use of frightening devices, exclusionary devices, and the risks of unintentional capture of a bird in a live-capture device as outlined under Alternative 1. Although the availability of WS assistance with non-lethal BDM methods could decrease incentives for non-WS entities to use lethal BDM methods, non-WS efforts to reduce or prevent damage could result in less experienced persons implementing bird damage management methods and lead to a greater removal of non-target wildlife.

Direct, Indirect, and Cumulative Effects:
Similar to Alternative 3, it is possible that frustration from the resource owner due to the inability to reduce losses could lead to illegal use of toxicants, or other non-specific damage management methods by others could lead to unknown direct or indirect effects to non-target species populations, including T&E species (Appendix D). Hazards to T&E species could be more variable under this alternative than Alternative 1. Potential direct or indirect effects to non-target species could therefore be greater under this alternative if methods that are less selective or toxicants that cause secondary poisoning are used by non-WS entities. Direct effects on non-targets from non-lethal methods of bird damage management conducted by WS would be similar to Alternative 1. Since WS would be able to employ non-lethal methods under this alternative, indirect effects on non-target species could occur when implementing exclusionary devices if the area is large enough, but these indirect effects are expected to be minimal. The ability to reduce negative effects 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 BDM programs. It is possible that frustration caused by the inability to reduce losses would lead to non-specific damage management methods or illegal use of toxicants by others which could increase adverse cumulative impacts, however to unknown degree. While cumulative impacts would be variable, WS does not anticipate any significant cumulative impacts from this alternative.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, birds could continue to be removed under depredation permits issued by the USFWS and the MDC, removal would continue to occur during the regulated harvest season, non-native bird species could continue to be removed without the need for a permit, blackbirds and cormorants could still be removed under the depredation orders, and Muscovy ducks could be lethally removed under the control order. 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 people 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.

Direct, Indirect, and Cumulative Effects:
Under this alternative, WS would not be directly involved with damage management activities. Therefore, no direct or indirect impacts to non-targets or T&E species would occur by WS under this alternative. The ability to reduce damage and threats of damage caused by birds to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to non-targets and T&E species would be similar across the alternatives since most of those methods described in Appendix C would be available across the alternatives. If those methods available were applied as intended, direct, indirect, and cumulative effects to non-targets would be minimal to non-existent. If methods available were 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 were not legally available for use, direct, indirect, and cumulative effects on 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 removal of non-target wildlife (e.g., White et al. 1989, USFWS 2001, FDA 2003). Therefore, adverse direct, indirect, or cumulative impacts to non-targets, including T&E species, could occur under this alternative; however WS does not anticipate any significant cumulative impacts.

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

A common concern is the potential adverse effects that available methods 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)

The cooperator requesting assistance is made aware through a MOU, cooperative service agreement, inter-agency agreement, or a similar document that those methods 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.

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. 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 by 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 MDC. Although some formulations of the avicide DRC-1339 are restricted to use by WS only, a similar product containing the same active ingredient as DRC-1339 could be made available for use as a restricted use pesticide by other entities.

WS' employees who conduct activities would be knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by birds. Prior to and during the utilization of lethal methods, WS' employees would consider risks to human safety based on location and method. Risks to human safety from the use of methods would likely be greater in urban areas when compared to rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property is controlled and monitored, the risks to human safety from the use of methods would likely be less. 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. Activities would generally be conducted when human activity is minimal (e.g., early mornings, at night) or in areas where human activities are minimal (e.g., in areas closed to the public).

The use of live-capture traps has 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 used to capture birds require direct contact to cause bodily harm.

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; thereby, limiting exposure of the public to misuse of the method.

Safety issues can arise related to misusing firearms and the potential human hazards associated with firearm use when employed to reduce damage and threats. 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 were 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 were considered before the use of firearms was deemed appropriate. All methods, including firearms, must be agreed upon with the cooperator to ensure the safe use of methods.

All WS' personnel who handle and administer chemical methods would be properly trained in the use of those methods. Training and adherence to agency directives would ensure the safety of employees applying chemical methods. Birds euthanized by WS or taken using chemical methods would be disposed of in accordance with WS Directive 2.515 and applicable federal and state permits. 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 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 be directly used by WS under this alternative would also be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. WS' involvement, either through recommending the use of repellents or the direct use of

repellents, would ensure that label requirements of those repellents are discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through WS' participation.

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 Missouri, but will be evaluated in this assessment as a repellent that could be employed under the proposed action if the product becomes available. Human safety risks associated with the use of Mesurol occur primarily to the mixer and handler during preparation. WS' personnel would 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.

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 Missouri is DRC-1339 (3-chloro-p-toluidine hydrochloride) that could be used for bird damage management. 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.

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 abandoned), 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 were determined, treated baits would be placed in feeding stations or would be 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 would be monitored for non-target activity and to ensure the safety of the public. After each baiting session, all uneaten bait would be retrieved. The prebaiting period allows treated bait to be placed at a location only when target birds were conditioned to be present at the site and provides a higher likelihood that treated bait would be 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 had been consumed by target species or was removed by WS, then treated bait would no longer be available and human exposure to the bait could not 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 during the development of this assessment occurred from November to March with no daily take (bag) limit or possession limit. Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur during the period of time when crows can be harvested. Although baiting could occur in rural areas during those periods, most requests for assistance to manage crow damage during the period of time when crows can be harvested 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.

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, 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 within 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 $\leq$ 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.

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 MDC 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 bird populations, which could then reduce damage or threats would not increase risks to human safety. Safety requirements established by the MDC 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.

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. 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 is the potential for human consumption of meat from waterfowl that have been immobilized using alpha chloralose. 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 waterfowl. Waterfowl are conditioned to feed during a period in the day when consumption of treated bait ensures waterfowl do not disperse from the immediate area where the bait is applied. The use of immobilizing drugs and reproductive inhibitors targets waterfowl in urban environments where hunting and the harvest of waterfowl 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 waterfowl to leave the immediate area where baiting is occurring after consuming bait and enter areas where hunting could occur. To mitigate this risk, withdrawal times are often established. A withdrawal time is the period established between when the animal consumed treated bait to when it is safe to consume the meat of the animal by humans. 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 was requested to immobilize waterfowl during a period of time when harvest of waterfowl was occurring or during a period of time where a withdrawal period could overlap with the start of a harvest season, WS would not use the immobilizing drugs. In those cases, other methods would be employed.

