ENVIRONMENTAL ASSESSMENT

REDUCING BIRD DAMAGE

IN THE STATE OF SOUTH CAROLINA

Prepared by:

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

March 2012

TABLE OF CONTENTS

LIST OF APPENDICES

ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AI	Avian Influenza
AQDO	Aquaculture Depredation Order
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BO	Biological Opinion
CBC	Christmas Bird Count
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CUDPR	Clemson University Department of Pesticide 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
ESC	Enteric Septicemia of Catfish
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
HP	Highly Pathogenic
INAD	Investigational New Animal Drug
IPN	Infectious Pancreatic Necrosis
LC	Lethal Concentration
LD	Lethal Dose
MA	Methyl Anthranilate
MANEM	Mid-Atlantic/New England/Maritime
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NAS	National Audubon Society
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWRC	National Wildlife Research Center
PRDO	Public Resource Depredation Order
PL	Public Law
ROD	Record of Decision
SCDA	South Carolina Department of Agriculture
SCDNR	South Carolina Department of Natural Resources
SOP	Standard Operating Procedure
SVC	Spring Viraemia of Carp
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
VHS	Viral Haemorrhagic Septicaemia
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 PURPOSE

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in South Carolina continues to receive requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with double-crested cormorants (*Phalacrocorax auritus*), great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), little blue herons (*Egretta caerulea*), cattle egrets (*Bubulcus ibis*), green herons (*Butorides virescens*), black-crowned night-herons (*Nycticorax nycticorax*), white ibis (*Eudocimus albus*), black vultures (*Coragyps atratus*), turkey vultures (*Cathartes aura*), Atlantic brants (*Branta bernicla hrota*), mute swans (*Cygnus olor*), feral geese, feral ducks, wood ducks (*Aix sponsa*), American wigeons (*Anas americana*), American black ducks (*Anas rubripes*), mallards (domestic/wild) (*Anas platyrhynchos*), blue-winged teal (*Anas discors*), Northern shovelers (*Anas clypeata*), Northern pintails (*Anas acuta*), green-winged teal (*Anas crecca*), canvasbacks (*Aythya valisineria*), lesser scaup (*Aythya affinis*), greater scaup (*Aythya marila*), hooded mergansers (*Lophodytes cucullatus*), common mergansers (*Mergus merganser*), ruddy ducks (*Oxyura jamaicensis*), osprey (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), Northern harriers (*Circus cyaneus*), sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks (*Accipiter cooperii*), red-shouldered hawks (*Buteo lineatus*), red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), peregrine falcons (*Falco peregrinus*), wild turkeys (*Meleagris gallopavo*), American coots (*Fulica americana*), killdeer (*Charadrius vociferous*), black-bellied plovers (*Pluvialis squatarola*), semipalmated plovers (*Charadrius semipalmatus*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), spotted sandpipers (*Actitis macularia*), solitary sandpipers (*Tringa solitaria*), semipalmated sandpipers (*Calidris pusilla*), Western sandpipers (*Calidris mauri*), least sandpipers (*Calidris minutilla*), pectoral sandpipers (*Calidris melantos*), buff-breasted sandpipers (*Tryngites suberficllis*), upland sandpipers (*Bartramia longicauda*), common snipe (*Gallinago gallinago*), laughing gulls (*Larus atricilla*), ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus*), lesser black-backed gulls (*Larus fuscus*), great black-backed gulls (*Larus marinus*), royal terns (*Sterna maxima*), common terns (*Sterna hirundo*), mourning doves (*Zenaida macroura*), great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), common nighthawks (*Chordeiles minor*), chimney swifts (*Chaetura pelagica*), belted kingfishers (*Megaceryle alcyon*), downy woodpeckers (*Picoides pubescens*), hairy woodpeckers (*Picoides villosus*), Northern flickers (*Colaptes auratus*), loggerhead shrikes (*Lanius ludovicianus*), blue jays (*Cyanocitta cristata*), American crows (*Corvus brachyrhynchos*), fish crows (*Corvus ossifragus*), horned larks (*Eremophila alpestris*), tree swallows (*Tachycineta bicolor*), Northern rough-winged swallows (*Stelgidopteryx serripennis*), bank swallows (*Riparia riparia*), cliff swallows (*Hirundo pyrrhonota*), barn swallows (*Hirundo rustica*), American robins (*Turdus migratorius*), gray catbirds (*Durnetella carolinensis*), Northern mockingbirds (*Mimus polyglottos*), Northern cardinals (*Cardinalis cardinalis*), red-winged blackbirds (*Agelaius phoeniceus*), Eastern meadowlarks (*Sturnella magna*), common grackles (*Quiscalus quiscula*), boat-tailed grackles (*Quiscalus major*), brown-headed cowbirds (*Molothrus ater*), purple finches (*Carpodacus purpureus*), and house finches (*Carpodacus mexicanus*).

Free-ranging or feral domestic waterfowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, and swans. Examples of domestic waterfowl include, but are not limited to, mute swans, Muscovy ducks, Pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, Khaki Campbell ducks, Embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy duck, and mallard-Muscovy hybrids.

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

Normally, individual wildlife damage management actions conducted by the WS program could be categorically excluded from further analysis under the National Environmental Policy Act (NEPA), in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c); 60 FR 6000-6003). The purpose of this Environmental Assessment (EA) is to evaluate activities conducted by WS to manage damage and threats to agricultural resources, property, natural resources, and threats to humans caused by birds in the State of South Carolina. This EA analyzes the potential effects of bird damage management when requested, as coordinated between WS and the United States Fish and Wildlife Service (USFWS) and the South Carolina Department of Natural Resources (SCDNR). In addition to those species listed previously, WS also is routinely requested to address damage and threats of damage associated with Canada geese (*Branta canadensis*), rock pigeons (*Columba livia*), European starlings (*Sturnus vulgaris*), and house sparrows (*Passer domesticus*). Activities conducted by WS to alleviate damage or threats of damage associated with Canada geese were evaluated in a separate EA (USDA 2006). WS' activities associated with alleviating damage or threats of damage associated with pigeons, starlings, and house sparrows were also addressed in a separate EA (USDA 2004). Those assessments are further discussed in Section 1.4 of this EA.

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

This EA evaluates the need for action to manage damage associated with birds in the State, the potential issues associated with bird damage management, and the environmental consequences of conducting different alternatives to address the need for action and the identified issues. Issues relating to the reduction of wildlife damage were raised during the scoping process for WS' programmatic FEIS (USDA 1997) and were considered in the preparation of this EA. The issues and alternatives associated with bird damage management were initially developed by WS in consultation with the USFWS, the SCDNR, and the South Carolina Department of Agriculture (SCDA). Issues relating to cormorant damage management (USFWS 2003) were also considered during the development of this EA.

1.2 NEED FOR ACTION

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

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

Both sociological and biological carrying capacities must be applied to 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 associated damage. This damage threshold determines the wildlife acceptance capacity. While the habitat may have a biological carrying capacity to support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or has been met. Once the wildlife acceptance capacity is met or exceeded, 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 1992). The imminent threat of damage or loss of resources is often sufficient for individual actions to be initiated and the need for damage management is derived from the specific threats to resources. Those species that cause damage or pose threats of damage have no intent to do harm. They utilize habitats (*e.g.*, reproduce, walk, forage) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and can be based on many factors (*e.g.*, economic, social, aesthetics). Therefore, how damage is defined is often unique to the individual person and damage occurring to one individual may not be considered damage by another individual. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e.*, has reached an individual threshold). The term "*damage*" is most often defined as economic losses to resources or threats to human safety but could also include a loss in aesthetic value and other situations where the actions of wildlife are no longer tolerable to an individual person.

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 (Smith et al. 1999). 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 disperses 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 South Carolina, 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 (USDA 1997, USFWS 2003).

The need for action to manage damage and threats associated with birds in South Carolina arises from requests for assistance[2] received by WS to reduce and prevent damage associated with birds from occurring to four major categories: agricultural resources, natural resources, property, and threats to human safety. WS has identified those bird species most likely to be responsible for causing damage to those four categories in the State based on previous requests for assistance and assessments of the threat of bird strike hazards at airports in the State. Table 1.1 lists WS' technical assistance projects involving bird damage or threats of bird damage to those four major resource types in South Carolina from the federal fiscal year[3] (FY) 2005 through FY 2011.

Table 1.1 – Technical assistance projects conducted by WS in South Carolina, FY 2005 - FY 2011†

Species	Projects	Species	Projects
Double-crested Cormorant	25	**Peregrine Falcon**	1
Great Blue Heron	9	**Wild Turkey**	3
Great Egret	1	**American Coot**	1
Cattle Egret	4	**Laughing Gull**	2
Black Vulture	314	**Ring-billed Gull**	9
Turkey Vulture	48	**Gull (unidentified)**	1
Vultures (mixed)	14	**Mourning Dove**	1
Mute Swan	1	**Great Horned Owl**	4
Feral Goose	3	**Barred Owl**	6
Feral Duck	14	**Downy Woodpecker**	2
Mallard	15	**Hairy Woodpecker**	1
Osprey	6	**Northern Flicker**	3
Bald Eagle	1	**American Crow**	8
Sharp-shinned Hawk	2	**Barn Swallow**	1
Cooper's Hawk	3	**Northern Mockingbird**	3
Red-shouldered Hawk	4	**Blackbirds (mixed)**	1
Red-tailed Hawk	20	**Common Grackle**	1
American Kestrel	1	**Brown-headed Cowbird**	2
		TOTAL	**535**

†Does not reflect the number of direct operational assistance projects conducted by WS in which WS was directly involved with resolving damage or threats when requested

[2] 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.

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

Technical assistance is provided by WS to those persons requesting assistance with resolving damage or the threat of damage by providing information and recommendations on bird damage management activities that can be conducted by the requestor without WS' direct involvement in managing or preventing the damage. WS' technical assistance activities 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 South Carolina. Since FY 2005, WS has conducted 535 technical assistance projects in South Carolina that addressed damage and threats of damage associated with those bird species addressed in this assessment. WS has conducted 376 technical assistance projects involving damage or threats of damage associated with turkey vultures and black vultures since FY 2005 which are the two bird species with the highest number of projects conducted. Vultures often roost in mixed species flocks in large numbers. Fecal droppings often accumulate under areas where vultures roost and loaf. Concerns are often raised about disease transmission to people that encounter fecal droppings on their property. The odor and aesthetically displeasing presence of fecal droppings at roost sites can also be a concern. Damage can also occur to property from vultures pulling and tearing shingles, trim, and rubber material on buildings and vehicles.

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

Table 1.2 lists those bird species and the resource types that those bird species can cause damage to in South Carolina. Many of the bird species addressed in this EA can cause damage to or pose threats to a variety of resources. In South Carolina, most requests for assistance received by WS are related to threats associated with those bird species being struck by aircraft at or near airports in the State. 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 species (*i.e.*, form large flocks), 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 South Carolina and the resource types damaged

	Resource*					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Double-crested Cormorant	X	X	X	X	Solitary Sandpiper			X	X
Great Blue Heron	X	X	X	X	Semipalmated Sandpiper			X	X
Great Egret	X	X	X	X	Western Sandpiper			X	X
Little Blue Heron	X		X	X	Least Sandpiper			X	X
Cattle Egret	X		X	X	Pectoral Sandpiper			X	X
Green Heron	X		X	X	Buff-breasted Sandpiper			X	X
Black-crowned Night-heron	X		X	X	Upland Sandpiper			X	X
White Ibis	X		X	X	Common Snipe			X	X

Species	Resource*				Species	Resource			
	A	N	P	H		A	N	P	H
Black Vulture	X		X	X	Laughing Gull	X	X	X	X
Turkey Vulture	X		X	X	Ring-Billed Gull	X	X	X	X
Atlantic Brant			X	X	Herring Gull	X	X	X	X
Mute Swan		X	X	X	Lesser Black-backed Gull	X	X	X	X
Feral Goose	X	X	X	X	Great Black-backed Gull	X	X	X	X
Feral Duck	X	X	X	X	Royal Tern			X	X
Wood Duck			X	X	Common Tern			X	X
American Wigeon			X	X	Mourning Dove			X	X
American Black Duck			X	X	Great Horned Owl	X	X	X	X
Mallard	X		X	X	Barred Owl	X	X	X	X
Blue-winged Teal			X	X	Common Nighthawk			X	X
Northern Shoveler			X	X	Chimney Swift			X	X
Northern Pintail			X	X	Belted Kingfisher	X		X	X
Green-winged Teal			X	X	Downy Woodpecker			X	X
Canvasback			X	X	Hairy Woodpecker			X	X
Lesser Scaup			X	X	Northern Flicker			X	X
Greater Scaup			X	X	Loggerhead Shrike			X	X
Hooded Merganser			X	X	Blue Jay			X	X
Common Merganser			X	X	American Crow	X	X	X	X
Ruddy Duck			X	X	Fish Crow	X	X	X	X
Osprey	X		X	X	Horned Lark			X	X
Bald Eagle	X	X	X	X	Tree Swallow			X	X
Northern Harrier	X	X	X	X	Northern Rough-winged Swallow			X	X
Sharp-shinned Hawk	X	X	X	X	Bank Swallow			X	X
Cooper's Hawk	X	X	X	X	Cliff Swallow			X	X
Red-shouldered Hawk	X	X	X	X	Barn Swallow	X		X	X
Red-tailed Hawk	X	X	X	X	American Robin			X	X
American Kestrel	X	X	X	X	Gray Catbird			X	X
Peregrine Falcon	X	X	X	X	Northern Mockingbird			X	X
Wild Turkey	X		X	X	Northern Cardinal			X	X
American Coot	X		X	X	Red-winged Blackbird	X		X	X
Killdeer			X	X	Eastern Meadowlark			X	X
Black-bellied Plover			X	X	Common Grackle	X		X	X
Semipalmated Plover			X	X	Boat-tailed Grackle	X		X	X
Greater Yellowlegs			X	X	Brown-headed Cowbird	X	X	X	X
Lesser Yellowlegs			X	X	Purple Finch			X	X
Spotted Sandpiper			X	X	House Finch			X	X

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

More specific information regarding bird damage is discussed in the following subsections of the EA:

Need to Resolve Bird Damage to Agricultural Resources

According to the National Agricultural Statistics Service (NASS), agriculture is one of the leading industries in South Carolina with approximately 4.9 million acres devoted to agricultural production with a market value of agricultural products sold estimated at nearly $2.4 billion in 2007 (NASS 2009). The top two farm commodities for cash receipts were poultry products and greenhouse/nursery products, which together, accounted for nearly 65% of the cash receipts. The poultry and egg industry in the State ranks eighth in the United States. The cattle inventory in South Carolina during 2007 was nearly 401,000 head with an estimated 294,000 hogs (NASS 2009). The sales value of the aquaculture industry was valued at nearly $4.8 million in 2007 (NASS 2009).

A variety of bird species can cause damage to agricultural resources in the State. Damage and threats of damage to agricultural resources is often associated with bird species that exhibit flocking behaviors (*e.g.*, red-winged blackbirds) or colonial nesting behavior (*e.g.*, swallows). 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 in the State.

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 injuries associated with bird predation as well as the threat of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites. The principal species propagated at aquaculture facilities in South Carolina are catfish (NASS 2009). Of those birds shown in Table 1.2 associated with causing damage to agricultural resources, of primary concern to aquaculture facilities in South Carolina are double-crested cormorants, osprey, herons, egrets, and to a lesser extent waterfowl, red-tailed hawks, gulls, kingfisher, crows, and common grackles.

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

Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. The magnitude of economic impacts that cormorants have on the aquaculture industry can vary dependent upon many

different variables including, the value of the fish stock, number of depredating birds present, and the time of year the predation is taking place.

In addition to cormorants, great blue herons are also known to forage at aquaculture facilities (Parkhurst et al. 1987). During a survey of aquaculture facilities in the northeastern United States, 76% of respondents identified the great blue heron as the bird of highest concern from predation (Glahn et al. 1999). 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 Pennsylvania 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 cormorants and herons, other bird species have also been identified as causing damage or posing threats to aquaculture facilities. In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities, including 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).

Mallards have been identified by aquaculture facilities as posing a threat of economic loss from foraging behavior (Parkhurst et al. 1987, Parkhurst et al. 1992). During a survey conducted in 1984 of fisheries primarily in the eastern United States, managers at 49 of 175 facilities reported mallards as feeding on fish at those facilities, which represented an increase in the number of facilities reporting mallards as feeding on fish when compared to prior surveys (Parkhurst et al. 1987). Parkhurst et al. (1992) found mallards foraging on trout fingerling at facilities in Pennsylvania. Mallards selected trout ranging in size from 8.9 centimeters to 12.2 centimeters in length. Once trout fingerlings reached a mean length of approximately 14 centimeters in raceways, mallards present at facilities switched to other food sources (Parkhurst et al. 1992). Of those predatory birds observed by Parkhurst et al. (1992), mallards consumed the most fish at the facilities with a mean of 148,599 fish captured and had the highest mean economic loss per year per site based on mallards being present at those facilities for a longer period of time per year compared to other species.

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).

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

Although primarily insectivorous during the breeding season and granivorous during migration periods (Peer and Bollinger 1997), common grackles have been identified as feeding on fish (Hamilton 1951,

Beeton and Wells 1957, Darden 1974, Zottoli 1976, Whoriskey and Fitzgerald 1985, Parkhurst et al. 1992). During a study of aquaculture facilities in central Pennsylvania, Parkhurst et al. (1992) found grackles feeding on trout fry at nine of the ten facilities observed. The mean length of trout captured by grackles was 7.6 centimeters with a range of 6.0 to 7.9 centimeters. Once fish reached a mean size of 14 centimeters, grackles switched to alternative food sources at those facilities (Parkhurst et al. 1992). Among all predatory bird species observed during the study conducted by Parkhurst et al. (1992), grackles captured and removed the most fish per day per site which was estimated at 145,035 fish captured per year per site.

Also of concern to aquaculture facilities is the transmission of diseases by birds between impoundments and from facility to facility. Given the confinement of aquatic 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 and result in extensive mortality. Although the actual transmission of diseases through transport by birds is difficult to document, birds have been documented as having the capability of spreading diseases through fecal droppings and possibly through other mechanical means such as on feathers, feet, and regurgitation.

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

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

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

Damage and Threats to Livestock Operations

Damage to livestock operations can occur from several bird species in South Carolina. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual or small

groups of birds can cause economic damage to livestock producers, such as a vulture or a group of vultures feeding on newborn cattle, most damage occurs from bird species that congregate in large flocks at livestock operations.

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

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

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. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily brown-headed cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000.

In addition, large concentrations of birds feeding, roosting, and/or loafing at livestock operations increase risks of disease transmission from fecal matter being deposited in areas where livestock feed, water, and are housed. Birds feeding in open troughs on livestock feed leave fecal deposits which can be consumed by feeding livestock, fecal matter can also be deposited in sources of water for livestock which increases the likelihood of disease transmission, and can contaminate other surface areas where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carrying infectious diseases which can be excreted in fecal matter which not only poses 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.

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

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.

Certain bird species are also known to prey upon livestock which can result in economic losses to livestock producers. 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 vultures in the United States during 2010 valued at $4.6 million (NASS 2011). While both turkey vultures and black vultures have been documented harassing expectant cattle, WS in South Carolina has documented calf predation by black vultures. Vulture predation on livestock is distinctive. Black vultures 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, vultures will peck at the half-expunged calf and kill it. Reports of calf depredation by vultures occur but are not necessarily common in South Carolina.

Economic losses can also result from raptors, particularly 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 of time 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 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 2007, the sale of fruits, tree nuts, and berries along with vegetables, melons, and potatoes accounted for 6.8% of the total agricultural sales in the State. Other crop commodities harvested in 2007 include oats, wheat, corn, soybeans, and alfalfa (NASS 2009). Damage to agricultural crops in the State occurs primarily from American crows, red-winged blackbirds, grackles, cowbirds, and to a lesser extent mallards, gulls, woodpeckers, and American robins.

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

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).

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 damaged often discolors and is susceptible to disease introduction into the ear (Besser 1985). Damage usually begins at the tip of the ear as the husk is ripped and pulled back but can occur anywhere on the ear (Besser 1985).

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

The most common waterfowl damage to agriculture is crop consumption, but also consists of unacceptable accumulations of feces on pastures, trampling of emerging crops, and increased erosion and runoff from fields where the cover crop has been grazed. Waterfowl graze a variety of crops, including oats, wheat, corn, soybeans, and alfalfa. Associated costs with agricultural damage involving waterfowl include costs to replant grazed crops, implement wildlife management practices, purchase replacement hay, and decreased yields.

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 and hawks, can pose risks to human safety.

Threat of Disease Transmission

Birds can play an important role in the transmission of diseases where humans may come into contact with fecal droppings of those birds. Few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to humans from transmission of those diseases. Study of this issue is complicated by the fact that some disease-causing agents associated with birds may also be contracted from other sources. The risk of disease transmission from birds to humans is likely very low. However, human exposure to fecal droppings through direct contact or through the disturbance of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. The gregarious behavior of bird species leads to accumulations of fecal droppings that can be considered a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings.

Birds can play an important role in the transmission of zoonotic diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Public health officials and residents near areas where fecal droppings accumulate express concerns for human health related to the potential for disease transmission. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum* which causes the disease histoplasmosis in humans (Weeks and Stickley 1984). The

disturbance of soil or fecal droppings under bird roosts where fecal droppings have accumulated can cause *H. capsulatum* to become airborne. Once airborne, the fungus could be inhaled by people in the area. Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by humans, livestock, and pets that can be associated with accumulations of bird droppings.

In most cases in which human health concerns are a major reason for requesting assistance, no actual cases of bird transmission of disease to humans have been proven to occur. Thus, it is the risk of disease transmission that is the primary reason for those persons to request assistance from WS.

Waterfowl may impact 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 and 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). Also, 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., *E. 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, Blandespoor 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.

Threat of Aircraft Striking Wildlife at Airports and Military Bases

In addition to threats of zoonotic diseases, birds also pose a threat to human safety from being struck by aircraft. Birds struck by aircraft, especially when ingested into engines, can lead to structural damage to the aircraft and can cause catastrophic engine failure. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transportation industry as a whole (Conover et al. 1995). In several instances, wildlife-aircraft collisions in the United States have resulted in human fatalities. In 1995, an Air Force E-3B AWACS aircraft collided with a flock of Canada geese at Elmendorf Air Force Base in Alaska which killed all 24 passengers and crew onboard the aircraft. In addition, a $190 million plane was lost (Dolbeer 1997). From 1990 through 2010, a total of 449 birds have been reported as struck by aircraft in South Carolina (Dolbeer et al. 2011).

Target bird species when in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on or near an airport, present a safety threat to aviation. Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered to be the most hazardous bird for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000). 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 2009, 96,626 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 go unreported (Cleary et al. 2005, Wright and Dolbeer 2005). Generally, bird collisions occur when aircraft are near the ground during take-off and approach to the runway. From 1990 through 2009, 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. 2011).

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 2009, gulls comprised 18% 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 8% of reported strikes (Dolbeer et al. 2011).

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 and Wright 2008). Between 1990 and 2009, 23 people have died after aircraft have stuck birds in the United States (Dolbeer et al. 2011). Of those 23 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. 2011). 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 2009, 42 strikes involving waterfowl have resulted in injuries to 47 people while 25 strikes involving vultures resulted in injuries to 27 people (Dolbeer et al. 2011).

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 (Smith et al. 1999). 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. If fecal droppings occur in areas with foot traffic, slipping could occur resulting in injuries to people. To avoid those conditions, regular clean-up 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 South Carolina. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property occurs through direct damage to structures, through roosting behavior, and through their nesting behavior. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. 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, or 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. Persons and businesses concerned about these types of damage may request WS' assistance.

Gulls, doves, raptors, and waterfowl are the bird groups most frequently struck by aircraft in the United States (Dolbeer et al. 2011). Of the total known birds struck in the United States from 1990 through 2009, 18% involved gulls where identification of the species occurred, pigeons and doves comprised nearly 15% of the total reported strikes while raptors accounted for 13% and waterfowl were identified in 8% of reported strikes. When struck, 24% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight while 30% of the reported waterfowl strikes resulted in damage or negative effects on the flight (Dolbeer et al. 2011). Since 1990, over $101 million in damages to civil aircraft have been reported from strikes involving waterfowl (Dolbeer et al. 2009). In total, aircraft striking birds has resulted in 424,936 hours of aircraft downtime and over $374.9 million in reported damages to civil aircraft since 1990 in the United States (Dolbeer et al. 2011).

Damage to property associated with large concentrations of roosting birds occurs primarily from accumulations of droppings and feather debris. Many of the bird species addressed in this assessment are gregarious (*i.e.*, form large flocks) especially during the fall and spring migration periods. Although damage and threats can occur throughout the year, damage is highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. Birds that routinely roost and loaf in the same areas often leave large accumulations of droppings and feather debris which is aesthetically displeasing and can cause damage to property. The reoccurring presence of fecal droppings under bird roosts can lead to constant 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, foot paths, swimming pools, play grounds, school grounds, and cemeteries. Property damage most often involves goose 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 wildlife management methods, loss of property use, loss of aesthetic value of flowers, gardens, and lawns consumed by waterfowl, loss of customers or visitors irritated by walking in fecal droppings, repair of golf greens, and replacing grazed turf. The costs of reestablishing overgrazed lawns and cleaning waterfowl feces from sidewalks have been estimated at more than $60 per bird (Allan et al. 1995).

Property losses associated with cormorants include impacts to privately-owned lakes that are stocked with fish; damage to boats and marinas or other properties found near cormorant breeding or roosting sites; and damage to vegetation on privately-owned land (USFWS 2003).

Gull attraction to landfills as a food source has been well documented (Mudge and Ferns 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 and use landfills as feeding and loafing areas throughout North America. In the northeastern United States, landfills often serve as foraging and loafing areas for gulls throughout the year, while attracting larger populations of gulls during migration periods (Bruleigh et al. 1998). Landfills have even been suggested as contributing to the increase in gull populations (Verbeek 1977, Patton 1988, Belant and Dolbeer 1993*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.

The nesting behavior of some bird species can also cause damage to property. Nesting material can be aesthetically displeasing and fecal droppings often accumulate near nests which can also be aesthetically displeasing. Many bird species are colonial nesters meaning they nest together in large numbers. Many of the gull, egret, and heron species addressed in this assessment nest in large colonies. Swallows can also nest in large colonies. Roof-top colonies of nesting gulls have been well documented and frequently cause damage to urban and industrial structures. Nesting gulls peck at spray-on-foam roofing and rubber roofing material, including caulking. This creates holes that must be repaired or leaks in the roof can result. Gulls transport large amounts of nest material and food remains to the roof-tops which can obstruct roof drainage systems and lead to structural damage or roof failure if clogged drains result in rooftop flooding (Vermeer et al. 1988, Blokpoel and Scharf 1991, Belant 1993). Nesting material and feathers can also clog ventilation systems resulting in cleaning and repairs.

Damage to property caused by birds that has been reported to or verified by WS in South Carolina has totaled $343,928 between FY 2005 and FY 2011 which is an average of $49,133 per year. In most situations, requests for assistance received by WS are associated with the accumulation of fecal droppings under areas where birds roost, loaf, and feed. Accumulations of fecal droppings can be aesthetically displeasing to employees and the public and can require constant cleaning costs.

Need to Resolve Bird Damage Occurring to Natural Resources

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

Habitat degradation in South Carolina occurs primarily in areas where colonial waterbirds nest or where the gregarious roosting behavior of birds occurs. The degradation of habitat occurs from the continuous accumulation of fecal droppings that occurs under nesting colonies of birds or under areas where birds consistently roost. Over time, the accumulation of fecal droppings under areas where colonial waterbirds

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

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

Cormorants can have a negative impact on vegetation that provides nesting habitat for other birds (Jarvie et al. 1999, Shieldcastle and Martin 1999) and wildlife, including State and federally-listed T&E species (Korfanty et al. 1999). Cuthbert et al. (2002) found that cormorants have a negative effect on normal plant growth and survival on a localized level in the Great Lakes region. Wires and Cuthbert (2001) identified vegetation die off as an important threat to 66% of the colonial waterbird sites designated as conservation sites of priority in the Great Lakes of the United States. Of the 29 priority conservation sites reporting vegetation die off as a threat, Wires and Cuthbert (2001) reported cormorants were present at 23 of those sites. Based on survey information provided by Wires et al. (2001), biologists in the Great Lakes region reported cormorants as having an impact to herbaceous layers and trees where nesting occurred. Damage to trees was mainly caused by fecal deposits, and resulted in tree die off at breeding colonies and roost sites. Impacts to the herbaceous layer of vegetation were also reported due to fecal deposition, and often this layer was reduced or eliminated from the colony site. In addition, survey respondents reported that the impacts to avian species from cormorants occurred primarily from habitat degradation and from competition for nest sites (Wires et al. 2001). Although loss of vegetation can have an adverse impact on many species, some colonial waterbirds such as pelicans and terns prefer sparsely vegetated substrates.

Large accumulations of fecal droppings under crow roosts could have a detrimental impact on desirable vegetation. A study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

Large concentrations of waterfowl have affected water quality around beaches and in wetlands by acting as nonpoint source pollution. There are four forms of nonpoint source pollution: sedimentation, nutrients, toxic substances, and pathogens. Large concentrations of waterfowl can remove shoreline vegetation resulting in erosion of the shoreline and soil sediments being carried by rainwater into lakes, ponds, and reservoirs (USFWS 2005).

Scherer et al. (1995) stated that waterfowl metabolize food very rapidly and most of the phosphorus contributed by bird feces into water bodies probably originates from sources within a lake being studied. In addition, assimilation and defecation converted the phosphorus into a more soluble form and, therefore was considered a form of internal loading. Waterfowl can contribute substantial amounts of phosphorus and nitrogen into lakes through feces creating excessive aquatic macrophyte growth and algae blooms (Scherer et al. 1995) and accelerated eutrophication through nutrient loading (Harris et al. 1981).

Some species listed as threatened and endangered under the Endangered Species Act of 1973 (ESA) are preyed upon or otherwise adversely affected by certain bird species. Concentrations of gulls often impact the productivity and survivorship of rare or endangered colonial species such as terns (U.S. Department of the Interior (USDI) 1996) and prey upon the eggs and chicks of colonial waterbirds. Colonial nesting gull species are also known to compete with other bird species for nest sites, such as terns and plovers.

Crows are considered omnivorous, consuming a variety of invertebrates, amphibians, reptiles, mammals, and small birds, including birds' eggs, nestlings, and fledglings as well as grain crops, seeds, fruits, carrion, and discarded human food (Verbeek and Caffrey 2002). With crows, the primary concern to natural resources occurs from predation on T&E species. Crows have been documented feeding on piping plover (*Charadrius melodus*) eggs and nestlings. Piping plovers are currently considered a threatened species by the USFWS.

The WS program in South Carolina has participated in interagency meetings to address the need for managing predation on T&E species inhabiting the coastal beach ecosystems of South Carolina. The coastal beach ecosystems of South Carolina support a variety of State and federally-listed species. There are approximately 330 kilometers of ocean-facing sandy beaches in South Carolina that provide suitable nesting habitat for sea turtles. To date, loggerhead sea turtle (*Dermochelys coriacea*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), and Kemp's ridleys sea turtle (*Lepidochelys kempii*) nests have been recorded on South Carolina beaches. Predation on T&E species nests and nestlings lowers the reproductive success of those species which in combination with other factors can inhibit the recovery of those species. WS in South Carolina has included American crows as a target species in an agreement to protect gopher tortoise (*Gopherus polyphemus*) nests from predation.

1.3 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

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

The methods available for use under the alternatives evaluated are provided in Appendix B. The alternatives and Appendix B also discuss how methods would be employed to manage damage and threats associated with birds in the State. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives and the employment of those methods by WS to manage or prevent damage and threats associated with birds from occurring when permitted by the USFWS 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 USC 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.

Native American Lands and Tribes

The WS program in South Carolina would only conduct damage management activities when requested by a Native American Tribe and only after a Memorandum of Understanding (MOU) or cooperative service agreement has been signed between WS and the Tribe requesting assistance. Therefore, the Tribe would determine when WS' assistance is required and what activities would be allowed. Because Tribal officials would be responsible for requesting assistance from WS and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would be anticipated. Those methods available to alleviate damage associated with birds on federal, State, county, municipal, and private properties under the alternatives analyzed in this EA would also be available for use to alleviate damage on Tribal properties when the use of those methods have been approved for use by the Tribe requesting WS' assistance. Therefore, the activities and methods addressed under the alternatives would include those activities that could be employed on Native American lands, when requested and agreed upon.

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 South Carolina 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 could cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, 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 indicates an Environmental Impact Statement (EIS) is not warranted, this EA would remain valid until WS determines that new needs for action, changed conditions, new issues, or new alternatives having different environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and supplemented pursuant to the NEPA. Review of the EA would occur to ensure that activities conducted under the selected alternative remain within the parameters evaluated in the EA. If the alternative analyzing no involvement in bird damage management activities by WS is selected, no additional analyses would occur based on the lack of involvement by WS. The monitoring of activities by WS ensures the EA remains appropriate to the scope of bird damage management activities conducted by WS in South Carolina under the selected alternative.

Site Specificity

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

This EA analyzes the potential impacts of bird damage management based on previous activities conducted on private and public lands in South Carolina 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 bird damage management efforts could occur. Thus, this EA anticipates the potential expansion and analyzes the impacts of such efforts as part of the alternatives.

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

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in South Carolina. The standard WS Decision Model (Slate et al. 1992, USDA 1997) would be the site-specific procedure for individual actions conducted by WS in the State (see Chapter 3 for a description of the Decision Model and its application). Additional information on the Decision Model is available in WS' programmatic FEIS (USDA 1997). Decisions made using the model would be in accordance with WS' directives[4] 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 South Carolina. 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 South Carolina were initially developed by WS in consultation with the USFWS and the SCDNR. Issues were defined and preliminary alternatives were identified through the scoping process. As part of this process, and as

[4]At the time of preparation, WS' Directives could be found at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

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

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential for 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.

1.4 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Programmatic Final Environmental Impact Statement: WS has developed a programmatic FEIS that addresses the need for wildlife damage management in the United States (USDA 1997). The FEIS contains detailed discussions of potential impacts to the human environment from wildlife damage management methods used by WS. The FEIS also contains a comprehensive risk assessment of several methods that would be available for use to manage bird damage in South Carolina. Information from WS' programmatic FEIS has been incorporated by reference into this EA.

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

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

Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act Final Environmental Assessment: The EA developed by the USFWS evaluated the issues and alternatives associated with permitting 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 authorized disturbance of eagles which constitutes "*take*" as defined under the Bald and Golden Eagle Protection Act, authorizes the removal of eagle nests where necessary to reduce threats to human safety, and evaluated the issuance of permits authorizing the lethal take of eagles in limited circumstances. A Decision and Finding of No Significant Impact (FONSI) was made for the preferred alternative in the EA (USFWS 2010).

Atlantic Flyway Mute Swan Management Plan 2002-2013: In response to increasing populations of mute swans along the Atlantic Flyway, the Atlantic Flyway Council developed a mute swan plan to reduce swan populations in the Flyway to minimize negative ecological damages occurring to wetland

habitats from the overgrazing of submerged aquatic vegetation by swans. Another goal of the Plan is to reduce swan populations in the Flyway to reduce competition between swans and native wildlife and to prevent the further expansion of mute swans (Atlantic Flyway Council 2003).

***Canada Goose Damage Management Environmental Assessment*:** WS has developed an EA that analyzes a need for action to manage damage associated with Canada geese in South Carolina (USDA 2006). The EA identified issues associated with goose damage management and analyzed alternatives to address those issues. After review of the analyses in the EA, a Decision and FONSI were signed on June 12, 2006, selecting the proposed action to implement an integrated approach to managing goose damage in the State.