Direct, Indirect, and Cumulative Effects:

No adverse direct or indirect effects to human safety have occurred from WS' use of methods to alleviate bird damage from FY 2009 through FY 2013. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, is considered low. No adverse direct effects to human health and safety are expected through the use of live-capture traps and devices or other non-lethal methods. Since WS personnel are required to complete and maintain firearms safety training, no adverse direct effects to human health and safety are expected as a result of the misuse of firearms by WS personnel. Additionally, all WS personnel are properly trained on all chemicals handled and administered in the field, ensuring their safety as well as the safety of the public. Therefore, adverse direct effects to human health and safety from chemicals used by WS are anticipated to be very low. The amount of chemicals used or stored by WS and cooperating agencies would be minimal to ensure human safety. No adverse indirect effects are anticipated from the application of any of the chemicals available for WS. According to the hazard profile for DCR-1339, it is not likely to cause contaminant of the water supply, especially when used in accordance to label requirements. Based on potential use patterns, the chemical and physical characteristics of the above mentioned toxicants and repellents, and factors related to the environmental fate, no cumulative impacts are expected from the chemical components used or recommended by the WS program in Missouri. Since DCR-1339 and alpha chloralose are only available to WS and Starlicide, which is available to licensed pesticide applicators, has a similar hazard profile to DCR-1339, WS does not anticipate any adverse cumulative impacts to human health and safety from the use of these chemicals. Since the MDC requires hunter and trapper safety training for all hunters and

trappers, WS does not expect any additional adverse cumulative impacts to human safety from the use of firearms when recommending that birds be harvested during regulated hunting seasons to help alleviate damage.

Alternative 2 - Bird Damage Management by WS using only Non-lethal Methods

Under this alternative, WS would not use lethal BDM methods. Concerns about human health risks from WS' use of lethal bird damage management methods would be alleviated because no such use would occur. However, Avitrol and the toxicant "Starlicide" which has the same active ingredient as DRC-1339 would be available to licensed pesticide applicators. Benefits to the public from WS BDM activities will depend on the ability of WS to resolve problems using non-lethal methods and the effectiveness of non-WS BDM efforts. In situations where risks to human health and safety from birds cannot be resolved using nonlethal methods, benefits to the public will depend on the efficacy of non-WS use of lethal BDM methods. If lethal BDM programs are implemented by individuals with less experience than WS, they may not be able to effectively resolve the problem or it may take longer to resolve the problem than with a WS program.

Direct, Indirect, and Cumulative Effects:
Since most methods available to resolve or prevent bird damage or threats are available to anyone, the direct, indirect, and cumulative effects to human safety from the use of those methods are similar between the alternatives. Private efforts to reduce or prevent damage would be expected to increase, and would likely result in less experienced persons implementing chemical or other damage management methods which may have variable adverse direct, indirect, and/or cumulative effects to human and pet health and safety than under Alternative 1. Ignorance and/or frustration caused by the inability to reduce losses could lead to illegal use of toxicants by others which could lead to unknown direct, indirect, and/or cumulative impacts to humans and pets. DRC-1339 and alpha chloralose would not be available under this alternative to non-WS entities experiencing damage or threats from birds and WS would not use DCR-1339 under this alternative since it is lethal, therefore no cumulative impacts to human health and safety should occur from these chemicals.

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, 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' assistance. Many of the methods discussed in Appendix C would be available to those persons experiencing damage or threats and could be used to remove birds if permitted by the USFWS and/or the MDC. The direct burden of implementing permitted methods would be placed on those experiencing damage.

Direct, Indirect, and Cumulative Effects:
Since most methods available to resolve or prevent bird damage or threats are available to anyone, the adverse direct, indirect, and cumulative effects to human safety from the use of those methods are similar between the alternatives. 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 adverse direct and indirect effects to human safety. Habitat modification and harassment methods are also generally regarded as posing minimal adverse direct and indirect effects to human safety. Although 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. DRC-1339 and alpha chloralose would not be available under this alternative to those experiencing damage or threats from birds, therefore no adverse direct, indirect, or cumulative impacts to human health and safety should occur from these chemicals. The only methods that would be available under this alternative that would involve the direct lethal taking of birds are shooting, publicly available pesticides and repellents, 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 the MDC. Firearms, when handled appropriately and with consideration for safety, pose minimal risks to human safety. However, methods employed by those persons not experienced in the use of methods or are not trained in their proper use, could increase the adverse direct, indirect, and/or cumulative impacts to human safety. Overall, the methods available to the public, when applied correctly and appropriately, pose minimal risks to human safety.

Summary

No significant cumulative environmental impacts are expected from any of the proposed actions analyzed in this supplement. Under the Current/Proposed Action, the lethal removal of birds by WS has not and would not have a significant impact on overall bird populations in Missouri or nationwide, but some local reductions may occur. No risk to public safety is expected when WS' services are provided and accepted by continuing the BDM program with the included supplemental actions since only trained and experienced wildlife biologists/specialists would conduct and recommend bird damage management activities. Although some persons will likely be opposed to WS' participation in bird damage management activities on public and private lands, the analysis in this EA indicates that WS integrated bird damage management program would not result in significant adverse cumulative impacts on the quality of the human environment.

CHAPTER 5 - LIST OF PREPARERS AND PERSONS CONSULTED

5.1 List of Preparers/Reviewers

USDA-APHIS-Wildlife Services:
Parker Hall, State Director
Dan McMurtry, Wildlife Biologist
Chris Croson, Staff Wildlife Biologist
Trevor Kahler, Wildlife Biologist
Bob Alexander, Wildlife Biologist
Luke Miller, Wildlife Biologist
Kevin McGrath, Wildlife Biologist

5.2 List of Persons Consulted

USFWS:
Larry Harrison, Migratory Bird Permits-Region 3
Richard Rottman, Migratory Bird Permit-Region 3

MDC:
Doreen Mengel, Wildlife Research Biologist
Brad Jacobs, Ornithologist
Andy Raedeke, Wildlife Research Biologist

APPENDIX A

LITERATURE CITED

Adams, C. E., K. J. Lindsey, and S. J. Ash. 2006. Urban wildlife management. Taylor and Francis Press, Boca Raton, Florida, USA.

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, 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.

Andelt, W. F. 2014. Preventing Woodpecker Damage. Colo. St. Univ. Coop. Ex. Fact sheet 6.516 Ft. Collins, Colo. 2 pp.

Apostolou, A. 1969. Comparative toxicity of the avicides 3-chloro-*p*-toluidine and 2-chloro-4-acetotoluidide in birds and mammals. Ph.D. Dissertation, Univ. of California-Davis. 178pp.

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.

Atlantic Flyway Council. 2009. 2008 Mid-summer Mute Swan Survey Results. Snow Goose, Brant, ans Swan Committee Atlantic Flyway Technical Section. Accessed online April 30, 2012: http://www.docstoc.com/docs/50462172/2008-Mid-Summer-Mute-Swan-Survey-Results-Atlantic-Flyway-Council.

Atlantic Flyway Council. 2011. Canada Goose Committee-Atlantic Flyway Game Bird Technical Section. 2011. Atlantic Flyway Resident Population Canada Goose Management Plan. Adopted by the Atlantic Flyway Council.

Avery, M. L., and D. G. Decker. 1994. Responses of captive fish crows to eggs treated with chemical repellents. J. Wildl. Manage. 58:261-266.