***Bird Damage Management Environmental Assessment*:** WS has also developed an EA that analyzes the need for action to manage damage associated with rock pigeons, European starlings, and house sparrows. The EA identified the issues associated with managing damage associated with pigeons, starlings, and house sparrows in the State and analyzed alternative approaches to meet that need while addressing the identified issues (USDA 2004). Based on the analyses in the EA, a Decision and FONSI were signed on December 13, 2004 which selected the proposed action alternative. The proposed action alternative addressed the implementation of an adaptive approach to managing damage using multiple methods that are integrated together to meet the need for action.

1.5 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 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 alleviate wildlife damage and threats.

United States Fish and Wildlife Service Authority

The USFWS mission is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. Responsibilities are shared with other federal, state, tribal, and local entities; however, the USFWS has specific responsibilities for the protection of T&E species under the 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, including lands under the National Wildlife Refuge System.

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

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

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

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

United States Environmental Protection Agency (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 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.

South Carolina Department of Natural Resources

The agency as organized on July 1, 1994, under the South Carolina Restructuring Act has the primary mission to serve as the principal advocate for and steward of South Carolina's natural resources.

South Carolina Department of Agriculture

The SCDA is a state agency established by the South Carolina Legislature in 1879. The mission of the South Carolina Department of Agriculture is to promote and nurture the growth and development of South Carolina's agriculture industry and its related businesses while assuring the safety and security of the buying public.

Clemson University Department of Pesticide Regulation (CUDPR)

The CUDPR is responsible for enforcing all pesticide regulations and laws, both state and federal in South Carolina. The CUDPR is responsible for carrying out provisions of the South Carolina Pesticide Control Act and the South Carolina Chemigation Act. Through cooperative agreements with the EPA, the department also implements provisions of the FIFRA.

1.6 COMPLIANCE WITH LAWS AND STATUTES

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

National Environmental Policy Act

All federal actions are subject to the NEPA (Public Law 9-190, 42 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 the 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 the CEQ regulations, this EA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives that could be 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 U.S.C 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 conducted in this EA would be in compliance with the regulations of the MBTA, as amended.

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

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

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to lethal take blackbirds when those species are found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to

constitute a health hazard or other nuisance. Those bird species that can be lethally taken under the blackbird depredation order that are addressed in the assessment include American crows, fish crows, red-winged blackbirds, common grackles, boat-tailed grackles, and brown-headed cowbirds.

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

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

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

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

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 ducks 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)

Congress enacted the Bald Eagle Protection Act (16 USC 668) in 1940; thereby, making it a criminal offense for any person to "*take*" or possess any bald eagle or any part, egg, or nest. The Act contained several exceptions which permitted take under select circumstances. The Secretary of the Interior could take and possess bald eagles for scientific or exhibition purposes of public museums, scientific societies, and zoological parks; possession of any bald eagle (or part, nest, or egg) taken prior to 1940 was not

prohibited; and the terms of the Act did not apply to Alaska. Since its original enactment, the Act has been amended several times to increase protections for eagles and/or provide exemptions for specific types of activities. For example, the amendment in 1962 was designed to give greater protection to immature bald eagles, and to include golden eagles. The 1962 amendment also created two exceptions to the Act: first, it allowed the taking and possession of eagles for the religious purposes of Native American tribes and second, it provided that the Secretary of the Interior, on request of the governor of any State, could authorize the taking of golden eagles to seasonally protect domesticated flocks and herds in that State.

While bald eagles were federally listed as a threatened species, the ESA was the primary regulation governing the management of bald eagles in the lower 48 states. Now that bald eagles have been removed from the federal list of T&E species, the Bald and Golden Eagle Protection Act is the primary regulation governing bald eagle management. 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 can "*molest"* or "*disturb"* eagles. For the purposes of the Act under 40 CFR 22.3, the term "*disturb"* as it relates to take has been defined as "*to agitate or bother a bald……eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."*

Endangered Species Act

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

WS obtained a Biological Opinion (BO) on programmatic activities from the USFWS in 1992 describing potential effects on T&E species, and prescribing reasonable and prudent measures for avoiding jeopardy (see Appendix F in USDA 1997). As part of the development of this EA, WS has also consulted with the USFWS regarding T&E species in South Carolina in regards to bird damage management activities proposed 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 operationally by WS causes major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources is planned under

an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

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

Investigational New Animal Drug (INAD)

The FDA can grant permission to use investigational new animal drugs commonly known as INAD (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. Alpha-chloralose as a method for resolving waterfowl damage and threats to human safety are discussed in Appendix B of this EA.

Environmental Justice - Executive Order 12898

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

Protection of Children - Executive Order 13045

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

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

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

Invasive Species - Executive Order 13112

Executive Order 13112 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 work until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All chemical methods available under the alternatives that would be available in South Carolina, including the use of or recommendation of repellents are registered with and regulated by the EPA and the CUDPR, and used or recommended by WS in compliance with labeling procedures and requirements.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; P.L. 92-583, October 27, 1972; 86 Stat. 1280).

This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, identify uses of the area to be regulated by the state, determine the mechanism (criteria, standards or regulations) for controlling such uses, and develop broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varied depending on whether the federal action involved a permit, license, financial assistance, or a federally authorized activity. As appropriate, a consistency determination would be conducted by WS to assure management actions would be consistent with the State’s Coastal Zone Management Program.

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. Alpha-chloralose as a method for resolving waterfowl damage and threats to human safety are discussed in Appendix B of this EA.

Occupational Safety and Health Act of 1970

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

South Carolina Permit to Remove Destructive Wildlife (§ 50-11-1050)

A permit is required from the SCDNR to remove damaging wildlife, including birds, *"where wildlife is destroying property, the department, upon the request of the property owner, may issue a permit authorizing the property owner, under supervision of the department, to take action necessary to remove the destructive wildlife from his property."*

South Carolina Pesticide Control Act (§ 46-13-10)

The South Carolina Pesticide Control Act defines public health control activities as, *"the use of any pesticide with the intent to prevent, destroy, repel, or otherwise mitigate any pest of public health significance or engaging in any other activities intended or claimed to mitigate pests of public health significance for compensation or as a government employee on the property of another, including the installation of devices."*

South Carolina Backflow Prevention Act, Chemigation Act (§ 46-1-140)

The South Carolina Backflow Prevention Act, Chemigation Act defines chemigation as, *"means any process whereby chemicals are applied to land and or agricultural commodities including, but not limited to: agricultural crops, nursery, turf, golf course or greenhouse sites, through an irrigation system."*

1.7 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Management of migratory birds is the responsibility of the USFWS. The SCDNR is responsible for managing wildlife in the State of South Carolina, including birds. The SCDNR establishes and enforces regulated hunting seasons in the State, including the establishment of seasons that allow the take of some of the bird species addressed in this assessment.

For migratory birds, the SCDNR can establish hunting seasons for those species under frameworks determined by the USFWS. WS' activities to reduce and/or prevent bird damage in the State would be coordinated with the USFWS and the SCDNR which ensure WS' actions are incorporated into population objectives established by those agencies for bird populations in the State. 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 and the SCDNR; therefore, the take of those bird species by WS to alleviate damage or reduce threats of damage would only occur at the discretion of those agencies. In addition, WS' annual take of birds to alleviate damage or threats of damage would only occur at levels authorized by those agencies as specified in depredation permits.

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

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

Upon receiving a request for assistance, activities could be conducted on federal, State, tribal, municipal, and private properties in South Carolina. Assistance requests to resolve bird damage could occur, but is not necessarily limited to, areas in and around buildings and 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.

Wildlife species, such as most native species are protected under state or federal law. For some bird species, take during the hunting season is regulated pursuant to the MBTA by the USFWS through the issuance of frameworks, that includes the allowable length of hunting seasons, methods of take, and allowed take which are implemented by the SCDNR. 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. Cormorants can be lethally taken in the State without the need for a depredation permit from the USFWS under the PRDO and the AQDO. In addition, Muscovy ducks can also be removed pursuant to a control order without the need for a permit in South Carolina. Pursuant to the MBTA, the USFWS can issue depredation permits to those entities experiencing damage associated with birds, when deemed appropriate. When a non-federal entity (*e.g.*, agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other non-federal entity) takes a bird damage management action, 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 would have 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, or through the issuance of depredation permits by the USFWS and since most methods for resolving damage are available to 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, or through the issuance of a depredation permit by the USFWS. Under those circumstances, WS would have virtually no ability to affect the environmental status quo since the action would likely occur in the absence of WS' direct involvement.

Therefore, based on the discussion above, in those situations where a non-federal entity has already made the decision to remove or otherwise manage birds to stop damage with or without WS' assistance, WS' participation in carrying out that action would not affect the environmental status quo.

[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.

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 safety or could lead to the use of inappropriate methods in an attempt to resolve damage. WS' personnel are trained in the use of methods which increases the likelihood that damage management methods are employed appropriately with regards to effectiveness, humaneness, minimizes non-target take, and reduces threats to human safety from those methods. WS' mission is to provide leadership in resolving and preventing damage to resources and to reduce threats to human safety caused by wildlife, including birds in South Carolina. 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 relating to the reduction of wildlife damage were raised during the scoping process for WS' programmatic FEIS (USDA 1997) and were considered in the preparation of this EA. Those issues are fully evaluated within WS' programmatic FEIS which analyzed specific data relevant to WS' programmatic activities at the time of preparation. Those issues identified in the cormorant management FEIS developed by the USFWS, in cooperation with WS, were also reviewed and considered during the development of this EA. Issues related to managing damage associated with birds in South Carolina were developed by WS in consultation with the USFWS and the SCDNR. 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 are the potential impacts of management actions on the populations of target species. Methods used to resolve damage or threats to human safety can involve altering the behavior of target species and may require the use of lethal methods when appropriate. Under the proposed action, WS would incorporate non-lethal and lethal methods described in Appendix B in an integrated approach in which all or a combination of methods may be employed to resolve a request for assistance. WS would recommend both non-lethal and lethal methods, as governed by federal, State, and local laws and regulations.

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

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

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 birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2011). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, as a result of variable local habitat and climatic conditions. Trends can be determined using different population equations and statistically tested to determine if a trend is statistically significant.

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. 2011).

Christmas Bird Count

The CBC is conducted in December and early January annually by numerous volunteers under the guidance of the National Audubon Society (NAS). The CBC reflects the number of birds frequenting a location during the winter months and is based on birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but can be used as an indicator of trends in the population 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) surveyed during the BBS to an area of interest. The model used by Rich et al. (2004) makes assumptions on the detectability of birds, which can vary for each species. Some species of birds that are more conspicuous (visual and auditory) are more likely to be detected during bird surveys when compared to bird species that are more secretive and do not vocalize often. Information on the detectability of a species is combined to create a detectability factor which may be combined with relative abundance data from the BBS to yield a population estimate (Rich et al. 2004).

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 South Carolina lies within the Southeastern Coastal Plain (Bird Conservation Region 27) and the Piedmont (Bird Conservation Region 29). The Southeastern Coastal Plain, also known as Bird Conservation Region 27, overlaps areas of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and small parts of Louisiana, Tennessee, and Kentucky. This region is characterized by extensive riverine swamps and marsh complexes along the Atlantic Coast. The region also includes the interior forests dominated by longleaf, slash, and loblolly pine forests. Areas within the western portion of the State along the Appalachian Mountains lie within the Piedmont region, also known as Bird Conservation Region 29. The Piedmont overlaps Georgia, South Carolina, North Carolina, Virginia, and a small part of Alabama extending northward into Maryland, Pennsylvania, and New Jersey. The region is characterized as a transitional area between the Appalachian Mountains and the Southeastern Coastal Plain consisting of a patchwork of various hardwood, grassland, and urban settings (USFWS 2000).

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 in the State by the SCDNR. Those species addressed in this EA that have established hunting seasons include: American crows, fish crows, wild turkeys, mallards, blue-winged teal, green-winged teal, American coots, American black ducks, common mergansers, hooded mergansers, canvasbacks, Northern pintails, Northern shovelers, ruddy ducks, greater scaup, lesser scaup, American wigeons, wood ducks, common snipe, mourning doves, and Atlantic brant.

For crows, take can also occur under the blackbird depredation order established by the USFWS. 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 SCDNR 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 which 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 B.

Concerns have also been raised about the potential for adverse effects to occur to non-target wildlife from the use of registered toxicants and repellents. Chemical methods being considered for use to manage damage and threats associated with birds in South Carolina are further discussed in Appendix B. Chemical methods considered for use to manage damage or threat associated with birds includes the avicide DRC-1339, Avitrol, alpha-chloralose, mesurol, nicarbazin, and taste repellents.

The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. WS conducts Section 7 consultations with the USFWS to ensure compliance with the ESA and to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)].

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. WS has consulted with the USFWS on programmatic activities under Section 7 of the ESA concerning potential impacts of methods available for use by WS on T&E species. The USFWS issued a BO on WS' programmatic activities in 1992 (USDA 1997). As part of the scoping process and to facilitate interagency cooperation, WS consulted with the USFWS under Section 7 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 to human safety associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. WS' employees use and recommend only those methods which are legally available, selective for target species, and are effective at resolving the damage associated with wildlife. Still, some concerns exist regarding the safety of WS' methods despite their legality. As a result, WS will analyze the potential for proposed methods to pose a risk to members of the public or employees of WS. In addition to the potential risks to the public associated with WS' methods, risks to employees are also an issue. WS' employees are potentially exposed to damage management methods as well as subject to workplace accidents. Selection of methods, as part of an integrated approach, includes consideration for public and employee safety.

Safety of Chemical Methods Employed

The issue of using 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. Several avian repellents are commercially available to disperse birds from an area or discourage birds from feeding on desired resources. Avitrol is a flock

dispersal agent 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, boat-tailed grackles, brown-headed cowbirds, 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. Alpha-chloralose, a sedative, is also being considered as a method that could be employed under the alternatives to manage damage associated with waterfowl. Nicarbazin is the only reproductive inhibitor currently registered with the EPA for use to manage populations of waterfowl by reducing or eliminating the hatchability of eggs laid. Chemical methods are further discussed in Appendix B of this EA.

The use of chemical methods is regulated by the EPA through the FIFRA, the SCDA, and by WS Directives[6]. WS' use of chemical methods is also discussed in WS' programmatic FEIS (USDA 1997).

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 may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include improved animal husbandry practices, altering feeding schedules, changes in crop rotations, or conducting structural repairs. Limited habitat modification would be practices that alter specific characteristic of a localized area, such as pruning trees to discourage birds from roosting or planting vegetation that are less palatable to birds. Animal behavior modification methods would include those methods designed to disperse birds from an area through harassment or exclusion. Behavior modification methods could include pyrotechnics, propane cannons, bird-proof barriers, electronic distress calls, effigies, mylar tape, lasers, eye-spot balloons, or nest destruction. Other mechanical methods could include live-traps, mist nests, cannon nets, shooting, or the recommendation that a local population of birds be reduced through the use of hunting.

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 South Carolina 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.

Effects of Not Employing Methods to Reduce Threats to Human Safety

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

[6]At the time of preparation, WS' Directives could be found at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

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

Issue 4 - Effects on the Aesthetic Values of Birds

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

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

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

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

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

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

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

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

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain and identifying the causes that elicit pain responses in humans would *"…probably be causes for pain in other animals…"* (AVMA 1987). However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

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

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

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

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

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

Another issue commonly identified is a concern that bird damage management activities conducted by WS would affect the ability of persons to harvest those species during the regulated hunting seasons either by reducing local populations through the lethal removal of birds or by reducing the number of birds present in an area through dispersal techniques. Those species that are addressed in this EA that also can be hunted during regulated seasons in the State include: American crows, fish crows, wild turkeys, mallards, blue-winged teal, green-winged teal, American coots, American black ducks, common mergansers, hooded mergansers, canvasbacks, Northern pintails, Northern shovelers, ruddy ducks, greater scaup, lesser scaup, American wigeons, wood ducks, common snipe, mourning doves, and Atlantic brant. Potential impacts could arise from the use of non-lethal or lethal damage management methods. Non-lethal methods used to reduce or alleviate damage caused by those birds species would be used to reduce bird densities through dispersal in areas where damage or the threat of damage was occurring. Similarly, lethal methods used to reduce damage associated with those birds could lower densities in areas where damage was occurring resulting in a reduction in the availability of those species during the regulated harvest season. WS' bird damage management activities would primarily involve local populations in areas where hunting access is restricted (*e.g.*, airports, urban areas) or has been ineffective. The use of non-lethal or lethal methods often disperses birds from areas where damage is occurring to areas outside the damage area which could serve to move those bird species from those less accessible areas to places accessible to hunters.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

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

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

A concern was raised that an EA for an area as large as the State of South Carolina 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 could 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 is 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 South Carolina would continue to conduct bird damage management in a very small area of the State where damage was occurring or likely to occur.

WS' Impact on Biodiversity

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

A Loss Threshold Should Be Established Before Allowing Lethal Methods

One issue identified through WS' implementation of the NEPA processes is a concern that a threshold of loss should be established before employing lethal methods to resolve damage and that wildlife damage should be a cost of doing business. Some damage and economic loss can be tolerated by cooperators until the damage reaches a threshold where damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. 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 that a forest supervisor needs only show that damage from wildlife is threatened, to establish a need for wildlife damage management (Civil No. 92-C-0052A January 20, 1993). Thus, there is judicial precedence indicating that it is not necessary to establish a criterion such as a percentage of loss of a particular resource to justify the need for wildlife damage management actions.

Bird Damage Management Should Not Occur at Taxpayer Expense

An issue identified through the development of WS' programmatic FEIS is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based (USDA 1997). Funding for bird damage management activities is derived from federal appropriations and through cooperative funding. Activities conducted in the State for the management of damage and threats to human safety from birds would be funded through cooperative service agreements with individual property owners or associations. A minimal federal appropriation is allotted for the maintenance of a WS program in South Carolina. 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 agreements between the requester and WS.

Cost Effectiveness of Management Methods

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

Effectiveness of Bird Damage Management Methods

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

The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on humans, target and non-target species, and the environment[7]. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and, for WS' personnel, the guidance provided by WS' Directives and policies.

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

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

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

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

Managing damage caused by birds can be divided into short-term redistribution approaches and long-term population and habitat management approaches (Cooper and Keefe 1997). Short-term approaches focus on redistribution and dispersal of birds to limit use of an area where damage or threats were occurring. Short-term redistribution approaches may include prohibiting feeding, the use of pyrotechnics, propane cannons, effigies, and other adverse noise, erecting access barriers such as wire grids, and taste aversion chemicals (Cooper and Keefe 1997). Population reduction by limiting survival or reproduction, removing birds, and habitat modification are considered long-term solutions to managing damage caused by birds (Cooper and Keefe 1997).

Redistribution methods are often employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing birds is often a short-term solution that moves birds to other areas where damages or threats could occur (Smith et al. 1999, Gorenzel et al. 2000, Gorenzel et al. 2002, Avery et al. 2008, Chipman et al. 2008). Chipman et al. (2008) found that crows could be dispersed from roost locations using non-lethal methods but crows would return to the original roost site within 2 to 8 weeks. Chipman et al. (2008) found that non-lethal methods had to be re-applied every year as crows often returned to the original roost sites. In addition, Chipman et al. (2008) found that using dispersal methods often relocated roosting crows to other areas resulting in damage occurring at the new roost location.

Some short-term methods may become less effective in resolving damage as a bird population increases, as birds become more acclimated to human activity, and as birds become habituated to harassment techniques (Smith et al. 1999, Chipman et al. 2008). Non-lethal methods often require a constant presence at locations when birds are present and must be repeated every day until the desired results are achieved which can increase the costs associated with those activities. During a six-year project using only non-lethal methods to disperse crows in New York, the number of events required to disperse crows remained similar amongst years and at some locations, the number of events required to harass crows increased from the start of the project (Chipman et al. 2008). Long-term solutions to resolving bird damage often require management of the population (Smith et al. 1999) and identifying the characteristics which attract birds to a particular location (Gorenzel and Salmon 1995).

Dolbeer et al. (1993) demonstrated that an integrated approach (including removal of offending birds) reduced bird hazards at airports and substantially reduced bird collisions with aircraft by as much as 89%. Boyd and Hall (1987) showed that a 25% reduction in a local crow roost resulted in reduced bird strike hazards at a nearby airport.

Based on the evaluation of the damage situation, the most effective methods would be employed individually or in combination based on prior evaluations of methods or combinations of methods in other

damage management situations. Once employed, methods would be further evaluated for effectiveness based on a continuous evaluation of activities by WS. Therefore, the effectiveness of methods is considered as part of the decision making-process under WS' use of the Decision Model described in Chapter 3 for each damage management request based on continual evaluation of methods and results.

Impacts of Avian Influenza (AI) on Bird Populations

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

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

Currently, there is no evidence to suggest AI has negatively affected bird populations in North America. As stated previously, most strains of AI do not cause severe illnesses or death in bird populations.

Bird Damage Should Be Managed By Private Nuisance Wildlife Control Agents

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

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to lethally take birds. As described in Appendix B, the lethal removal of birds with firearms by WS to alleviate damage or threats could 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 as defined in 50 CFR 20.21(j). To alleviate concerns associated with lead exposure in wildlife, WS would only use non-toxic shot as defined in 50 CFR 20.21(j) when using shotguns to take all birds.

The take of birds by WS in the State occurs primarily from the use of shotguns. However, the use of rifles could be employed to lethally take some species. To reduce risks to human safety and property damage from bullets passing through birds, the use of rifles is applied in such a way (*e.g*., caliber, bullet weight, distance) to ensure the bullet does not pass through birds. Birds that are removed using rifles would occur within areas where retrieval of all bird carcasses for proper disposal is highly likely (*e.g.*, at roost sites). With risks of lead exposure occurring primarily from ingestion of 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 water, either ground water or surface water, from runoff. Stansley et al. (1992) studied lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "*transport*" readily in surface water when soils were neutral or slightly alkaline in pH (*i.e*., not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot where it was believed the lead contamination was due to runoff from the parking lot, and not from the shooting range areas. The study also indicated that even when lead shot is highly accumulated in areas with permanent water bodies present, the lead does not necessarily cause elevated lead contamination of water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e*., requiring action to treat the water to remove lead). The study found that the dissolution (*i.e*., capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments (Craig et al. 1999). Therefore, the transport of lead from bullets or shot distributed across the landscape is reduced once the bullets and shot form crusty lead oxide deposits on their surfaces, which serves to naturally further reduce the potential for ground or surface water contamination (Craig et al. 1999). 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 since those birds removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement. The amount of lead deposited into the environment may be lowered by WS' involvement in

bird damage management activities due to efforts by WS to ensure projectiles do no pass through but are contained within the bird carcass which limits the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by WS' employees in firearm use and accuracy increases the likelihood that birds are lethally removed humanely in situations that ensure accuracy and that misses occur infrequently which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. In addition, WS' involvement ensures bird carcasses lethally removed using firearms would be retrieved and disposed of properly to limit the availability of lead in the environment and ensures bird carcass are removed from the environment to prevent the ingestion of lead in carcasses by scavengers. Based on current information, the risks associated with lead bullets that are deposited into the environment from WS' activities due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination of water. As stated previously, when using shotguns, only non-toxic shot would be used by WS as defined in 50 CFR 20.21(j).

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

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

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

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

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

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

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

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

3.1 DESCRIPTION OF THE ALTERNATIVES

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

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

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by birds in South Carolina. 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 consultation the USFWS, the SCDNR, and the SCDA, would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding is available, operational damage management. Funding could occur through federal appropriations or from cooperative funding. The adaptive approach to managing damage associated with birds would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by site-specific evaluation to reduce damage or threats to human safety for each request. City/town managers, agricultural producers, property owners, and others requesting assistance would be provided information regarding the use of appropriate non-lethal and lethal techniques.

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 the SCDNR and only at levels specified in the permit, unless those bird species are afforded no protection under the MBTA or a depredation order has been established by the USFWS in which case no permit for take is required.

Property owners or managers requesting assistance would be provided with information regarding the use of effective and practical non-lethal and lethal techniques. Property owners or managers may choose to implement WS' recommendations on their own (*i.e.*, technical assistance), use contractual services of private businesses, use volunteer services of private organizations, use 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 and the SCDNR 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 B 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.

WS would work with those persons experiencing bird damage to address those birds responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as birds begin to cause damage. Bird damage that has been ongoing can be difficult to resolve using available methods since birds are conditioned to feed, roost, loaf, and are familiar with a particular location. Subsequently, making that area unattractive through the use of available methods can be difficult to achieve once damage has been ongoing. WS would work closely with those entities requesting assistance to identify situations where damage could occur and begin to implement damage management activities under this alternative as early as possible to increase the likelihood of those methods achieving the level of damage reduction requested by the cooperating entity.

The 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[8] 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, exclusionary devices, frightening devices, alpha-chloralose,

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

reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods considered by WS include: live-capture followed by euthanasia, DRC-1339, and shooting. Euthanasia would occur through the use of cervical dislocation or carbon dioxide once birds are live-captured using other methods. Carbon dioxide is an acceptable form of euthanasia for birds while cervical dislocation is a conditionally acceptable[9] method of euthanasia (AVMA 2007). The use of firearms could also be used to euthanize birds live-captured and is considered a conditionally acceptable method for wildlife (AVMA 2007).

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

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

Technical Assistance Recommendations

Under the proposed action, WS would provide technical assistance to those persons requesting bird damage management as part of an integrated approach to managing damage. Technical assistance would occur as described in Alternative 2 of this EA. Technical assistance is also further discussed in WS' programmatic FEIS (USDA 1997).

The WS program in the State regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing bird damage. Technical assistance includes collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator has attempted to resolve the problem. WS then provides information on appropriate methods that the cooperator may consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

From FY 2005 through FY 2011, WS conducted 535 technical assistance projects that involved bird damage to agricultural resources, property, natural resources, and threats to human safety in South Carolina (see Table 1.1).

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

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

of WS' personnel are often required to effectively resolve problems, especially if restricted-use chemicals are necessary or if the problems are complex.

Educational Efforts

Education is an important element of activities because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. Cooperating agencies frequently cooperate 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 wildlife damage management techniques. For example, research biologists from the NWRC were involved with developing and evaluating mesurol for reducing crow predation on eggs. NWRC biologists have authored hundreds of scientific publications and reports, and are respected world-wide for their expertise in wildlife damage management.

WS' Decision Making Procedures

WS' personnel use a thought process for evaluating and responding to damage complaints which is depicted by the WS Decision Model (WS Directive 2.201) and described by Slate et al. (1992). WS' programmatic FEIS also provides further discussion and examples of how the Decision Model is used to address damage and threats associated with wildlife (USDA 1997). WS' personnel are frequently contacted after requesters have tried or considered 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 to be practical for the situation are incorporated into a damage management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the WS Decision Model, most damage management efforts consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

Community-based Decision Making

The WS program in South Carolina under this alternative would follow the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, 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 in the State have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

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

Community Decision-Makers

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

Private Property Decision-Makers

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

Public Property Decision-Makers

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. WS could provide technical assistance to this person and recommendations to reduce damage. Direct control could be

provided by WS if requested, funding provided, and the requested actions were within the recommendations made by WS.

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

Under this alternative, WS would provide those cooperators requesting assistance with managing damage and threats associated with birds with technical assistance only. Technical assistance would provide those cooperators experiencing damage or threats associated with birds with information, demonstrations, and recommendations on available and appropriate methods. The implementation of methods and techniques to resolve or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that are of limited availability for use by private entities (*e.g.*, loaning of propane cannons).

The WS program regularly provides technical assistance to individuals, organizations, and other federal, State, and local government agencies for managing bird damage. Technical assistance includes collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator has attempted to resolve the problem. WS then provides information on appropriate methods that the cooperator may consider to resolve the damage themselves. Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues. Between FY 2005 and FY 2011, WS has conducted 535 technical assistance projects that involved bird damage to agricultural resources, property, natural resources, and threats to human safety. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems; these strategies are based on the level of risk, need, and the practicality of their application. In some instances, wildlife-related information provided to the requestor results in tolerance/acceptance of the situation. In other instances, management options are discussed and recommended. Only those methods legally available for use by the appropriate individual would be recommend or loaned by WS. Similar to Alternative 1, those methods described in Appendix B would be available to those persons experiencing damage or threats associated with birds in the State except for alpha-chloralose, DRC-1339, and mesurol.

Those persons experiencing damage or are concerned with threats posed by birds could seek direct operational assistance from other governmental agencies, private entities, or conduct damage managements on their own. In situations where non-lethal methods are ineffective or impractical, WS would advise the property owner or manager of appropriate lethal methods to supplement non-lethal methods. In order for the property owner or manager to use lethal methods, they would be required to apply for their own depredation permit to take birds from the USFWS and the SCDNR, when a permit is required. In those situations, 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.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those persons experiencing damage or threats could take action using those methods legally available to resolve or prevent bird damage as permitted by federal, State, and local laws and regulations or those persons could take no action.

Alternative 3 – No Bird Damage Management Conducted by WS

This alternative precludes any and all activities by WS to reduce threats to human health and safety, and alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management in the State. All requests for assistance received by WS to resolve damage caused by birds would be referred to the USFWS, the SCDNR, 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 in the State. Many of the methods listed in Appendix B 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 bird damage management methods. The USFWS needs professional recommendations on individual damage situations before issuing a depredation permit for lethal take, and the USFWS does not have the mandate or the resources to conduct bird 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 take 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 in the State, those persons experiencing damage caused by birds could continue to resolve damage by employing those methods legally available since the take of birds can occur either through the issuance of depredation permits by the USFWS and the SCDNR, take during the hunting seasons, blackbirds can be taken at any time when found committing or about to commit damage or posing a human safety threat without the need for a depredation permit, cormorants can be taken pursuant to the PRDO and AQDO, Muscovy ducks can be taken under the control order, and non-native bird species can be taken without the need for a depredation permit. All methods described in Appendix B would be available for use by those persons experiencing damage or threats except for the use of alpha-chloralose for waterfowl, DRC-1339 for blackbirds and gulls, along with mesurol for crows which can only be used by WS. The only formulations of DRC-1339 registered in the State at the time this EA was developed was the DRC-1339 formulation to manage blackbird damage at feedlots (EPA Reg. No. 56228-10), the formulation for pigeons (EPA Reg. No. 56228-28), and a formulation for gulls (EPA Reg. No. 56228-17). Mesurol was not registered for use in the State at the time this EA was developed.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

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

Non-lethal Methods Implemented Before Lethal Methods

This alternative would require that all non-lethal methods or techniques described in Appendix B be applied to all requests for assistance to reduce damage and threats to safety from birds in the State. If the use of all non-lethal methods 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). Evaluating in detail a non-lethal before lethal alternative and the associated analysis would not add additional information to the analyses in the EA.

Use of Non-lethal Methods Only by WS

Under this alternative, WS would be required to implement non-lethal methods only to resolve damage caused by birds in South Carolina. Only those methods discussed in Appendix B that are considered non-lethal would be employed by WS. No lethal take of birds would occur by WS. The use of lethal methods could continue to be used under this alternative by those persons experiencing damage by birds. Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary exclusionary methods are netting and over-head lines. Exclusion is most effective when applied to small areas to protect high value resources. However, exclusionary methods are neither feasible nor effective for protecting human safety, agriculture, or native wildlife species from birds across large areas. The non-lethal methods used or recommended by WS under this alternative would be identical to those identified in any of the alternatives.

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

Property owners or managers could conduct management using any non-lethal or lethal method that is legal, once a permit has been issued for lethal take, when required. Property owners or managers might choose to implement WS' non-lethal recommendations, implement lethal methods, or request assistance from a private or public entity other than WS. Property owners/managers frustrated by lack of WS' assistance with the full range of bird damage management techniques may try methods not recommended by WS or use illegal methods (*e.g.*, poisons). In some cases, property owners or managers may misuse some methods or use some methods in excess of what is necessary which could then become hazardous and pose threats to the safety of humans and non-target species.

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

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with birds. However, non-lethal methods can be effective in preventing damage in certain instances. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. Non-lethal methods have been effective in alleviating bird damage. For example, the use of non-lethal methods has been effective in dispersing urban crow roosts (Avery et al. 2008, Chipman et al. 2008). In

those situations where damage could be alleviated using non-lethal methods deemed effective, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

Trap and Translocate Birds Only

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Birds would be live-captured using alpha-chloralose, live-traps, cannon nets, rocket nets, bow nets, or mist nests. All birds live-captured through direct operational assistance by WS would be translocated. Translocation sites would be identified and have to be approved by the USFWS, the SCDNR, 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 the SCDNR. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the SCDNR, 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 SCDNR, this alternative was not considered in detail. In addition, translocation of birds could occur under any of the alternatives analyzed in detail, except Alternative 3.

The translocation of birds to other areas following live-capture that have caused damage generally would not be effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. Also, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (*e.g.*, urban crow 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).

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

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

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

Population modeling indicates that reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates (Dolbeer 1998).

Additionally, the need to treat a sufficiently large number of target animals, multiple treatments, and population dynamics of free-ranging populations place considerable logistic and economic constraints on the adoption of reproduction control technologies as a wildlife management tool for some species. Currently, no reproductive inhibitors are available for use to manage most bird populations. Given the costs associated with live-capturing and performing sterilization procedures on birds and the lack of availability of chemical reproductive inhibitors for the management of most bird populations, this alternative was not evaluated in detail. If a reproductive inhibitor becomes available to manage a large number of bird populations and has proven effective in reducing localized bird populations, the use of the inhibitor could be evaluated under the proposed action as a method available that could be used in an integrated approach to managing damage. This EA would be reviewed and supplement to the degree necessary to evaluate the use of the reproductive inhibitor as part of an integrated approach described under the proposed action. Currently, the only reproductive inhibitors that are registered with the EPA are nicarbazin which is registered for use to manage local populations of Canada geese, domestic waterfowl, and pigeons. However, the only reproductive inhibitor available in South Carolina at the time this EA was developed was nicarbazin to manage local rock pigeon populations.

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 in WS' programmatic FEIS indicated that a compensation only alternative had many drawbacks. Compensation would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) compensation most likely would be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) not be practical for reducing threats to human health and safety.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

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

Some key minimizing measures 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.

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

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

- WS has consulted with the USFWS and the SCDNR to determine the potential risks to T&E species in accordance with the ESA and State laws.

- 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.

- The use of non-lethal methods would be considered prior to the use of lethal methods when providing technical assistance and/or direct operational assistance.

- 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.

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

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

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

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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

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

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

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

- 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.

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

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

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

- 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.

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

- WS would retrieve all dead birds to the extent possible following treatment with DRC-1339.

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

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

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

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

- Damage management via shooting would be conducted during time periods 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 to use 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 CUDPR.

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

Issue 4 - Effects on the Aesthetic Values of Birds

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

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

- Preference would be given to non-lethal methods, when practical and effective under WS Directive 2.101.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

- 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.

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

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

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

- Preference is given to non-lethal methods, when practical and effective under WS Directive 2.101.

- Damage management activities would only occur after a request for assistance is received by WS.

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

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

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

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

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

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not

occur as a result of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

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

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

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

As was discussed previously, methods available to address bird damage or threats of damage in the State that would be available for use or recommendation under Alternative 1 (technical and operational assistance) and Alternative 2 (technical assistance only) are either lethal methods or non-lethal methods. Under Alternative 2, WS would recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance. Alternative 1 addresses requests for assistance received by WS through technical and operational assistance where an integrated approach to methods would be employed and/or recommended. Non-lethal methods include, but are not limited to: habitat/behavior modification, lure crops, visual deterrents, live traps, exclusionary devices, frightening devices, nets, immobilizing drugs, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods considered by WS to address bird damage include: live-capture followed by euthanasia, DRC-1339, shooting, and the recommendation of hunting, where appropriate. Euthanasia would occur through the use of cervical dislocation or carbon dioxide once birds are live-captured using other methods. Carbon dioxide is an acceptable form of euthanasia for birds while cervical dislocation is a conditionally acceptable[10] method of euthanasia (AVMA 2007). No assistance would be provided by WS under Alternative 3 but many of those methods available to address bird damage would continue to be available for use by other entities under Alternative 3.