AVMA. 2013. AVMA guidelines on euthanasia. American Veterinary Medical Association. Accessed online December 23, 2013: https://www.avma.org/KB/Policies/Documents/euthanasia.pdf.

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.

Belant, J. L., and R. A. Dolbeer. 1993*a*. Population status of nesting Laughing Gulls in the United States: 1977-1991. Am. Birds. 47:220-224.

Belant, J. L. and R. A. Dolbeer. 1993*b*. Migration and dispersal of Laughing Gulls in the United States. J. Field Ornithol. 64:557-565.

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 S. K. Ickes. 1993. Importance of landfills to nesting herring gulls. Condor. 95:817-830.

Belant, J. L., S. K. Ickes, and T. W. Seamans. 1995*a*. Importance of landfills to urban-nesting herring and ring-billed gulls. (Task I). Part 2. Bird use of waste management facilities. Final. Rep., Fed. Aviation Admin. Tech. Cent., Atlantic City, N.J. (DTFA01-91-Z-02004). 23 pp.

Belant, J. L., T. W. Seamans, S. W. Gabrey, and R. A. Dolbeer. 1995*b*. Abundance of gulls and other birds at landfills in northern Ohio. Am. Midl. Nat. 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. J. Wildl. Manage. 60:923-928.

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 Wildlife Service, 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. Bird Damage Research Rep. No. 340. U.S. Fish and Wildlife Service, Denver Wildl. Res. Center. 84 pp.

Besser, J. F., W. C. Royal, and J. W. DeGrazio. 1967. Baiting European starlings with DRC-1339 at a cattle feedlot. J. Wildl. Manage. 3:48-51.

Besser, J. F., J. W. DeGrazio, and J. L. Guarino. 1968. Costs of wintering European starlings and red-winged blackbirds at feedlots. J. Wildl. Manage. 32:179-180.

Beyersbergen, G. W., R. C. Bazin, W. A. Calvert, S. J. Barry and B. A. Gingras. 2009. Spatial and temporal distribution and abundance of the Franklin's Gull in the Canadian Prairie Provinces: 2005 – 2007. Canadian Wildlife Service unpublished report. Prairie and Northern Region. Edmonton, AB. 120 pp.

Blackwell, B. F., G. E. Bernhardt, and R. A. Dolbeer. 2002. Lasers as non-lethal avian repellents. J. Wildl. Manage. 66:250-258.

Blankespoor, 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.

Bomford, M. 1990. Ineffectiveness of a sonic device for deterring European Starlings. Wild. Soc. Bull. 18:151-156.

Boyd, F. L., and D. I. Hall. 1987. Use of DRC-1339 to control crows in three roosts in Kentucky and Arkansas. 3rd E. Wildl. Damage Control Conf. 3:3-7.

Brauning, D. W., ed. 1992. Atlas of breeding birds in Pennsylvania. Univ. Pittsburgh Press, Pittsburgh, Pa. 484 pp.

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. Slate, R. B. Chipman, M. Borden, C. Allen, J. Janicke, and R. Noviello. 1998. Management of Gulls and Landfills to Reduce Public Health and Safety Conflict (Abstract). The Wildlife Society 5th Annual Conference. Bulletin No. 4. p. 66.

Buehler, D. A. 2000. Bald eagle (*Haliaeetus leucocephalus*) *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.

Burger, J. and M. Gochfeld. 2009. Franklin's Gull (*Leucophaeus pipixcan*), 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/116.

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.

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.

Bynum, K. S., C. A. Yoder, J. D. Eisman, J. J. Johnston, and L. A. Miller. 2005. Development of nicarbazin as a reproductive inhibitor for resident Canada geese. Proc. Vertebr. Pest Conf. 11:179-189.

Caudell J., and S. Shwiff. 2006. Cost effectiveness of OvoControl G for managing nuisance Canada goose (*Branta canadensis*) populations. 12th Wildl. Damage Manage. Conf. April 9-12, 2007.

Cleary, E. C. 1994. Waterfowl. Pp E-129-E-138 *in* S.E. Hygnstrom, R.M. Timm, and G.E. Larson, eds. Prevention and Control of Wildlife Damage. University of Nebraska Cooperative Extension Service, Lincoln, Nebraska.

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.

Coleman, J. S. and J. D. Fraser. 1989. Habitat use and home ranges of black and turkey vultures. J. Wildl. Manage. 53:782–792.

Conover, M. R. 1982. Evaluation of behavioral techniques to reduce wildlife damage. Proc. Wildl.-Livestock Relation. Sym. 10:332-344.

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., 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.

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

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 Ornithology. 76:27-32.

Davidson, W. R. and V. F. Nettles. 1997. Field manual of wildlife diseases in the southeastern United States. Southeastern Cooperative Wildlife Disease Study. Athens, Georgia. 417 pp.

Day, G. I., S. D. Schemnitz, and R. D. Taber. 1980. Capturing and marking wild animals. Pp. 61-88 *in* Wildlife management techniques manual, S.D. Schemnitz ed., The Wildlife Society, Inc. Bethesda, MD. 686 pp.

DeCino, T. J., D. J. Cunningham, and E. W. Schafer, Jr. 1966. Toxicity of DRC-1339 to European starlings. J. Wildl. Manage. 30:249-253.

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.

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

Decker, D. J., and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildl. Soc. Bull. 16:53-57

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. Appl. Ecol. 27:200-209.

Dixon, W. J., and A. M. Mood. 1948. A method for obtaining and analyzing sensitive data. J. Am. Stat. Assoc. 43:109-126.

Dolbeer, R.A., C.R. Ingram, and J.L. Seubert. 1976. Modeling as a management tool for assessing the impact of blackbird control measures. Proc. Vertebr. Pest Conf. 7:35-45.

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, Nebraska.

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. 2000. Birds and aircraft: fighting for airspace in crowded skies. Proc. Vert. Pest Conf. 19:37-43.

Dolbeer, R. A. 2009. Birds and aircraft: Fighting for airspace in ever more crowded skies. Human-Wildlife Conflicts. 3:165-166.

Dolbeer, R. A., and R. A. Stehn. 1983. Population status of blackbirds and starlings in North America, 1966-81. Proc. East. Wildl. Damage Control Conf. 1:51-61.

Dolbeer, R. A., P. P. Woronecki, and R. L. Bruggers. 1986. Reflecting tapes repel blackbirds from millet, sunflowers, and sweet corn. Wildl. Soc. Bull. 14:418-425.

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., S. E. Wright, and E. C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. Wildl. Soc. Bull. 28:372-378.

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., 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. J. Wildl. Manage. 62:1558-1564.

Dolbeer, R. A., S. E. Wright, J. Weller, and M. J. Begier. 2011. Wildlife strikes to civil aircraft in the United States 1990-2010. 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.

Drilling N., R. Titman, and F. McKinney. 2002. Mallard (*Anas platyrhynchos) 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.