Non-lethal methods can disperse or otherwise make an area unattractive to birds causing damage; thereby, reducing the presence of birds at the site and potentially the immediate area around the site where non-lethal methods are employed. Non-lethal methods would be given priority when addressing requests for assistance (WS Directive 2.101). However, non-lethal methods would not necessarily be employed to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance has already 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. Non-lethal methods are used to excluded, harass, and disperse target wildlife from areas where damage or threats are occurring. When

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

effective, non-lethal methods would disperse birds from the area resulting in a reduction in the presence of those birds at the site where those methods were employed.

The use of non-lethal methods in an integrated approach has proved effective in dispersing birds. For example, Avery et al. (2008) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Non-lethal methods have been effective in dispersing crow roosts (Gorenzel et al. 2000, Chipman et al. 2008), including the use of crow effigies (Avery et al. 2008), lasers (Gorenzel et al. 2002), and electronic distress calls (Gorenzel and Salmon 1993). Chipman et al. (2008) found the use of only non-lethal methods to disperse urban crow roosts often requires a long-term commitment of affected parties, including financial commitments, to achieve and maintain the desired result of reducing damage.

However, those species would be 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 such 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 populations of birds in the State under any of the alternatives.

The continued use of non-lethal methods often leads to the habituation of birds to those methods which can decrease the effectiveness of those methods (Avery et al. 2008, Chipman et al. 2008). For any management methods employed, the proper timing is essential in effectively dispersing those birds causing damage. Employing methods soon after damage begins or soon after threats are identified increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of bird damage.

Lethal methods would be employed or recommended to resolve damage associated with those birds identified by WS as responsible for causing damage or threats to human safety only after receiving a request for the use of those methods. The use of lethal methods 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 birds that have been identified as causing damage or posing a threat to human safety. The use of lethal methods would result in local reductions of birds in the area where damage or threats were occurring. The number of birds removed from the population using lethal methods 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.

Most lethal methods are intended to reduce the number of birds present at a location since a reduction in the number of birds at a location leads to a reduction in damage which is applicable whether using lethal or non-lethal methods. The use of lethal methods has been successful in reducing bird damage (Boyd and Hall 1987, Gorenzel et al. 2000). The intent of non-lethal methods is to harass, exclude, or otherwise make an area unattractive to birds which disperses those birds to other areas which leads to a reduction in damage at the location where those birds were dispersed. The intent of using lethal methods is similar to the objective trying to be achieved when using non-lethal methods which is to reduce the number of birds in the area where damage is occurring which can lead to a reduction in the damage occurring at that location.

Although the use of firearms can reduce the number of birds using a location (similar to dispersing birds), the use of a firearm is most often used to supplement and reinforce the noise associated with non-lethal

methods. The capture of birds using live-traps and subsequently euthanizing those birds is employed to reduce the number of birds using a particular area where damage is occurring. Similarly, the recommendation that birds be harvested during the regulated hunting season for those species in the State is intended to manage those populations in an area where damage is occurring.

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

Often of concern with the use of lethal methods is that birds that are lethally taken would only be replaced by other birds either during the application of those methods (from other birds that immigrate into the area) or by birds the following year (increase in reproduction that could result from less competition). As stated previously, the use of lethal methods are not intended to be used as population management tools (except for hunting) over broad areas. The use of lethal methods, including the use of DRC-1339, are intended to reduce the number of birds present at a location where damage is occurring by targeting those birds causing damage or posing threats. Since the intent of lethal methods is to manage those birds causing damage and not to manage entire bird populations, those methods are not ineffective because birds return the following year.

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

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

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

WS may recommend birds be harvested during the regulated hunting 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 seasons and the allowed take during those seasons is the responsibility of the SCDNR under frameworks developed by the USFWS. WS does not have the authority to establish hunting seasons or to set allowed harvest numbers during those seasons.

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

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 to those persons requesting assistance with managing damage and threats associated with birds in the State. WS would employ those methods described in Appendix B in an adaptive approach that would integrate methods to effectively reduce damage and threats associated with birds in the State.

The issue of the effects on target bird species arises from the use of non-lethal and lethal methods to address the need for reducing damage and threats. Methods employed in an integrated approach to reduce damage and threats are categorized into non-lethal and lethal methods. As part of an integrated approach to managing damage and threats, WS could apply both lethal and non-lethal methods when requested by those persons experiencing damage.

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

Double-Crested Cormorant Biology and Population Impacts

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Hatch and Weseloh 1999). As stated in the cormorant management FEIS developed by the

USFWS, the recent increase in the double-crested cormorant population in North America, and the subsequent range expansion, has been well-documented along with concerns of negative impacts associated with the expanding cormorant population (USFWS 2003). Wires et al. (2001) and Jackson and Jackson (1995) have suggested that the current cormorant resurgence may be, at least in part, a population recovery following years of DDT-induced reproductive suppression and unregulated take prior to protection under the MBTA. There appears to be a correlation between increasing cormorant populations and growing concern about associated negative impacts, thus creating a very real management need to address those concerns (USFWS 2003, USFWS 2009).

The double-crested cormorant is one of six species of cormorants breeding in North America and has the widest range (Hatch 1995). Double-crested cormorants range throughout North America, from the Atlantic coast to the Pacific coast (USFWS 2003). During the last 20 years, the cormorant population has expanded to an estimated 372,000 nesting pairs; with the population (breeding and non-breeding birds) in the United States estimated to be greater than 1 million birds (Tyson et al. 1999). The USFWS estimated the continental population at approximately 2 million cormorants during the development of the cormorant management FEIS (USFWS 2003). Tyson et al. (1999) found that the cormorant population increased about 2.6% annually during the early 1990s. The greatest increase was in the Interior region which was the result of a 22% annual increase in the number of cormorants in Ontario and those states in the United States bordering the Great Lakes (Tyson et al. 1999). From the early 1970s to the early 1990s, the Atlantic population of cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995). While the number of cormorants in this region declined by 6.5% overall in the early to mid-1990s, some populations were still increasing during this period (Tyson et al. 1999). The number of breeding pairs of cormorants in the Atlantic and Interior population was estimated at over 85,510 and 256,212 nesting pairs, respectively (Tyson et al. 1999). The breeding population in the southeastern United States, including South Carolina, has been estimated at 10,600 breeding pairs (Hunter et al. 2006).

The double-crested cormorant was documented as a breeding species relatively recently in South Carolina, with the first nesting record occurring in 1985. Currently, there are 17 known cormorant nesting colony sites in the State (Wires et al. 2001). Complete ground counts for all known colonies were conducted in 1995 and 1996, and 717 and 895 pairs, respectively, were estimated (Wires et al. 2001). In the Eastern BBS Region, the number of cormorants observed during the BBS has also shown an increasing trend estimated at 3.8% annually since 1966; however, an 11.6% annual increase has been observed between 2000 and 2010 (Sauer et al. 2011). Cormorants observed in the Southeastern Coastal Plain (Bird Conservation Region 27) have also shown an increasing trend estimated at 3.1% annually since 1966 (Sauer et al. 2011). In the Piedmont region (Bird Conservation Region 29), the number of cormorants observed in areas surveyed during the BBS has shown an increasing trend estimated at 8.2% annually between 1966 and 2010 (Sauer et al. 2011). In South Carolina, the number of cormorants observed during the BBS has shown an increase estimated at 11.4% between 1966 and 2010 (Sauer et al. 2011). Since 1966, the number of cormorants observed during the CBC has shown a general increasing trend in the State (NAS 2010). The Southeast United States Regional Waterbird Conservation Plan ranks cormorants in the "*population control*" action level which includes those species' populations that are increasing to a level where damages to economic ventures or adverse effects to populations of other species are occurring (Hunter et al. 2006).

One of the objectives in the Conservation Plan is to maintain no more than 15,000 pairs of double-crested cormorants in the southeastern United States with no more than 4,000 breeding pairs occurring in the South Atlantic Coastal Plain, which includes South Carolina (Hunter et al. 2006). Cormorants are considered a species that "*...may impact either native species or economic interests in portions of the Southeastern U.S. Region for which no increase and potentially population decreases may be recommended*" (Hunter et al. 2006).

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

The cormorant management FEIS developed by the USFWS predicted the number of cormorants taken by authorized entities under the PRDO would increase by 4,140 cormorants per State above the take level that had occurred previously in each of the 24 States covered under the PRDO, including South Carolina (USFWS 2003). The FEIS estimated that authorized entities would take a total of 99,360 cormorants annually pursuant to the PRDO in those 24 States where take would be authorized (USFWS 2003). The FEIS predicted the total combined take under the PRDO, the AQDO, and take pursuant to depredation permits would result in the lethal take of nearly 160,000 cormorants annually. The FEIS predicted the total combined take evaluated under the selected alternative would result in the authorized lethal take of up to 8.0% of the continental cormorant population (USFWS 2003).

The take of cormorants from 2004 through 2008 under the depredation orders and under depredation permits in the 24 States included in the PRDO are shown in Table 4.1. Between 2004 and 2008, an average of 40,618 cormorants have been taken under the two depredation orders (PRDO and AQDO) and under depredation permits issued by the USFWS, including those cormorants lethally taken in South Carolina. The USFWS (2009) estimated the take of cormorants under the depredation orders and depredation permits involved primarily those cormorants that are considered a part of the Interior cormorant population. Those cormorants found in South Carolina are considered part of the Southeast population of cormorants (Tyson et al. 1999).

The cormorant management FEIS developed by the USFWS estimated the number of cormorants lethally taken under an alternative implementing a PRDO, an expanded AQDO, and under depredation permits would increase to 159,635 cormorants taken annually (USFWS 2003). The FEIS determined the lethal take of up to 159,635 cormorants annually under the depredation orders and under depredation permits would impact approximately 8% of the continental cormorant population.

Table 4.1 – Double-crested cormorant take in the 24 States included in the PRDO*

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

* preliminary take data provided by the USFWS

As shown in Table 4.1, the annual take of cormorants from 2004 through 2008 has not exceeded 159,635 cormorants in any given year. The highest level of cormorant take occurred in 2006 when 54,821 cormorants were lethally taken which represents 34.3% of the 159,635 cormorants evaluated in the

cormorant management FEIS. The FEIS determined an annual take of 159,635 cormorants annually would be sustainable at the State, regional, and national level (USFWS 2003, USFWS 2009). The take that has occurred since the implementation of the preferred alternative in the FEIS which implemented the PRDO and modified the existing AQDO, has only reached a high of 34.3% of the level evaluated in the FEIS which determined the higher level of take would not significantly impact cormorant populations. Upon further evaluation, the USFWS determined the implementation of the preferred alternative in the FEIS that has allowed the annual take level of cormorants under the PRDO, the AQDO, and under depredation permits has not reached a level where undesired adverse effects to cormorant populations would occur (USFWS 2009). The USFWS subsequently extended the expiration dates of the PRDO and the current AQDO (USFWS 2009).

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

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

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

From FY 2005 through FY 2011, WS did not lethally remove any cormorants in the State to alleviate damage or threats (see Table 4.2). WS has employed non-lethal methods to disperse six cormorants in the State to alleviate damage or threats between FY 2005 and FY 2011. In addition to the take that could occur by WS, the take of cormorants can also occur by other entities in South Carolina through the issuance of a depredation permit by the USFWS or pursuant to the PRDO and the AQDO. Between 2005

and 2010, a total of 797 cormorants have been lethally removed in South Carolina by other entities to alleviate damage, which is an average of 133 cormorants lethally removed per year.

Although only limited cormorant damage management activities have been conducted by WS in South Carolina, WS anticipates the number of requests for assistance to manage damage caused by cormorants will increase based on the increasing number of cormorants observed in the State during the breeding season and overwintering within the State. If an increase in the number of requests for assistance occurs, under the proposed action, the number of cormorants lethally taken annually by WS would also likely increase to address those requests for assistance. Threats to natural resources could occur if cormorants are competing with other colonial waterbirds for nest sites. Based on increasing trends in the number of cormorants in the State observed during the development of this EA, WS anticipates that up to 100 cormorants total could be lethally taken by WS annually to alleviate damage either under depredation permits, under the PRDO, and/or under the AQDO.

Table 4.2 – Double-crested cormorants addressed in South Carolina from 2005 to 2010

Year	Dispersed by WS[1]	Take by Entity	
		WS	All Entities[2]
2005	0	0	100
2006	1	0	108
2007	2	0	127
2008	0	0	124
2009	0	0	171
2010	3	0	167
2011	0	0	N/A[†]
TOTAL	**6**	**0**	**797**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

[†]data is currently unavailable

As stated previously, the cormorant management FEIS developed by the USFWS predicted the number of cormorants taken by authorized entities under just the PRDO would total 4,140 cormorants per State in each of the States included in the PRDO, including South Carolina (USFWS 2003). The take under the PRDO would be in addition to take occurring under the AQDO and under depredation permits. Furthermore, the USFWS predicted through the analyses that the authorized take of cormorants and their eggs for the management of double-crested cormorant damage, including those taken in South Carolina, was anticipated to have no significant impact on regional or continental double-crested cormorant populations (USFWS 2003, USFWS 2009). This includes cormorants that may be killed in the State under USFWS issued depredation permits. Cormorants are a long-lived bird and egg destruction programs are anticipated to have minimal effects on regional or continental cormorant populations (USFWS 2003).

The average total take of cormorants under the PRDO, AQDO, and depredation permits from 2004 through 2008 has been 40,618 cormorants with the highest level of take occurring in 2006 when 54,821 cormorants were taken by all entities in the 24 States listed under the PRDO and AQDO (USFWS 2009). The highest total take and the average annual take that has occurred by all entities covered under the PRDO and the AQDO from 2004 through 2008 is below the 160,000 cormorants taken annually addressed in the cormorant management FEIS.

WS' proposed take of up to 100 cormorants annually to address damage and threats falls within the parameters of take evaluated within the cormorant management FEIS (USFWS 2003, USFWS 2009). If

WS' anticipated take of up to 100 cormorants is included with the average take by all entities from 2005 through 2010 of 133 cormorants, the combined take would be below the level of take analyzed in the FEIS. From 2005 through 2010, the highest level of cormorant take occurred in 2009 when 171 cormorants were lethally taken by all entities in the State. When the proposed take of 100 cormorants by WS is included with the highest level of take that has occurred in the State from 2005 through 2010, the total take would be 271 cormorants which is below the take level analyzed in the cormorant management FEIS.

Great Blue Heron Biology and Population Impacts

The head of the great blue heron is largely white with dark under parts and the body is primarily bluish in color. Great blue herons are a common widespread wading bird that can be found throughout most of North America and can be found year-around in most of the United States, including South Carolina (Butler 1992). Great blue herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (MANEM Waterbird Plan 2006). Herons are known to nest in trees, rock ledges, and coastal cliffs and may travel up to 30 km to forage with a mean forage distance of 2.6 to 6.5 km (MANEM Waterbird Plan 2006). Great blue herons feed mainly on fish but are also known to capture invertebrates, amphibians, reptiles, birds, and mammals (Butler 1992).

Great blue herons are showing a statistically significant increase across all survey routes of the BBS. Since 1966, the number of great blue herons observed survey-wide has increased at an annual rate of 0.8% which is a statistically significant increase (Sauer et al. 2011). In South Carolina, herons observed on BBS routes are also showing an increasing trend estimated at 2.1% annually since 1966 (Sauer et al. 2011). Herons observed overwintering in South Carolina have shown a general increasing trend since 1966 (NAS 2010). The number of counts reporting great blue herons during CBC surveys increased from four counts reporting herons in 1966 to 25 counts reporting herons during the 2010 survey. The number of birds observed increased from 55 birds observed in 1966 in South Carolina to 1,790 individuals in 2010 (NAS 2010). The current population of great blue herons is unknown in South Carolina.

In 2006, the breeding population of great blue herons was estimated at 69,331 breeding pairs or 138,662 adult herons in the southeastern United States (Hunter et al. 2006). The overall population objective for herons in the southeastern United States is 50,000 to 100,000 breeding pairs (Hunter et al. 2006). In the Southeastern Coastal Plain (Bird Conservation Region 27), which includes South Carolina, the breeding population of great blue herons was estimated at 26,700 breeding pairs in 2006 with a population objective of 39,000 breeding pairs (Hunter et al. 2006). Approximately 2,300 breeding pairs are estimated to occur in the Piedmont region (Bird Conservation Region 29), including those areas of the region in South Carolina.

To alleviate damage, WS has employed non-lethal methods to disperse 26 herons from FY 2005 through FY 2011 (see Table 4.3). One heron was lethally removed by WS during FY 2011 to alleviate damage. The USFWS has issued depredation permits to other entities for the take of herons. As shown in Table 4.3, six herons were lethally taken in the State by all entities to alleviate damage or threats associated with great blue herons from 2005 through 2010. The highest level of take occurred in 2009 when five herons were lethally taken in the State pursuant to depredation permits issued by the USFWS and the SCDNR.

To address requests for assistance to manage damage associated with great blue herons in the future, up to 30 herons could be lethally taken annually by WS to alleviate damage and threats. The increased level of take analyzed when compared to the take occurring by WS from FY 2005 through FY 2011 is in anticipation of requests to address threats of aircraft strikes at airports and to reduce damage to natural resources, such as nest site competition between herons and other colonial nesting waterbirds.

Table 4.3 – Number of great blue herons addressed in South Carolina from 2005 to 2010

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS' Take	Total Take by All Entities[2]
2005	1	0	0
2006	7	0	0
2007	1	0	0
2008	0	0	0
2009	1	0	5
2010	16	0	1
2011	0	1	N/A[†]
TOTAL	**26**	**1**	**6**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

[†]data is currently unavailable

The number of great blue herons present in South Carolina at any given time likely fluctuates throughout the year. No breeding or wintering population estimates are available for great blue herons in South Carolina. If the annual take of herons by other entities is reflective of take that would occur in the future, the combined WS' take and take by other entities would total up to 35 herons.