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). U.S. Environmental Protection Agency, Prevention, Pesticides and Toxic Substances. EPA-738-F-96-003. 4 pp.

EPA. 1999. ECOFRAM terrestrial draft report. Ecological Committee on FIFRA Risk Assessment Methods. U.S. Environmental Protection Agency, Washington, D. C. Accessed online February 11, 2013: http://www.epa.gov/oppefed1/ecorisk/terreport.pdf.

FAA. 2015. National Wildlife Strike Database. Accessed online January 12, 2015: http://wildlife-mitigation.tc.faa.gov/wildlife/database.aspx.

FDA. 2003. Bird poisoning of federally protected birds. Office of Criminal Investigations. Enforcement Story 2003.

Feare, C. 1984. The Starling. Oxford University Press. Oxford, New York.

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. J. Hyg. Camb. 86:195-202.

Fitzwater, W. D. 1994. House sparrows. Pp. E101–108 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. Accessed online January 28, 2013: http://digitalcommons.unl.edu/icwdmhandbook/.

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.

Flyways.us. 2015. Waterfowl hunting management in North America, http://www.flyways.us/regulations-and-harvest/harvest-trends

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. Proc.3rd Vertebr. Pest Conf. 3:104-110.

Fuller-Perrine, L. D., and M. E. Tobin. 1993. A method for applying and removing bird exclusion netting in commercial vineyards. Wildl. Soc. Bull. 21:47-51.

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.

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. Pp. 38–45 *in* Vertebrate Pest Control and Management Materials: Third Conference, Special Technical Bulletin 752. E. W. Schaefer, Jr., and C. R. Walker, editors. American Society for Testing and Materials, West Conshohocken, Pennsylvania, USA.

Glahn, J. F., and D. L. Otis. 1986. Factors influencing blackbird and European Starling damage at livestock feeding operations. J. Wildl. Manage. 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., 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., Wilson. E. A.. Avery. M. L. 1990. Evaluation of DRC- 1339 baiting program to reduce sprouting rice damage caused by spring roosting blackbirds. National Wildlife Research Control Report 448. 25pp.

Glahn, J. F., T. Tomsa, and K. J. Preusser. 1999. Impact of great blue heron predation at trout-rearing facilities in the northeast United States. N. Am. J. Aquaculture. 61:349–354.

Glahn, J. F., G. Ellis, P. Fiornelli, and B. Dorr. 2000. Evaluation of low to moderate power lasers for dispersing double-crested cormorants from their night roosts. Proc. 9th Wildl. Damage Manage. Conf. 9:34-35.

Golab, A. 2012. Kayaker drowns after coming too close to swan. Chicago Sun-Times. Accessed online December 19, 2012: http://www.suntimes.com/11923182-417/man-drowns-in-kayak-after-coming-too-close-to-swan.html.

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.

Hatch, J. J. 1996. Threats to public health from gulls (*Laridae*). J. Enviro. Health Res. 6:5-16.

Hatch, J. J., and D. V. Weseloh. 1999. Double-crested Cormorant (*Phalacrocorax auritus*) *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.

Hepp, G. R and F. C. Bellrose. 1995. Wood Duck (Aix sponsa, The Birds of North America Online (A. Poole, ED.). Ithica: Cornell Lab of Ornithology. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/169/articles/introduction.

Heusmann, H. W., and R. Bellville. 1978. Effects of nest removal on starling populations. Wilson Bull. 90:287-290.

Hill, G. A., and D. J. Grimes. 1984. Seasonal study of freshwater lake and migratory waterfowl for *Campylobacter jejuni*. Can. J. Micro. 30:845-849.

Holler, N. R., and E. W. Schafer, Jr. 1982. Potential secondary hazards of Avitrol baits to sharp-shinned hawks and American kestrels. J. Wildl. Manage. 46:457-462.

Hunter, W. C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. Waterbird Conservation for the Americas. Accessed online May 12, 2010: http://www.waterbirdconservation.org/.

Jackson, B. J. S., and J. A. Jackson. 2000. Killdeer (*Charadrius vociferus*). *In* The Birds of North America, No. 517 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Jamieson, R. L. 1998. Tests show Canada geese are cause of polluted lake water. Seattle Pilot. July 9, 1998. Seattle,WA.

Johnson, R. J. 1994. American Crows *in* S. E. Hyngstrom, R. M. Timm, and G. E. Larson, editors. Prevention and control of wildlife damage. Univ. Of Nebraska, Lincoln, NE. pp 33-40.

Johnson, R. J., and J. F. Glahn. 1994. European Starlings *in* S. E. Hygnstrom, R.M. Timm, and G.E. Larson, editors. Prevention and control of wildlife damage - 1994. Univ. NE Coop. Ext., Instit. of Ag. and Nat. Res., Univ. of NE-Lincoln, USDA, APHIS, Animal Damage Control, Great Plains Ag. Council Wildl. Committee. pp 109 - 120.

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. Env. Hygiene. 16:905-909.

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.

Kilham, L. 1989. The American Crow and the Common Raven. Texas A&M Press, College Station, Texas. 255 pp.

King, D. T. and D. W. 2005. Anderson, Recent Populations Status of the American White Pelican: A Continental Prospective. Waterbirds 28 (Special Publication): 48-54.

Klett, B. R., D. F. Parkhurst, and F. R. Gaines. 1998. The Kensico Watershed Study: 1993 - 1995. Accessed online November 24, 2009: http://www.epa.gov/owow/watershed/Proceed/sess41-60.pdf.

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. 160 pp.

Kreps, L. B. 1974. Feral pigeon control. Proc. Vertebr. Pest. Conf. 6:257-262.

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.

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.

Link, W. A., and J. R. Sauer. 2002. A hierarchical model of population change with application to Cerulean Warblers. Ecology. 83:2832–2840.

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

Linnell, M. A., M. R. Conover, and T. J. Ohashi. 1999. Biases in bird strike statistics based on pilot reports. J. Wildl. Manage. 63:997-1003.

Linz, G. M., D. L. Bergman, H. J. Homan, and W. J. Bleier. 1999. Effects of herbicide induced habitat alterations on blackbird damage to sunflower. Crop Protection. 14:625–629.

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. Pp 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. 1999. Damage by black and Turkey Vultures in Virginia, 1990-1996. Wildl. Soc. Bull. 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; Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/047.

Lowther, P. E., and C. L. Cink. 2006. House sparrow (*Passer domesticus*) in A. Poole and F. Gill, editors. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/012.

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, Ottawa, Ontario, Canada.

Mancl, K. M. 1989. Bacteria in drinking water: Bulletin 795. The Ohio State University Cooperative Extension Service, Columbus, Ohio, USA.

MANEM Regional Waterbird Plan. 2006. Waterbird Conservation Plan: 2006-2010. Accesed online September 7, 2009: http://www.manomet.org/pdf/waterbird07/waterbird_species_profiles.pdf.