Given the increasing population trends observed for herons in South Carolina, the limited take proposed by WS when compared to the estimated breeding population, the magnitude of WS' estimated take could be considered low. The permitting of the take by the USFWS and the SCDNR ensures the cumulative take of herons in the southeastern United States, including the take proposed by WS in South Carolina under this assessment, would not reach a magnitude where adverse effects occur. The take of herons by WS would occur within allowed levels of take permitted by the USFWS and the SCDNR.

Cattle Egret Biology and Population Impacts

The cattle egret is a relatively new arrival to the North American continent with the first record for the continental United States occurring in south Florida in 1941 (Telfair II 2006). Today, cattle egrets can be found across much of North America, including South Carolina (Telfair II 2006, Sauer et al. 2011). As their name implies, cattle egrets are closely associated with cattle where they forage on invertebrates disturbed by foraging livestock, primarily grasshoppers, crickets, and flies (Telfair II 2006). Cattle egrets are also known to consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2006).

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

The population of cattle egrets in South Carolina is currently unknown. BBS data indicates the number of egrets observed in the State during the breeding season has declined annually at an estimated rate of -1.5% since 1966 (Sauer et al. 2011). In the United States, the number of egrets observed during the BBS have also shown a declining trend estimated at -0.5% annually since 1966 (Sauer et al. 2011). The total

population of cattle egrets in North America has been estimated to range from 750,000 to 1,500,000 egrets (MANEM Regional Waterbird Plan 2006). The Southeast United States Regional Waterbird Conservation Plan ranks cattle egrets in the "*population control*" action level indicating that populations are increasing to a level where damages to economic ventures or adverse effects to populations of other species are occurring (Hunter et al. 2006). The increases in populations and the range expansion exhibited by cattle egrets have been attributed to the species broad use of terrestrial habits relative to other waterbirds (Hunter et al. 2006, Telfair II 2006). Cattle egrets have also been implicated as contributing to the declining trends of little blue herons and snowy egrets given the aggressive behavior exhibited by cattle egrets and the use of similar nesting habitats (Hunter et al. 2006, Telfair II 2006).

The cattle egret population in the southeastern Bird Conservation Regions have been estimated at approximately 350,000 breeding pairs with nearly 57,000 breeding pairs occurring in the Southeastern Coastal Plain (Bird Conservation Region 27) and approximately 1,050 breeding pairs occurring in the Piedmont Bird Conservation Region (Bird Conservation Region 29), all of which include parts of South Carolina (Hunter et al. 2006). The Southeastern United States Waterbird Conservation Plan calls for the reduction of cattle egret populations in the southeastern Bird Conservation Regions to less than 200,000 breeding pairs of cattle egrets with 30,000 breeding pairs in the Southeastern Coastal Plain Region which includes most of South Carolina. Therefore, the Plan calls for reducing the cattle egret population by 300,000 egrets in the southeastern United States (Hunter et al. 2006). In the Southeastern Coastal Plain Bird Conservation Region which includes those egrets nesting in South Carolina, the Plan calls for reducing the cattle egret breeding population by approximately 30,000 egrets (Hunter et al. 2006).

Although cattle egrets have been observed overwintering in the State, the number observed during the CBC has been variable with some years reporting no egrets observed. The highest number of egrets observed in the State during the CBC occurred in 1992 when 49 egrets were observed (NAS 2010).

Similar to other bird species addressed in this assessment, the take of cattle egrets is prohibited under the MBTA unless a depredation permit has been issued by the USFWS pursuant to the Act. The number of cattle egrets taken by all entities in South Carolina as permitted by the USFWS to alleviate damage and reduce threats is shown in Table 4.4. As shown in Table 4.4, the take of cattle egrets by entities other than WS did not occur from 2005 through 2010. Since FY 2005, WS has lethally taken 154 egrets in the State or an average of 22 egrets per year. As part of an integrated approach to resolving previous requests for assistance, WS also dispersed 14,248 egrets using non-lethal methods from FY 2005 through FY 2011.

Table 4.4 – Number of cattle egrets addressed in South Carolina from 2005 to 2011

Fiscal Year	Dispersed by WS[1]	Take by Entity	
		WS' Take[1]	Other Entities
2005	1,615	30	0
2006	2,690	14	0
2007	4,203	4	0
2008	1,083	31	0
2009	1,612	12	0
2010	1,166	11	0
2011	1,879	52	N/A[†]
Total	**14,248**	**154**	**0**

[1]The number of bird dispersed by WS and WS' take are reported by federal fiscal year

[†]data is currently unavailable

Nearly 99% of the egrets addressed by WS between FY 2005 and FY 2011 were harassed using non-lethal methods. As the number of requests for assistance increases and the number of egrets addressed to manage those requests increase, the lethal take of egrets could also increase under the proposed action along with an increase in the use of non-lethal methods. The use of non-lethal methods is generally regarded as having no effect on bird populations since those birds addressed are only dispersed to other areas and the disturbance is not widespread enough to cause adverse effects to reproduction or survivability that would result in population declines. If the number of requests for assistance to manage damage and threats associated with cattle egrets increases, WS could take annually up to 400 cattle egrets in the State. Take of up to 400 egrets annually would be of low magnitude when compared to the breeding population estimates for the southeastern United States.

Since the take of cattle egrets is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits, WS' take of up to 400 cattle egrets annually in the State would only occur when authorized by the USFWS and the SCDNR through the issuance of a depredation permit. Therefore, the number of egrets taken annually by WS in the State would be at the discretion of the USFWS and the SCDNR based on allowable harvest levels and population information. The take of cattle egrets by other entities to alleviate damage or threats of damage is expected to remain similar to previous annual take levels in the State. Since the take of egrets by other entities can only occur when permitted by the USFWS and the SCDNR through the issuance of depredation permits, the cumulative take by all entities is considered by the USFWS and the SCDNR when authorizing the take of egrets.

Black Vulture Biology and Population Impacts

Historically in North America, black vultures occurred in the southeastern United States, Texas, Mexico, and parts of Arizona (Wilbur 1983). Black vultures have been expanding their range northward in the eastern United States (Wilbur 1983, Rabenhold and Decker 1989). Black vultures are considered locally resident (Parmalee and Parmalee 1967, Rabenhold and Decker 1989); however, some populations will migrate (Eisenmann 1963 cited from Wilbur 1983). Black vultures nest and roost primarily in mature forested areas. Black vultures typically feed by scavenging but occasionally take live prey, especially newborn livestock (Brauning 1992). Black vultures have been reported to live up to 25 years of age (Henny 1990).

According to BBS trend data provided by Sauer et al. (2011), the number of black vultures observed in the State during the breeding season has increased at an annual rate of 6.1% from 1966 through 2010. During this same time period, the number of black vultures observed in the Southeastern Coastal Plain during the BBS has also increased at an annual rate of 2.8%, which is a statistically significant increase (Sauer et al. 2011). The number of black vultures observed overwintering in the State has shown a general increasing trend since 1966 (NAS 2010). Rich et al. (2004) estimated the statewide black vulture population at 11,000 vultures based on BBS data available from South Carolina.

Estimates of bird populations calculated by Rich et al. (2004) were derived from BBS data for individual species. BBS survey data is derived from surveyors identifying bird species based on visual and auditory cues at stationary points along roadways. Vultures produce very few auditory cues that would allow for identification (Buckley 1999) and thus, surveying for vultures is reliant upon visual identification. For visual identification to occur during surveys, vultures must be either flying or visible while roosting. Coleman and Fraser (1989) estimated that black and turkey vultures spend 12 to 33% of the day in summer and 9 to 27% of the day in winter flying. Avery et al. (2011) found that both turkey vultures and black vultures were most active in the winter (January to March) and least active during the summer (July to September). Avery et al. (2011) found that across all months of the year, black vultures were in flight only 8.4% of the daylight hours while turkey vultures were in flight 18.9% of the daylight hours.

Most vultures during surveys are counted while flying since counting at roosts can be difficult due to obstructions limiting sight and due to the constraints of boundaries used during the surveys, especially the BBS since observers are limited to counting only those bird species observed or heard within a quarter mile of a survey point along a roadway. Bunn et al. (1995) reported vulture activity increased from morning to afternoon as temperatures increased. Avery et al. (2011) found turkey vulture flight activity peaked during the middle of the day. Three hours after sunrise, Avery et al. (2011) found only 10% of turkey vultures in flight and black vultures lagged about an hour behind turkey vultures in their flight activities. Therefore, surveys for vultures should occur later in the day to increase the likelihood of vultures being observed by surveyors. Observations conducted for the BBS are initiated in the morning since mornings tend to be periods of high bird activity. Since vulture activity tends to increase from morning to afternoon when the air warms and vultures can find thermals for soaring, vultures are probably under-represented in BBS data. The limitations associated with surveying for vultures under current BBS guidelines likely resulted in lower than expected population estimates of black vultures and turkey vultures. Given the limitations of current survey protocols, populations of vultures in South Carolina are likely higher than derived by Rich et al. (2004) using data from the BBS.

The number of black vultures addressed by WS and other entities are shown in Table 4.5. From FY 2005 through FY 2011, WS has lethally taken 92 black vultures in the State to alleviate damage and threats. In addition, WS has employed non-lethal harassment methods to disperse 1,597 vultures in the State to address requests for assistance to manage damage. The number of black vultures lethally taken by all entities in the State under depredation permits has totaled 157 since 2005.

Table 4.5 – Number of black vultures addressed in South Carolina from 2005 to 2010

Fiscal Year	Dispersed by WS[1]	Take by Entity	
		WS[1]	All Entities[2]
2005	9	0	10
2006	136	19	37
2007	62	6	6
2008	180	14	52
2009	101	18	33
2010	214	19	19
2011	895	16	N/A†
TOTAL	**1,597**	**92**	**157**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

†data is currently unavailable

Based on the increasing need to address damage associated with black vultures in the State, up to 200 black vultures could be lethally taken under the proposed action to address damage and threats associated with black vultures.

As shown in Table 4.5, a total of 157 black vultures have been taken in South Carolina from 2005 through 2010 to alleviate damage which is an average of 27 vultures taken annually by all entities. Based on a stable population trend, take of up to 200 black vultures annually would represent 1.8% of the estimated statewide population of black vultures. If the number of black vultures taken by other entities in South Carolina remains similar to the number of black vultures taken from 2005 through 2010 and if 200 vultures were taken by WS, the annual take of vultures would be 214 vultures which would represent 2.0% of the estimated statewide population if the population remains stable. As stated previously, the statewide population of black vultures is likely higher than the population estimate derived from BBS data by Rich et al. (2004) given vulture behavior and the limitations of the BBS.

Similar to the other native bird species addressed in this assessment, the take of vultures can only occur when authorized through the issuance of depredation permits by the USFWS and the SCDNR. The permitting of the take ensures the cumulative take of black vultures annually occurs within allowable take levels to achieve desired population objectives for the species. Therefore, the take of vultures by WS would only occur at levels permitted by the USFWS and the SCDNR through the issuance of depredation permits.

Turkey Vulture Biology and Population Impacts

Turkey vultures can be found throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenhold and Decker 1989). Turkey vultures can be found throughout the year in South Carolina (Kirk and Mossman 1998). Turkey vultures can be found in virtually all habitats but are most abundant where forested areas are interrupted by open land (Brauning 1992). Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Walsh et al. 1999). Turkey vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Turkey vultures prefer carrion but will eat virtually anything, including insects, fish, tadpoles, decayed fruit, pumpkins, and recently hatched heron and ibis chicks (Brauning 1992). Turkey vultures have been reported to live up to 16 years of age (Henny 1990).

The statewide population of turkey vultures is currently unknown but has been estimated at 10,000 turkey vultures based on BBS data (Rich et al. 2004). Trending data from the BBS indicates the number of turkey vultures observed along BBS routes in the State have shown an increasing trend estimated at 6.7% annually (Sauer et al. 2011). The numbers of turkey vultures observed during the CBC in the State are also showing an increasing trend (NAS 2010).

The take of turkey vultures is also prohibited under the MBTA except through the issuance of depredation permits issued by the USFWS and the SCDNR. The number of turkey vultures addressed in South Carolina by all entities to alleviate damage is shown in Table 4.6. From FY 2005 through FY 2011, the WS program in South Carolina has lethally taken 62 turkey vultures in the State and employed non-lethal methods to disperse 5,284 vultures to alleviate damage. Nearly 99% of the turkey vultures addressed by WS from FY 2005 through FY 2011 have been dispersed using non-lethal methods. A total of 66 turkey vultures have been lethally taken from 2005 through 2010 by all entities in the State pursuant to depredation permits issued by the USFWS and the SCDNR. From 2005 through 2010, 11 turkey vultures on average have been lethally taken in the State per year by all entities to alleviate damage pursuant to depredation permits.

As the population of turkey vultures in the State has increased, the number of requests for assistance to alleviate damage associated with turkey vultures has also increased. Based on current population trends for turkey vultures in the State, the number of requests for assistance with managing damage associated with turkey vultures and the number of vultures that could be addressed to meet those requests is also likely to increase. Therefore, based on previous requests for assistance and in anticipation of an increasing number of requests and the subsequent need to address more vultures, up to 200 turkey vultures could be lethally taken annually by WS to alleviate damage and threats.

Table 4.6 – Number of turkey vultures addressed in South Carolina from 2005 to 2010

Fiscal Year	Dispersed by WS[1]	Take by Entity	
		WS[1]	All Entities[2]
2005	80	4	4
2006	488	1	2
2007	423	3	3
2008	681	3	3
2009	796	20	28
2010	1,709	22	26
2011	1,107	9	N/A[†]
TOTAL	**5,284**	**62**	**66**

[1] The number of bird dispersed by WS and WS' take are reported by federal fiscal year

[2] Data reported by calendar year

[†] data is currently unavailable

If up to 200 turkey vultures were taken annually by WS, WS' take would represent 2% of the estimated statewide population of turkey vultures estimated at 10,000 vultures if the population remains at least stable. From 2005 through 2010, other entities in the State have lethally taken 13 vultures which is an average of two vultures taken annually. If the take by other entities remains stable, the cumulative take of vultures annually by all entities would be 202 vultures. The cumulative take of vultures would represent 2% of the statewide population if the population remains stable. Similar to black vultures, the statewide population of turkey vultures is likely higher than estimated by Rich et al. (2004) given the limitation of the BBS and the behavior of vultures. Therefore, the cumulative take of vultures is likely to represent a smaller percentage of the actual statewide population. The permitting of the take by the USFWS and the SCDNR pursuant to the MBTA ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for turkey vultures in the State. WS would also continue to address requests for assistance associated with turkey vultures using non-lethal dispersal methods.

Mallard Biology and Population Impacts

Mallards are one of the most recognizable waterfowl species with a wide range across most of North America (Drilling et al. 2002). In South Carolina, mallards can be found throughout the year across State (Drilling et al. 2002). The number of mallards observed in the State during the BBS has increased an estimated 7.3% annually since 1966 (Sauer et al. 2011). In the Southeastern Coastal Plain region, a similar trend has been observed with the number of mallards observed during the BBS increasing at a 5.6% annual rate since 1966 (Sauer et al. 2011). The number of mallards observed in the State during the CBC has shown a general increasing trend since 1966 (NAS 2010). The number of mallards observed in the State during the Midwinter Waterfowl Survey conducted in 2010 was estimated at 2,190 mallards (Klimstra et al. 2010).

Like other waterfowl species, mallards can be harvested during a regulated season in the State. An estimated 34,504 mallards were harvested in the State during 2009 and 33,590 mallards were harvested in the State during 2010 (Raftovich et al. 2011). In addition, Raftovich et al. (2011) estimated that 4,631 domestic mallards were harvested in the State during the 2009 season with 3,075 domestic mallards being taken during 2010 season. Since 2005, an estimated 180,767 mallards and 14,235 domestic mallards have been harvested in the State during the regulated season (see Table 4.7), which is an average of 39,000 mallards harvested annually from 2005 through 2010.

Table 4.7 - Take of mallards in South Carolina by all entities from 2005 through 2010

Year	WS' Take[1]	Hunter Harvest		Take by Other Entities[2]
		Mallard	Domestic Mallard	
2005	0	24,817	2,345	0
2006	0	35,874	1,135	0
2007	0	26,790	1,683	0
2008	0	25,192	1,366	0
2009	0	34,504	4,631	6
2010	4	33,590	3,075	0
2011	13	N/A†	N/A†	N/A†
TOTAL	**17**	**180,767**	**14,235**	**6**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

†data is currently unavailable

In addition to the take of mallards during the hunting season, a total of 17 mallards have been lethally taken by WS from FY 2005 through FY 2011. A total of six mallards have been lethally taken under depredation permits by all entities to alleviate damage in South Carolina between 2005 and 2010. From 2005 through 2010, the combined take of WS and the take of mallards under depredation permits by other entities represented 0.01% of the total number of mallards harvested in South Carolina during the regulated hunting season from 2005 through 2010.

Based on the number of requests received for assistance previously and in anticipation of an increase in the number of requests for assistance that could be received annually, an annual take of up to 200 mallards could occur under the proposed action. WS anticipates the number of airports requesting assistance with managing threats associated with mallards on or near airport property could increase. Since 2005, the average number of mallards harvested in the State has been estimated at 32,500 mallards. Based on the average take of mallards from 2005 through 2010 during the hunting season, take of up to 200 mallards by WS would have represented 0.6% of the estimated take of mallards in the State.

Based on the known take of mallards in the State, take of up to 200 mallards annually by WS to alleviate damage would not adversely affect mallard populations in South Carolina. All take by WS would occur under a depredation permit issued by the USFWS and the SCDNR for the take of those mallards which ensures the cumulative take of mallards from all known sources would be considered when establishing population objectives for mallards.