Mason, J. R. 1989. Avoidance of methiocarb-poisoned apples by Red-winged Blackbirds. J. Wildl. Manage. 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., 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., M. A. Adams, and L. Clark. 1989. Anthranilate repellency to European starlings: chemical correlates and sensory perception. Journal of Wildlife Management 53:55-64.

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. 3 pp.

McCracken, H. F. 1972. Starling control in Sonoma County. Proc. Vertebr. Pest Conf. 5:124-126.

MDC. 2015. Mourning Dove. http://mdc.mo.gov/node/3183. Accessed online January 15, 2015.

MDC. 2015. Turkey Vultures. http://mdc.mo.gov/node/978. Accessed online January 15, 2015.

MDC. 2015. American Kestrel. http://mdc.mo.gov/node/3843. Accessed online January 15, 2015.

Mitterling, L. A. 1965. Bird damage on apples. Proc. Am. Soc. Horticultural Science. 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. J. Appl. Ecol. 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 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., and S. K. Timbrook. 1988. Alleviating nuisance Canada goose problems with acoustical stimuli. Proc. Vertebr. Pest. Conf. 13:301-305.

Mudge, G. P., and P. N. Fern. 1982. The feeding ecology of five species of gulls (Aves: Larini) in the inner Bristol Channel. J. Zool. Lond. 197:497-510.

NAS. 2002. National Audubon Society. The Christmas Bird Count Historical Results. Accessed online November 15, 2011: www.audubon.org/bird/cbc.

NAS. 2010. The Christmas Bird Count Historical Results. Accessed online June 18, 2013: www.christmasbirdcount.org.

NASS. 2014. 2014 Census of Agriculture. U.S. Department of Agriculture, National Agricultural Statistics Service. Accessed online October 24, 2014: http://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=MISSOURI

NASS. 2011. Cattle Death Loss 2010. U.S. Department of Agriculture, National Agricultural Statistics Service, Washington, D.C., USA.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pp 12-51 *in* L. Nielsen and R. D. Brown, eds. Translocation of wild animals. Wis. Humane Soc., Inc., Milwaukee and Caesar Kleberg Wildl. Res. Inst., Kingsville, TX. 333pp.

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.

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. Wildl. Soc. Bull. 15:386-394.

Parkhurst, J. A., R. P. Brooks, and D. E. Arnold. 1992. Assessment of predation at trout hatcheries in central Pennsylvania. Wildl. Soc. Bull. 20:411-419.

Parmelee, D. F. 1992. Snowy Owl (Bubo scandiacus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed online November 25, 2013: http://bna.birds.cornell.edu/bna/species/010.

PFSC - Partners in Flight Science Committee. 2013. Population Estimates Database, version 2013. Accessed online November 25, 2014: http://rmbo.org/pifpopestimates.

Patton, S. R. 1988. Abundance of gulls at Tampa Bay landfills. Wilson Bull., 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. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/271.

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.

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. J. Wildl. Manage. 62:395-398.

Poole, A. F., R. O. Bierregaard, and M. S. Martell. 2002. Osprey (*Pandion haliaetus*) *in* The Birds of North America, No. 683 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Portnoy, J. W. 1990. Gull contributions of phosphorous and nitrogen to a Cape Cod kettle pond. Hydrobiologia. 202:61-69.

Preston, C. R., and R. D. Beane. 2009. Red-tailed hawk (*Buteo jamaicensis*) *in* A. Poole and F. Gill, editors. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/052.

Price, I. M., and J. G. Nickum. 1995. Aquaculture and birds: the context for controversy. Colonial Waterbirds. 18:33–45.

Quessey, S., and S. Messier. 1992. Prevalence of *Salmonella* spp., *Campylobacter* spp. and *Listeria* spp. in ring-billed gulls (*Larus delawarensis*). J. Wildl. Disease. 28:526-531.

.

Raftovich, R. V. and K. A. Wilkins. 2013. Migratory bird hunting activity and harvest during the 2011-12 and 2012-13 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

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.

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.

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. J. Wildl. Manage. 41:444-447.

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., 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.

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. 2011. The North American Breeding Bird Survey, Results and Analysis 1966 - 2011. Version 10.13.2008. USGS Patuxent Wildlife Research Center, Laurel, Maryland.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2012. Version 02.19.2014 USGS Patuxent Wildlife Research Center, Laurel.*

Sauer, J. R., and W. A. Link. 2011. Analysis of the North American Breeding Bird Survey Using Hierarchical Models. Auk. 128:87–98.

Schafer, E. W., Jr. 1970. *A Summary of the Acute Toxicity,Chronic Toxicity and Secondary Hazards of 4-Aminopyridine DRC-1327) to Birds and Mammals,"* Unpublished Denver Wildlife Research Center report, #10 109, Denver Wildlife Research Center, Denver, Colorado.

Schafer, E. W., Jr. 1972. The acute oral toxicity of 369 pesticidal, pharmaceutical, and other chemicals to wild birds. Toxicol. Appl. Pharmacol. 21:315.

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. J. Wildl. Manage. 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. H., and R. J. Johnson. 1984. Bird dispersal recordings: an overview. ASTM STP. 817. 4:43-65.

Simmons, G. M., Jr., S. A. Herbein, and C. M. James. 1995. Managing nonpoint fecal coliform sources to tidal inlets. Universities Council on Water Resources. Water Resour. Update 100:64–74.

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

Smallwood, J. A., and D. M. Bird. 2002. American Kestrel (*Falco sparverius*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/602.

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.

Sobeck, E. 2010. Department of the Interior, Fish and Wildlife Service, 50 CFR Part 21, Migratory Bird Permits: Removal of rusty blackbird and Tamaulipas (Mexican) crows from the depredation order for blackbirds, cowbirds, grackles, crows, and magpies, and other changes to the order, final rule. Federal Register 75 (231, Thursday, December 2, 2010): 75153-75156.

Stansley W., L. Widjeskog, and D. E. Roscoe. 1992. Lead contamination and mobility in surface water at trap and skeet ranges. Bulletin of Environmental Contamination and Toxicology. 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, Ltd., New York.

Stroud, R. K., and M. Friend. 1987. Salmonellosis. Pp 101-106 *in* Field Guide to Wildlife Diseases: General Field Procedures and Diseases of Migratory Birds. M. Friend (ed.). U.S. Department of the Interior, Fish and Wildlife Service, Washington, D. C. Resource Publication 167. 225 pp.

Sullivan, B. D., and J. J. Dinsmore. 1990. Factors affecting egg predation by American Crows. J. Wildl. Manage. 54:433-437.

Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. Wings Bros. New York, New York.

The Wildlife Society. 2010. Conservation policies of the Wildlife Society. The Wildlife Society. Washington, D.C. 20 pp.

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. Wildl. Soc. Bull. 16:300-303.

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.

USDA. 2001. Compound DRC-1339 Concentrate-Staging Areas. Tech Note. USDA/APHIS/WS. National Wildlife Research Center, Fort Collins, Colorado.

USDA. 2002. Environmental Assessment: Canada goose damage management. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. Raleigh, North Carolina.

USDA. 2005. An Early Detection System for Asian H5N1 Highly Pathogenic Avian Influenza in Wild Migratory Birds. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Operational Support Staff, Riverdale, Maryland, USA. 87 pp.

USDA. 2008. Environmental Assessment: Statewide Bird Damage Management. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. Columbia, MO.

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, U.S. Fish and Wildlife Service, Div. of Migratory Bird Management, 4401 N. Fairfax Drive MS 634, Arlington, VA 22203.

USFWS. 2005. Final Environmental Impact Statement: Resident Canada goose management. U.S. Fish and Wildlife Service, Div. of Migratory Bird Management. Arlington, Virginia. Accessed online January 29, 2014: http://www.fws.gov/migratorybirds/currentbirdissues/management/cangeese/finaleis.htm.

USFWS. 2007. Final Environmental Impact Statement: Light goose management. U.S. Fish and Wildlife Service. Accessed online January 29, 2014: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/snowgse/FinalEIS2007/Light%20goose%20EIS.pdf.

USFWS. 2009. Environmental Assessment: Extended management of double-crested cormorants under 50 CFR 21.47 and 21.48. U.S. Fish and Wildlife Service, Div. of Migratory Bird Management, 4401 N. Fairfax Drive, Mail Stop 4107, Arlington, VA 22203.

USFWS. 2010. Final Environmental Assessment: proposal to permit take as provided under the Bald and Golden Eagle Protection Act. U.S. Fish and Wildlife Service, Div. of Migratory Bird Management. Arlington, Virginia.

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.

Venable, N. J. 1996. Birds of Prey. West Virginia University Extension Services.

Verbeek, N. A. M. 1977. Comparative feeding behavior of immature and adult Herring Gulls. Wilson Bull. 87:415–421.

Verbeek, N. A. and C. Caffrey. 2002. American Crow (*Corvus brachyrhynchos), in* The Birds of North America, No. 647 (A. Poole, Ed.). The Birds of North American Online, Ithaca, New York.

VerCauteren, K. C., and D. R. Marks. 2004. Movements of urban Canada geese: implications for nicarbazin treatment programs. Pp. 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. Proc. 2003 International Canada Goose Symposium. Madison, Wisconsin.

Vogt, P. F. 1997. Control of nuisance birds by fogging with REJEX-IT TP-40. Proc. Great Plains Wildl. Damage Contr. Workshop. 13: 63-66.

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 Wildlife Service. 23pp.

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, California.

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. J. Wildl. Dis. 25:144-188.

Wilbur, S. R. 1983. The status of vultures in the western hemisphere. Pp. 113-123. *in* Vulture biology and management. Eds. By S.R. Wilbur and J.A. Jackson. 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, 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.

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, Nebraska.

Wobeser, G., and C. J. Brand. 1982. Chlamydiosis in 2 biologists investigating disease occurrences in wild waterfowl. Wildl. Soc. Bull. 10170-172.

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. 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 black bird (Agelaius phoeniceus) in A. Poole and F. Gill, editors. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/184.

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.

APPENDIX B
BIRD SPECIES AND NUMBER OF PROJECTS FOR FY 2009 TO FY 2013

Species	Projects	Species	Projects
blackbirds, red-winged	8	gulls, ring-billed	3
blackbirds, (mixed species)	15	hawks, cooper`s	8
coots, american	1	hawks, harrier, northern (marsh hawks)	5
cormorants, double-crested	2	hawks, red-shouldered	1
cowbirds, brown-headed	5	hawks, red-tailed	52
crows, american	6	hawks, rough-legged	1
doves, mourning	25	hawks, sharp-shinned	1
ducks, bufflehead	2	hawks, swainson`s	3
ducks, canvasback	1	herons, great blue	23
ducks, feral	2	herons, green	3
ducks, gadwall	2	herons, little blue	2
ducks, goldeneye, barrow`s	2	herons, night, black-crowned	1
ducks, goldeneye, common	2	jays, blue	2
ducks, mallards	9	killdeers	5
ducks, merganser, hooded	1	kingbirds, eastern	2
ducks, northern pintail	3	kingbirds, western	1
ducks, northern shoveler	2	kingfishers, belted	1
ducks, redhead	1	larks, horned	3
ducks, ring-necked	2	meadowlarks, eastern	2
ducks, ruddy	1	mockingbirds, northern	3
ducks, scaup, greater	2	ospreys	3
ducks, scaup, lesser	2	owls, barred	3
ducks, teal, blue-winged	3	owls, common barn	1
ducks, teal, green-winged	3	owls, great horned	9
ducks, wigeon, american	2	owls, short-eared	2
ducks, wood	3	pelicans, american white	1
eagles, bald	3	pigeons, feral (rock)	53
egrets, cattle	4	robins, american	15
egrets, great	3	sandpipers, spotted	1
egrets, snowy	3	sandpipers, upland	1
falcons, american kestrels	10	sparrows, house/english	27
falcons, peregrine	9	starlings, european	71
falcons, prairie	2	swallows, bank	1
finches, house	1	swallows, barn	6
finches, purple	1	swallows, cliff	3
flycatchers, scissor-tailed	4	swans, trumpeter	1
geese, canada	83	swifts (all)	1
geese, ross`s	1	terns, common	1
geese, snow, lesser	20	turkeys, wild	4
grackles, common	8	vultures, black	10
grackles, great-tailed	4	vultures, turkey	20
grebes, pied-billed	3	woodcock, american	1
gulls, bonaparte`s	4	woodpeckers, downy	1
gulls, franklin`s	2	woodpeckers, red-bellied	1
Total:		**1226**	

APPENDIX C

BIRD DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE

NON-LETHAL METHODS - NONCHEMICAL

Agricultural producer and property owner practices. These 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 these methods, based on the level of risk, need, and professional judgment on their effectiveness and practicality. These methods include:

Cultural methods. These may include altering planting dates so that crops are not young and more vulnerable to damage when the damage-causing species is 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, closed barns or corrals, 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 and blackbirds 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.

Animal behavior modification. This 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, scarecrows, mylar tape, lasers, and eye-spot balloons.

These techniques are generally only practical for small areas. Scaring devices such as distress calls, helium-filled eyespot 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, Andelt 2014, Bomford 1990). Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988).

Paintball guns are used as a non-lethal harassment method to disperse birds from areas using physical harassment. Paintballs are most often used to harass waterfowl. Paintballs can be used to produce physically and visually negative-reinforcing stimuli that can aid in the dispersement of birds from areas where damages or threats of damages are occurring.

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 crow 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, trashy, and cause a decreased aesthetic value of the neighborhood when used over personal gardens.

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. These 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.

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, and 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.