Bald Eagle Biology and Population Impacts

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). The bald eagle has been the national emblem of the United States since 1782 and has been a key symbol for Native Americans (Buehler 2000). During the migration period, eagles can be found throughout the United States and parts of Mexico (Buehler 2000). The migration of eagles has been labeled as "*complex*" which can make determining migration movement difficult to ascertain. Migration is dependent on many factors, including the age of the eagle, location of the breeding site, severity of the climate at the breeding site, and availability of food (Buehler 2000). Generally, the fall migration period begins in mid-August and extends through mid-November with peak periods occurring from September through October. The spring migration period generally begins in March and extends through May with peak periods occurring from mid-March through mid-May (Buehler 2000).

Eagles are opportunistic feeders with a varied diet that consists of mammalian, avian, and reptilian prey; however, eagles are most fond of fish (Buehler 2000). Buehler (2000) describes food acquisition by eagles as "[An eagle] *often scavenges prey items when available, pirates food from other species when it can, and captures its own prey only as a last resort*". Eagles are thought to form life-long pair bonds but information on the relationship between pairs is not well documented (Buehler 2000). Nesting normally occurs from late-March through September with eggs present in nests from late-May through the end of May. Eaglets can be found in nests generally from late-May through mid-September (Buehler 2000). Nests of bald eagles occur primarily near the crown of trees with typical nests ranging in size from 1.5 to 1.8 meters in diameter and 0.7 to 1.2 meters tall (Buehler 2000).

Populations of bald eagles showed periods of steep declines in the lower United States during the early 1900s. Population declines have been attributed to the loss of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail steep declining trends in bald eagles, the Bald Eagle Protection Act was passed in 1940 which prohibited the taking or possession of bald eagles or any parts of eagles. 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 (see Section 1.6). Certain populations of bald eagles were listed as "*endangered*" under the Endangered Species Preservation Act of 1966 which was extended when the modern ESA of 1973 was passed. 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 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 except for the Sonora Desert bald eagle population which remained classified as a threatened species. Although officially removed from the protection of the ESA across most of the range of the eagle, the bald eagle now is afforded protection under the Bald and Golden Eagle Protection Act.

As was discussed in Chapter 1, under the Bald and Golden Eagle Protection Act, the definition of "*take*" includes actions that can "*molest"* or "*disturb"* eagles. For the purposes of the Act under 50 CFR 22.3, the term "*disturb"* as it relates to take has been defined as "*to agitate or bother a bald.…..eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."*

The Bald and Golden Eagle Protection Act allows the USFWS to permit the take of eagles when "*necessary for the protection of...other interests in any particular locality*" after determining the take is "*...compatible with the preservation of the bald eagle*" (16 USC 668a). The USFWS developed an EA that evaluated alternatives and issues associated with regulations establishing new permits for the take of eagles pursuant to the Act (USFWS 2010). Based on the evaluations in the EA and a FONSI, 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).

WS has previously received requests for assistance associated with bald eagles posing threats at or near airports in the State. 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 "*molest*" and "*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 of aircraft strikes at airports. Under this proposed action alternative, WS could employ harassment methods to disperse eagles from airports 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 where WS is working as a subpermittee under the permit issued to the airport. 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).

Osprey Biology and Population Impacts

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Poole et al. 2002). Historically, nests of osprey were constructed on tall trees and rocky cliffs. Today, ospreys are most commonly found nesting on man-made structures such of power poles, cell towers, and man-made nesting platforms (Poole et al. 2002). Osprey can be located throughout the year along the coastal areas of the State with breeding populations also occurring further inland (Poole et al. 2002).

Requests for assistance received by WS to alleviate damage or the threat of damage associated with osprey involved threats to aircraft from strikes and were associated with nesting behavior. Osprey nests are often constructed of large sticks, twigs, and other building materials that can cause damage and prevent access to critical areas when those nests are built on man-made structures (*e.g.*, power lines, cell towers, boats). Disruptions in the electrical power supply can occur when nests are located on utility structures and can inhibit access to utility structures for maintenance by creating obstacles to workers. For example, the United States Geological Survey (USGS) found the average osprey nest size in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (USGS 2005). In 2001, 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites (USGS 2005).

WS has responded to requests for assistance involving osprey previously by providing technical assistance and by providing direct operational assistance through the use of harassment methods to disperse osprey. Between FY 2005 and FY 2011, the WS program in South Carolina conducted six technical assistance projects involving osprey and has harassed 10 ospreys using non-lethal methods. No lethal take of ospreys has occurred by WS in the State to alleviate damage or threats of damage between FY 2005 and FY 2011. However, under the proposed action alternative, WS could be requested to use lethal methods to remove osprey when non-lethal methods are ineffective or are determined to be inappropriate using WS Decision model. An example could include osprey that pose an immediate strike threat at an airport where attempts to disperse the osprey are ineffective. WS would continue to employ primarily non-lethal methods to address requests for assistance with managing damage or threats of damage associated with osprey in the State. Based on previous requests for assistance to manage damage associated with osprey and in anticipation of receiving an increasing number of requests for assistance, WS could lethally take up to 10 ospreys annually in the State to alleviate damage.

In addition, up to 10 osprey nests could be destroyed that are associated with damage to structures, including eggs contained within the nest. Eggs would be destroyed using addling and by breaking open

the eggs. Nests would be removed by hand and/or using hand tools. Egg-laying in osprey occurs from mid-April through late-June with late-April through mid-June being the primary period when eggs are laid (Poole et al. 2002). Nestlings can be found from early-June through early-September with the peak occurring from early-June through late-August (Poole et al. 2002). The removal of the nest and eggs would occur in an attempt to cause the osprey to abandon the nest site and to disperse the osprey from the area. The take of the osprey nest, including the removal of osprey eggs is prohibited by the MBTA unless authorized through the issuance of a depredation permit by the USFWS pursuant to the Act.

Since 1966, the number of osprey observed along routes surveyed in the State during the BBS has shown an increasing trend estimated at 4.0% annually (Sauer et al. 2011). Along routes surveyed in the eastern United States during the BBS, the number of osprey observed since 1966 has shown an increasing trend estimated at 3.4% annually, which is a statistically significant increasing trend (Sauer et al. 2011). From 2000 through 2010, the number of osprey observed during the BBS conducted in the eastern United States has continued to show an increasing trend estimated at 5.3% annually (Sauer et al. 2011). Across all routes surveyed in the United States during the BBS, the number of osprey counted has shown an increasing trend estimated at 2.9% annually since 1966 and 5.1% annually between 2000 and 2010 which are statistically significant upward trends (Sauer et al. 2011). The number of osprey observed in areas surveyed during the CBC has also shown increasing trends in the State (NAS 2010). Based on BBS data, Rich et al. (2004) estimated the statewide population of osprey was 190 birds.

Based on a statewide population estimated at 190 osprey and if up to 10 osprey were taken in any given year, WS' take would represent 5.3% of the estimated population if the population remains at least stable. The take of osprey by WS would only occur when permitted and only at levels authorized on depredation permits issued by the USFWS and the SCDNR. The limited removal of nests is generally regarded has having minimal impacts on a species' overall population. Based on the limited number of nests that could be removed and the permitting of any removal by the USFWS and the SCDNR, the destruction of up to 10 osprey nests and associated eggs would have minimal impacts on statewide breeding populations of osprey.

Wild Turkey Biology and Population Impacts

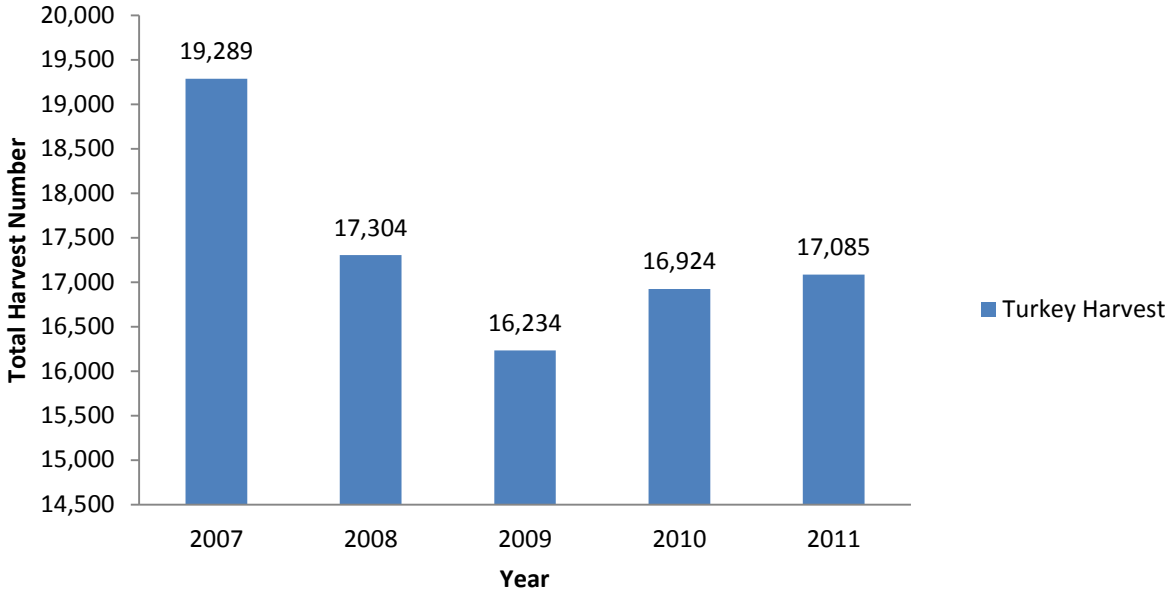
Wild turkeys found in South Carolina consist of the Eastern wild turkey subspecies that is endemic to the eastern half of the United States (Kennamer 2010). The Eastern wild turkey can be found in 38 States and four Canadian provinces, ranging from southern Canada and New England to northern Florida and west to Texas, Missouri, Iowa, and Minnesota (Kennamer 2010). There are six distinct subspecies of wild turkeys in North America, with the Eastern wild turkey subpopulation being the most abundant and most widely distributed. In the Eastern United States, wild turkeys inhabit hardwood, mixed, and pine forests foraging on a variety of acorns, fruit, seeds, and insects. Turkeys are considered permanent residence in States where they are present and are considered non-migratory. There are an estimated 5.1 million to 5.3 million wild turkeys in the Eastern subspecies in the United States and Canada (National Wild Turkey Federation 2010).

Once nearly extirpated from the State from over-hunting and habitat loss, the wild turkey now can be found nearly statewide in suitable habitat. From 1951 to 1958, the SCDNR carried out a live-trapping and transplanting program in an effort to replenish turkey populations in the piedmont and mountain portions of the State. Turkeys now occupy all 46 counties of the State. The number of turkeys observed in areas surveyed during the BBS has shown an increasing trend in the State estimated at 10.9% since 1966 (Sauer et al. 2011). The numbers of turkeys observed in the State during the CBC have been cyclical but have shown an overall increasing trend since 1966 (NAS 2010). Presently, approximately 90,000 wild turkeys are now distributed throughout the State in suitable habitat (SCDNR 2009).

Populations of turkeys in the State are sufficient to allow for annual hunting seasons. The numbers of turkeys harvested in the State from 2007 through 2011 during the annual turkey hunting seasons are shown in Figure 4.1. Since 2007, the highest number of turkeys harvested during the hunting seasons occurred in 2007 when 19,289 turkeys were harvested in the State.

Requests for assistance received by the WS program in South Carolina to manage damage or threats of damage associated with wild turkeys occur primarily at airports where turkeys can pose strike risks to aircraft. Turkeys are also known to cause damage to windows, siding, and vehicles when turkeys, primarily males during the breeding season, mistake their reflection as another turkey and attempt to attack the image which can scratch paint on vehicles and siding on houses. Between FY 2005 through FY 2011, WS has dispersed a total of 328 turkeys to manage damage or threats of damage occurring within the State when requested. In addition, WS has also employed lethal methods to take a total of two wild turkeys in the State between FY 2005 and FY 2011. Turkeys were primarily encountered at airports where those turkeys posed an immediate threat of aircraft strikes by feeding or loafing on or moving across active runways and/or taxiways.

Figure 4.1 –Turkey harvest in South Carolina 2007 – 2011 (SCDNR 2011*a*).



Based on previous requests for assistance and in anticipation of receiving an increasing number of requests for assistance as the turkey population increases, WS could lethally take up to 30 wild turkeys annually under the proposed action alternative. With a statewide population estimated at 90,000 turkeys, take of up to 30 turkeys by WS would represent 0.03% of the estimated statewide population if the population in the State remains at least stable. If WS had lethally taken 30 turkeys in 2009, the take would have represented 0.2% of the number of turkeys harvested in the State in 2009 which was the lowest harvest level in the State between the 2007 season and the 2011 season. The take of wild turkeys in the State by WS would only occur at levels permitted by the SCDNR which regulates the take of wild turkeys in the State.

As stated previously, most requests received previously by WS in the State were associated with threats associated with turkeys at airports which are restricted areas and hunting is not permitted. Therefore, the take of turkeys by WS based on the areas where requests for assistance are likely to occur and based on the low magnitude of take that is likely to occur when compared to the estimated population and the

annual harvest of turkeys, the take of turkeys by WS would not reach a magnitude where the ability to harvest turkeys in the State during the regulated seasons would be affected.

Killdeer Biology and Population Impacts

Killdeer occur over much of North America from the Gulf of Alaska southward throughout the United States with their range extending from the Atlantic coast to the Pacific coast (Hayman et al. 1986). Although killdeer are technically in the family that includes other shorebirds, they are unusual shorebirds in that they often nest and live far from water. Killdeer are commonly found in a variety of open areas, even concrete or asphalt parking lots at shopping malls, as well as fields and beaches, ponds, lakes, road-side ditches, mudflats, airports, pastures, and gravel roads and levees but are seldom seen in large flocks. The clutch of up to four eggs is laid in a ground scrape in open habitats (Leck 1984).

Requests for assistance associated with killdeer occur primarily at airports in the State. As the number of airports requesting assistance from WS to manage damage and threats associated with killdeer increases, the number of killdeer lethally taken annually is also likely to increase when lethal methods are deemed appropriate for use to resolve damage and threats. To address an increasing number of requests for assistance, up to 100 killdeer could be lethally taken by WS annually under the proposed action.

From FY 2005 through FY 2011, WS has lethally taken a total of three killdeer in the State at airports to reduce damages and threats associated with aircraft striking killdeer. The highest level of killdeer take by WS occurred in FY 2009 when three killdeer were lethally taken (see Table 4.8). In addition, WS has employed non-lethal methods to harass 297 killdeer at airports in the State from FY 2005 through FY 2011. Since FY 2005, 99% of the killdeer addressed by WS have been harassed using non-lethal methods. No take was reported to the USFWS by other entities from 2005 through 2010.

Since 1966, the number of killdeer observed during the breeding season in the State has shown an increasing trend estimated at 4.4% annually, which is a statistically significant trend (Sauer et al. 2011). However, between 2000 and 2010, the number of killdeer observed along routes surveyed in the State during the BBS has shown a declining trend estimated at -3.0% annually (Sauer et al. 2011). Killdeer observed on BBS routes in the eastern United States are showing a declining trend estimated at -1.4% annually since 1966 and a declining trend across the United States estimated at -0.3% annually, which are both statistically significant trends (Sauer et al. 2011). However, from 2000 to 2010, the number of killdeer observed during the BBS conducted across all routes in the United States has shown an increasing trend estimated at 0.4% annually (Sauer et al. 2011). No current population estimates are available for the number of killdeer residing in the State.

With a relative abundance estimated at 0.7 killdeer per route in South Carolina (Sauer et al. 2011), the killdeer population could be estimated at nearly 2,100 birds based on the land area of the State (United States Census Bureau 2010) estimated at 30,061 mi^2. Using a killdeer population estimated at 2,100 birds in South Carolina, WS lethal removal of 100 killdeer would constitute 4.8% of the estimated population in the State. WS' impacts are likely much lower given the number of killdeer in North Carolina is likely more than 2,100 birds as a result of the bias associated with BBS data for certain species that were described previously. Survey data from the CBC indicates the number of killdeer overwintering in the State has shown a general increasing trend since 1966 (NAS 2010).

Table 4.8 – Killdeer addressed by WS in South Carolina from FY 2005 through FY 2011

Year	Dispersed	Take
2005	0	0
2006	0	0
2007	39	0
2008	38	0
2009	85	3
2010	20	0
2011	115	0
TOTAL	**297**	**3**

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. All take of killdeer would occur within the levels permitted by the USFWS pursuant to the MBTA and when permitted by the SCDNR.

Laughing Gull Biology and Population Impacts

The laughing gull is a common gull species found year-round in the southeastern United States with breeding colonies occurring along the coastal areas of the Atlantic Ocean, Gulf of Mexico, and the coastal areas of the Caribbean Islands (Burger 1996). Localized breeding colonies can also be found along the Gulf of California and the Pacific Coast of Mexico (Burger 1996). Characterized by a black hood, laughing gulls are often associated with human activities near coastal areas where food sources are readily available (Burger 1996). Burger (1996) cites several sources that indicate laughing gulls are opportunistic foragers feeding on a wide-range of aquatic and terrestrial invertebrates, small vertebrates, garbage, and plant material, such as berries.

Belant and Dolbeer (1993*a*) estimated the population of breeding laughing gulls in the United States at 258,851 pairs based on state population records. Non-breeding and sub-adult gulls were not considered as part of the breeding population in the United States estimated by Belant and Dolbeer (1993*a*). Laughing gulls do nest in the State and can be found year-round along the coastal areas (Burger 1996). Nesting colonies occur on coastal islands and man-made structures along the coast. The Waterbird Plan for the southeastern United States recommended reducing the laughing gull population in the southeast from 170,000 pairs currently to 100,000 pairs due to the negative affects laughing gulls can have on other higher priority waterbird species (Hunter et al. 2006).