Lasers are a non-lethal technique recently evaluated by the NWRC (Glahn et al. 2000, 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 mallards 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 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.

Nest box traps may be used by WS for corrective damage management and are effective in capturing cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976).

Mist nets are more commonly used for capturing small-sized birds, 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 into the United States in the 1950s 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/Air cannon nets are normally used for larger birds and use mortar projectiles to propel a net up and over birds which have been baited to a particular site.

Raptor traps are varied in form and function and includes but is not limited to Bal-chatri, Dho Gaza traps, Phai hoop traps, and Swedish goshawk traps. These traps could be used specifically to live-trap raptors.

Corral traps could be used to live-capture birds, primarily geese and other waterfowl. Corral traps can be effectively used to live capture Canada geese during the annual molt when birds are unable to fly. Each year for a few weeks in the summer, geese are flightless as they are growing new flight feathers. Therefore, geese can be slowly guided into corral-traps.

Funnel traps could be used to live-capture waterfowl. Traps are set up in shallow water and baited. Funnel traps allow waterfowl to enter the trap but prevents the ducks from exiting. Traps would be checked regularly to address live-captured waterfowl. Captured ducks can be relocated or euthanized.

Nest/egg 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 or safety issues for home and business owners. Removal of nests is intended to deter birds from nesting in the same area again. Birds generally attempt to re-nest, so the method may need to be conducted repeatedly throughout the nesting season, and over several years. 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 Treatment (addling/shaking, puncturing, or oiling) is a method of suppressing reproduction in local nuisance bird populations by destroying egg embryos to arrest their development and eliminate hatching. Treated eggs are returned to the nest and the adult bird remains attached to the nest site. Treatment of eggs is typically done where the current number of birds is tolerable, but additional birds would not be.

Treatment of eggs will not reduce the overall problem bird population, but may slow its growth and make adult birds more responsive to harassment (also see *Egg oiling* below).

Lure crops/alternate foods. 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.

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 birds begin 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, Jr. 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, Jr. 1991). However, a laboratory study by Schafer, Jr. 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, Jr. 1981, Holler and Shafer 1982).

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[10]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[11]), and of relatively low toxicity to fish and other invertebrates. 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 U.S. Food and Drug Administration (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. In addition, 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 (Vogt 1997). 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.

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, crows develop post-ingestional malaise (Mason 1989) and subsequently develop an aversion to consuming similar-looking eggs (Dimmick and Nicolaus 1990). Repeated exposures may be necessary to develop and maintain aversion to eggs of T&E species 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 T&E species nesting areas. Treated eggs are not placed in locations where T&Especies 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.

Other chemical repellents. A number of other chemicals have shown bird repellent capabilities. Anthraquinone, 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

[10]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.
[11]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.

repellent against Canada goose grazing on turf and as a seed repellent against brown-headed cowbirds (Dolbeer et al. 1998).

Tactile repellents. 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.

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 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, Jr. 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.

Resource Management. Resource management includes a variety of practices that may be used by resource owners to reduce the potential for wildlife damage. Implementation of these practices is appropriate when the potential for damage can be reduced without significantly increasing a resource owner's costs or diminishing his/her ability to manage resources pursuant to goals. Resource management recommendations are made through WS technical assistance efforts.

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. 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 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 within 3 months of their appointment and a refresher course every 2 years afterwards (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 MDC and the 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 Clemson University Department of Pesticide Regulation). WS' personnel that use restricted-use chemical methods are certified as pesticide applicators by the State of Missouri and are required to adhere to all certification requirements set forth in FIFRA and Missouri pesticide control laws and regulations. Chemicals are only used on private, public, or tribal property sites with authorization from the property owner/manager.

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. 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 (DeCino et al. 1966, Besser et al. 1967, West et al. 1967). 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), and dispersing crow roosts in urban/suburban areas (Boyd and Hall 1987). 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, Jr. 1981, Schafer, Jr. 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, Jr. 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 (EPA 1995). 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, Jr. 1984, Schafer, Jr. 1991, Johnston et al. 1999). DRC-1339 acts in a humane manner producing a quiet and apparently painless death.

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. Although DRC-1339 is highly toxic to aquatic invertebrates (EPA 1995), following labeling requirements eliminates the risks to non-target mussel species. These label requirements include application more than 50 feet from a body of water, observation and pre-baiting to ensure the rapid uptake of treated bait by the target bird species.

APPENDIX D

USFWS Listing of Threatened and Endangered Species in Missouri

Summary of Animals listings http://www.fws.gov/midwest/endangered/lists/e_th_pr.html

Species listed in this state and that occur in this state (35 species)	
Status	**Species**
T	Rufa red knot (*Calidris canutus rufa*)
E	Least tern (*Sterna antillaru)*
T	Plover, piping (*Charadrius melodus*)
E	Gray bat (*Myotis grisescens*)
E	Indiana bat (*Myotis sodalis*)
E	Ozark big-eared bat (*Plecotus townsendii ingens*)
P	Northern long-eared bat (Myotis septentrionalis)
E	Ozark hellbender (*Cryptobranchus alleganiensis bishop*)
E	Grotto sculpin (*Cottus specus*)
T	Neosho madtom (*Noturus placidus*)
T	Niangua darter (*Etheostoma nianguae*)
T	Ozark cave fish (*Amblyopsis rosae*)
E	Pallid sturgeon (*Scaphirhynchus albus*)
E	Topeka shiner (*Notropis topeka*)
E	Hine's emerald dragonfly (*Somatochlora hineana*)
E	Curtis' pearlymussel (*Epioblasma florentina curtisi)*
E	Fat pocketbook (*Potamilus capax*)
E	Higgins eye pearlymussel (*Lampsilis higginsii*)
E	Neosho mucket (*Lampsilis rafinesqueana*)
E	Pink mucket (*Lampsilis abrupta*)
T	Rabbitsfoot (*Quadrula cylindrical cylindrical*)
E	Scaleshell (*Leptodea leptodon*)
E	Sheepnose (*Plethobasus cyphyus*)
E	Snuffbox (*Epioblasma triquetra*)
E	Spectaclecase (Cumberlandia monodonta)
E	Winged mapleleaf (*Quadrula frugosa*)
E	Tumbling Creek cave snail (*Antrobia culveri*)
E	Cave crayfish (*Cambarus aculabrum*)
P	Rufa red knot (Calidris canutus rufa)

Summary of Plant listings

Plant species listed in this state and that occur in this state (9 species)	
Status	**Species**
T	Eastern prairie fringed orchid *(Platanthera leucophaea*))
T	Decurrent false aster (*Boltonia decurrens*)
E	Geocarpon (*Geocarpon minimum*)
T	Mead's milkweek (*Asclepias meadii*)
T	Missouri bladderpod (*Physaria filiformis*)
E	Pondberry (*Lindera milissifolium*)
E	Running Buffalo clover (*Trifolium stoloniferum*)
T	Virginia sneezeweed (*Helenium virginicum*)
T	Westen prairie fringed orchid (*Platanthera praeclara*)

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.
- Click on the highlighted scientific names below to view a Species Profile for each listing.
- Critical habitat exists for Indiana bat, Niangua darter, Hine's emerald dragonfly and Tumbling Creek cavesnail and it has been proposed for Neosho mucket and rabbits foot mussels.

Obtained from the USFWS website at
http://www.fws.gov/midwest/endangered/lists/e_th_pr.html

APPENDIX E
MDC THREATENED AND ENDANGERED SPECIES IN MISSOURI

http://mdc.mo.gov/sites/default/files/resources/2010/04/2015speciesconcern.pdf

SCIENTIFIC NAME	COMMON NAME	STATE[1] STATUS	FEDERAL[2] STATUS
PLANTS			
Asclepias meadii	Mead's Milkweed	Endangered	Threatened
Boltonia decurrens	Decurrent False Aster	Endangered	Threatened
Geocarpon minimum	Geocarpon	Endangered	Threatened
Helenium virginicum	Virginia Sneezeweed	Endangered	Threatened
Isotria medeoloides	Small Whorled Pogonia[3]	Endangered	Threatened
Lindera melissifolia	Pondberry	Endangered	Endangered
Physaria filiformis	Missouri Bladder-pod	Endangered	Threatened
Platanthera leucophaea	Eastern Prairie Fringed Orchid[3]	Endangered	Threatened
Platanthera praeclara	Western Prairie Fringed Orchid	Endangered	Threatened
Trifolium stoloniferum	Running Buffalo Clover	Endangered	Endangered
MOLLUSKS			
Antrobia culveri	Tumbling Creek Cavesnail	Endangered	Endangered
Cumberlandia monodonta	Spectaclecase	Endangered	
Elliptio crassidens	Elephantear	Endangered	
Epioblasma florentina	Curtis Pearlymussel	Endangered	Endangered
Epioblasma triquetra	Snuffbox	Endangered	Endangered
Fusconaia ebena	Ebonyshell Endangered		
Lampsilis abrupta	Pink Mucket	Endangered	Endangered
Lampsilis higginsii	Higgins Eye	Endangered	Endangered
Lampsilis rafinesqueana	Neosho Mucket	Proposed	Endangered
Leptodea leptodon	Scaleshell	Endangered	Endangered
Plethobasus cyphyus	Sheepnose	Endangered	Endangered
Potamilus capax	Fat Pocketbook	Endangered	Endangered
Quadrula fragosa	Winged Mapleleaf	Endangered	Endangered
Quadrula cylindrica	Rabbitsfoot	Proposed	Threatened
CRUSTACEANS			
Cambarus aculabrum	Cave Crayfish		Endangered
INSECTS			
Nicrophorus americanus	American Burying Beetle[3]	Endangered	Endangered
Somatochlora hineana	Hine's Emerald	Endangered	Endangered
FISH			
Acipenser fulvescens	Lake Sturgeon	Endangered	
Amblyopsis rosae	Ozark Cavefish	Endangered	Threatened
Cottus specus	Grotto Sculpin		Proposed Endangered
Crystallaria asprella	Crystal Darter	Endangered	
Etheostoma cragini	Arkansas Darter		Candidate
Etheostoma fusiforme	Swamp Darter	Endangered	
Etheostoma histrio	Harlequin Darter	Endangered	
Etheostoma nianguae	Niangua Darter	Endangered	Threatened
Etheostoma parvipinne	Goldstripe Darter	Endangered	
Etheostoma whipplei	Redfin Darter	Endangered	
Forbesichthys agassizi	Spring Cavefish	Endangered	
Hybognathus hayi	Cypress Minnow	Endangered	
Notropis maculatus	Taillight Shiner	Endangered	

Notropis sabinae	Sabine Shiner	Endangered	
Notropis topeka	Topeka Shiner	Endangered	Endangered
Noturus eleutherus	Mountain Madtom	Endangered	
Noturus placidus	Neosho Madtom	Endangered	Threatened
Percina nasuta	Longnose Darter	Endangered	
Platygobio gracilis	Flathead Chub	Endangered	
Scaphirhynchus albus	Pallid Sturgeon	Endangered	Endangered
Scaphirhynchus platorynchus	Shovelnose Sturgeon		Threatened/SA
Umbra limi	Central Mudminnow	Endangered	

AMPHIBIANS

Cryptobranchus a. alleganiensis	Eastern Hellbender	Endangered	
Cryptobranchus a. bishopi	Ozark Hellbender	Endangered	Endangered

REPTILES

Deirochelys reticularia miaria	Western Chicken Turtle	Endangered	
Emydoidea blandingii	Blanding's Turtle	Endangered	
Kinosternon flavescens	Yellow Mud Turtle	Endangered	
Nerodia cyclopion	Mississippi Green Water Snake[3]	Endangered	
Sistrurus catenatus catenatus	Eastern Massasauga[3]	Endangered	Candidate
Sistrurus catenatus tergeminus	Western Massasauga	Endangered	

BIRDS

Botaurus lentiginosus	American Bittern	Endangered	
Circus cyaneus	Northern Harrier	Endangered	
Egretta thula	Snowy Egret	Endangered	
Falco peregrinus	Peregrine Falcon	Endangered	
Limnothlypis swainsonii	Swainson's Warbler	Endangered	
Peacaea aestivalis	Bachman's Sparrow	Endangered	
Rallus elegans	King Rail	Endangered	
Sterna antillarum athalassos	Interior Least Tern	Endangered	Endangered
Tympanuchus cupido	Greater Prairie-chicken	Endangered	

MAMMALS

Canus lupus	Gray Wolf	Endangered	
Corynorhinus townsendii ingens	Ozark Big-eared Bat[3]	Endangered	Endangered
Lepus californicus	Black-tailed Jackrabbit	Endangered	
Myotis grisescens	Gray Bat Endangered	Endangered	
Myotis sodalis	Indiana Bat Endangered	Endangered	
Spilogale putorius interrupta	Plains Spotted Skunk	Endangered	

[1] Listed in the Wildlife Code of Missouri, Rule 3 CSR10-4, 111 Endangered Species.
[2]Federally Listed Species under the Endangered Species Act (ESA) of 1973 as Amended:
Endangered = Any species that is in danger of extinction throughout all or a significant portion of its range.
Threatened = Any species that is likely to become endangered within the foreseeable future.
Candidate = Plants or animals that the U.S. Fish & Wildlife Service is reviewing for possible addition to the list of Endangered and Threatened species.
Proposed = Any species proposed for listing as Threatened or Endangered by the U.S. Fish & Wildlife Service.
Threatened/SA = Any species listed Threatened due to Similarity of Appearance by the U.S. Fish & Wildlife Service.
[3]Considered extirpated, historical or accidental occurrence in Missouri.