In South Carolina, the number of laughing gulls observed during the breeding season has been annual increases estimated at 13.9% annually since 1966 (Sauer et al. 2011). In the Southeastern Coastal Plain region, the number of laughing gulls observed along routes surveyed during the BBS has increased annually since 1966 estimated at 7.6% which is a statistically significant increase (Sauer et al. 2011). Laughing gull populations in South Carolina in the 1990s were reported as stable with approximately 6,563 nesting pairs in the State (Belant and Dolbeer 1993*a*). CBC data indicates the number of laughing gulls observed overwintering in the State has been increasing since 1966 (NAS 2010). In the Southeastern Coastal Plain (Bird Conservation Region 27), which includes areas where laughing gulls nest in South Carolina, Hunter et al. (2006) recommend reducing the breeding population from 46,300 pairs to 25,000 pairs.

From FY 2005 through FY 2011, the WS program in South Carolina has responded to requests for assistance to manage damage or threats associated with laughing gulls. The number of laughing gulls addressed by WS between FY 2005 and FY 2011 to alleviate damage or threats of damage when

requested are shown in Table 4.9. WS has employed non-lethal methods to disperse 1,764 laughing gulls in the State since FY 2005 to alleviate damage or threats of damage. WS has lethally removed 168 laughing gulls since FY 2005.

Based on the number of gulls addressed previously by WS in response to requests for assistance, WS anticipates that up to 200 laughing gulls could be lethally taken annually in the State by WS to address requests for assistance under the proposed action alternative. Based on a breeding population estimated at 6,563 pairs (which does not include non-breeding laughing gulls that are also present in the State), take of up to 200 gulls annually would represent 1.5% of the estimated breeding population if the population remains at least stable. A total of two laughing gulls have been taken in the State by other entities since 2005 to alleviate damage or threats of damage.

Table 4.9 – Number of laughing gulls addressed in South Carolina from 2005 to 2011

		Take under Depredation Permits	
Year	**Dispersed by WS**	**WS' Take[1]**	**Take by Other Entities[2]**
2005	465	72	0
2006	67	12	0
2007	315	27	2
2008	276	26	0
2009	421	31	0
2010	171	0	0
2011	49	0	N/A[†]
TOTAL	**1,764**	**168**	**2**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

[†]data is currently unavailable

The cumulative take of laughing gulls would likely represent a smaller percentage of the actual population in the State since the breeding population estimate of 6,563 breeding pairs does not include non-breeding laughing gulls. Dolbeer (1998) estimated that the number of non-breeding laughing gulls equaled about 50% of the nesting population.

No take of laughing gulls would occur by WS in the State without the issuance of a depredation permit by the USFWS and also the SCDNR. Therefore, take would only occur as determined and analyzed by the USFWS and the SCDNR to ensure the desired population objectives for laughing gulls are achieved.

Ring-billed Gull Biology and Population Impacts

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

Currently there are no known breeding ring-billed gull colonies in South Carolina; however, non-breeding ring-billed gulls can be found in the State during the breeding season. Ring-billed gulls do overwinter in the State mainly along the coastal regions. In 1984, the population of ring-billed gulls in the Great Lakes region was estimated at approximately 648,000 pairs (Blokpoel and Tessier 1986). Blokpoel and Tessier (1992) found that the nesting population of ring-billed gulls in the Canadian portion of the lower Great

Lakes system increased from 56,000 pairs to 283,000 pairs from 1976 through 1990. Across all BBS routes, the number of ring-billed gulls observed during the survey has shown an increasing trend in the United States estimated at 3.4% since 1966, with an 11.5% increase estimated from 2000 through 2010 which are statistically significant increases (Sauer et al. 2011). In the Atlantic Northern Forest region (Bird Conservation Region 14) where breeding populations occur, the number of ring-billed gulls observed during the BBS has increased 4.3% annually since 1966 which is also statistically significant (Sauer et al. 2011). In the Southeastern Coastal Plain region, the number of ring-billed gulls observed during the BBS has shown a declining trend estimated at -0.2% annually since 1966; however, from 2000 to 2010 the number observed has shown increasing trends estimated at 1.1% annually (Sauer et al. 2011). The number of ring-billed gulls observed in areas surveyed during the CBC is showing a generally increasing trend in the State (NAS 2010).

WS' take of gulls would occur under permits issued to WS or under permits issued to cooperators where WS is acting as an agent on the permit. The take of ring-billed gulls authorized by the USFWS previously is shown in Table 4.10.

Table 4.10 – Number of ring-billed gulls addressed in South Carolina from 2005 to 2011

		Take under Depredation Permits	
Year	**Dispersed by WS**	**WS' Take[1]**	**Take by Other Entities[2]**
2005	0	0	0
2006	17	0	0
2007	1,880	5	0
2008	200	1	0
2009	0	0	0
2010	965	0	0
2011	144	1	N/A†
TOTAL	**3,206**	**7**	**0**

[1]Data reported by federal fiscal year

[2]Data reported by calendar year

†data is currently unavailable

Since FY 2005, the WS program in South Carolina has addressed 3,206 gulls using non-lethal dispersal methods to alleviate damage. In addition, WS has employed lethal methods to lethally take seven ring-billed gulls in the State since FY 2005.

Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, up to 200 ring-billed gulls could be taken annually in the State by WS to address damage and threats of damage when a request for assistance is received. Between 2005 and 2010, an average of 17,918 ring-billed gulls has been observed annually in the State during the CBC (NAS 2010). If 200 ring-billed gulls were taken by WS, WS' take would represent 1.1% of the average number of ring-billed gulls observed in the State during the CBC from 2005 through 2010. Over the 6-year period, the number of gulls observed during the CBC in the State has ranged from a low of 9,906 gulls observed in 2010 to a high of 32,319 gulls observed in 2007 (NAS 2010). Therefore, if WS had taken 200 ring-billed gulls annually from 2005 through 2010 in the State, the annual take by WS would have ranged from a low of 0.6% to a high of 2.0% of the number of gulls observed in the State during the CBC.

CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the State and is not intended to represent population estimates of wintering bird populations. However, the information is presented in this analysis and compared to WS' proposed take to indicate the low magnitude of take occurring by WS when compared to the number of ring-billed gulls observed in

the State during the CBC which would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the State.

From 2005 through 2010, no ring-billed gulls were lethally taken by other entities in the State. No take of ring-billed gulls would occur by WS in the State without the issuance of a depredation permit by the USFWS and also the SCDNR, if needed. Therefore, take would only occur as determined and analyzed by the USFWS and the SCDNR to ensure the desired population objectives for ring-billed gulls are achieved.

Herring Gull Biology and Population Impacts

Herring gulls are the most widely distributed gulls in the Northern Hemisphere. Herring gulls breed in colonies near oceans, lakes, or rivers (Bent 1921). Herring gulls nest along the Atlantic coast and will nest on natural or man-made sites, such as rooftops and breakwalls. Herring gulls are increasingly nesting on man-made structures, particularly on rooftops or in areas with complete perimeter fencing such as electrical substations.

CBC data gathered in South Carolina from 1966 through 2010 indicates the number of herring gulls observed during the survey has fluctuated in the State (NAS 2010). The number of herring gulls observed on the BBS has shown a downward trend in the United States estimated at -3.6% annually since 1966, which is statistically significant (Sauer et al. 2011). BBS data currently indicates an increasing trend in the Southeastern Coastal Plain region estimated at 1.6% annually since 1966 and 2.6% annually from 2000 through 2010 (Sauer et al. 2011). No current population estimates are available for the number of herring gulls residing in the State. Hunter et al. (2006) recommended the number of nesting herring gulls be reduced to reduce competition for nest sites between herring gulls and other higher priority waterbirds. Herring gulls are considered predatory, feeding on eggs and nestlings of other waterbird species, including terns and plovers (Hunter et al. 2006).

No herring gulls were dispersed or lethally taken by WS in South Carolina from FY 2005 to FY 2010 to manage damage and threats to human safety; however, 15 herring gulls were dispersed using pyrotechnics during FY 2011. WS reasonably expects the need to lethally take herring gulls to increase but would not exceed 100 herring gulls annually. The increase in the estimated annual take level by WS in the State when compared to take by WS previously arises primarily from the increased requests to address damage associated with herring gulls at airports. Herring gulls often will form large flocks when foraging and loafing which poses strike risks at airports and increases the risks of aircraft striking multiple birds.

Herring gulls have also been lethally taken by other entities in the State to alleviate damage as permitted by the USFWS through the issuance of depredation permits. The only lethal take of herring gulls in the State from 2005 through 2010 occurred in 2009 when eight gulls were lethally removed to alleviate damage in the State by entities other than WS.

WS would continue to assist airport personnel in identifying habitat and other attractants to herring gulls on airport property. Herring gulls would continue to be addressed using primarily non-lethal harassment and dispersal methods. All take of herring gulls would occur within the levels permitted by the USFWS pursuant to the MBTA and when permitted by the SCDNR.

Mourning Doves Biology and Population Impacts

Mourning doves are migratory game birds with substantial populations throughout much of North America. Many States have regulated annual hunting seasons for doves. South Carolina allows doves to be harvested during a hunting season each year with generous bag limits. In 2010, the preliminary

mourning dove harvest in South Carolina was estimated at 998,700 doves compared with a preliminary estimate of 885,700 doves harvested in 2009 (Raftovich et al. 2011). Across the United States, the preliminary mourning dove harvest in 2010 was estimated at 17.2 million doves (Raftovich et al. 2011).

According to BBS trend data provided by Sauer et al. (2011), mourning dove populations have remained relatively stable in South Carolina since 1966, with a slight decline observed from 1966 to 2010 estimated at -0.1% annually. However, from 2000 through 2010, no change in the number of doves observed during the BBS has occurred in the State (Sauer et al. 2011). BBS routes across the region in the eastern United States are showing a statistically significant annual increase estimated at 0.5% since 1966 (Sauer et al. 2011). The Partners in Flight population database estimated the mourning dove population in South Carolina to be 1.1 million doves (Rich et al. 2004). CBC data gathered in South Carolina from 1966 through 2010 shows a general stable trend overall but has been highly cyclical (NAS 2010).

From FY 2005 through FY 2011, WS has addressed 1,121 doves to alleviate damage and threats (see Table 4.11). Of those doves addressed by WS in the State from FY 2005 through FY 2011, 201 were addressed using lethal methods while 920 doves were addressed using non-lethal methods. Over 82% of the doves addressed by WS from FY 2005 through FY 2011 were dispersed using non-lethal methods. The number of doves addressed by WS annually has increased each year from FY 2009 to FY 2011. Requests for assistance received by WS often arise from airports where the gregarious flocking behavior of doves can pose risks to aircraft at or near airports. Based on the number of requests to manage damage associated with doves received previously and based on the increasing need to address damage and threats associated with doves in the State, up to 500 mourning doves could be lethally taken by WS annually in the State to address damage or threats.

The take of doves by other entities from 2005 through 2010 to alleviate damage or the threat of damage under depredation permits has not occurred in the State previously. The number of doves that could have been lethally taken during 2011 by other entities was not available at the time this EA was developed. Take of up to 500 doves by WS annually would be a small percentage of the 1.1 million doves estimated to be present in the State during the breeding season, if the population remains at least stable.

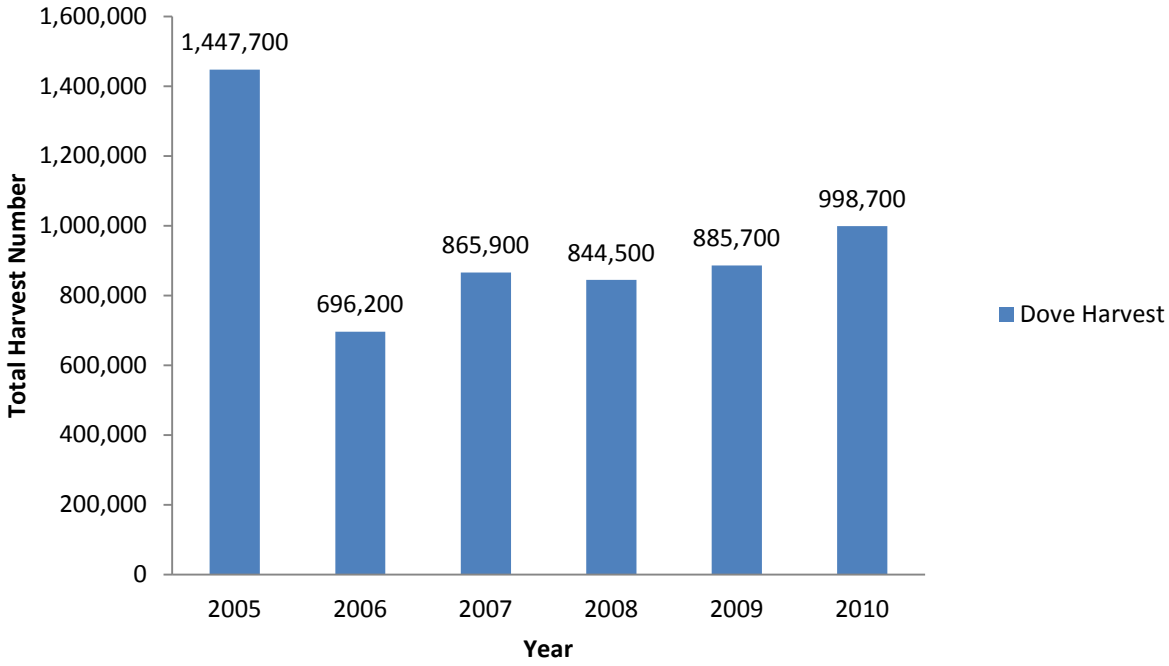
As mentioned previously, mourning doves maintain sufficient population levels to sustain an annual harvest. Annual hunting seasons in the State are established by the SCDNR under frameworks developed by the USFWS pursuant to the MBTA. Under those frameworks, an estimated 998,700 doves were harvested in State during the 2010 hunting season for doves while an estimated 885,700 doves were harvested during the 2009 hunting season in the State (Raftovich et al. 2011).

Table 4.11 – Number of mourning doves addressed in South Carolina by WS, FY 2005 to FY 2011

	Number of Mourning Doves Addressed by WS	
Year	**Dispersed**	**Take**
2005	33	0
2006	90	10
2007	30	0
2008	68	8
2009	208	45
2010	182	94
2011	309	44
TOTAL	**920**	**201**

The numbers of doves harvested in the State annually from 2005 through 2010 are listed in Figure 4.2. An estimated 17.2 million mourning doves were harvested in the United States during the 2010 seasons which was similar to the number of doves harvested during the 2009 season (Raftovich et al. 2011).

Figure 4.2 – Mourning doves harvested in South Carolina, 2005 – 2010 (Raftovich et al. 2011).



As shown in Figure 4.2, over 5 million mourning doves have been harvest in the State between 2005 and 2010. The highest harvest levels in the State occurred in 2005 when 1,447,700 doves were harvested. If WS had taken 500 mourning doves in 2005, the take by WS would have represented 0.03% of the number of doves harvested in the State. An annual take by WS of up to 500 mourning doves would represent 0.05% of the estimated statewide breeding population of 1.1 million doves based on a stable population trend. Local populations of mourning doves in the State are likely augmented by migrating birds during the migration periods and during the winter months. Like other native bird species, the take of mourning doves 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 mourning doves by WS would only occur when a depredation permit has been issued and only at levels authorized by the USFWS and the SCDNR 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 South Carolina.

American Crow Biology and Population Impacts

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

Historically, crow populations have benefited from agricultural development because of grains available as a food supply. Crows typically roost in trees with the combination of food and tree availability being favored. In some areas where abundant food and roosting sites are available, large flocks of crows tend to

concentrate. In the fall and winter, crows often form large roosting flocks in urban areas. These large flocks disperse to different feeding areas during the day. Crows will fly from 6 to 12 miles from a 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.

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

The American crow population in South Carolina has been estimated at 410,000 crows statewide based on BBS data (Rich et al. 2004). From 1966 through 2010, trend data from the BBS indicates the number of crows observed in the State during the survey has increased at an annual rate of 0.4% (Sauer et al. 2011). The number of crows observed in South Carolina in areas surveyed during the CBC has also shown a general increasing trend since 1966 (NAS 2010). Between 2005 and 2010, observers conducting surveys for the CBC have counted an average of 5,189 crows annually in the State. The fewest number of crows observed during the CBC conducted in the State occurred in 2008 when 4,029 crows were observed (NAS 2010). The highest number of crows observed during the CBC occurred in 2009 when 7,033 crows were counted (NAS 2010). As has been stated previously, the data available from the CBC is intended to provide long-term trending information. However, the information on the actual number of crows observed in areas surveyed during the CBC conducted in the State is provided here to evaluate the magnitude of WS' proposed take on the number of crows that could be present in the State. The number of crows observed by surveyors during the CBC would be considered minimum estimates since not all areas of the State are surveyed during the CBC.

From FY 2005 through FY 2011, WS has employed lethal methods to take one American crow in South Carolina and employed non-lethal methods to disperse 542 crows. Based on the requests for assistance received previously and the relative abundance of crows in the State, WS anticipates that up to 100 American crows could be lethally taken annually in the State to resolve requests for assistance. With a statewide population estimated at 410,000 crows, an annual take by WS of 100 crows would represent 0.02% of the estimated population if the population remains stable. Take of up to 100 crows by WS annually would represent 1.9% of the average number of crows observed in the State in areas surveyed during the CBC. Between 2005 and 2010, the lowest number of crows observed during the CBC occurred in 2008 when 4,029 crows were counted. If WS had lethally taken 100 crows in 2008, the take would have represent 2.5% of the number of crows observed. However, the number of crows observed during the CBC would be considered a minimum since not all areas of the State are surveyed.

As was stated previously, the take of crows by other entities either to alleviate damage or during the annual hunting seasons is unknown. Given the relative abundance of American crows in the State and the long-term stable to increasing population trends observed for the species, the take of crows by other entities to alleviate damage or threats of damage and the take of crows during the annual hunting season is likely of low magnitude. The use of population trends as an index of magnitude is based on the assumption that annual harvests do not exceed allowable harvest levels. State wildlife management agencies act to avoid over-harvests by restricting take (either through hunting season regulation and/or permitted take) to ensure that annual harvests are within allowable harvest levels. If crow populations

remain stable in the State, WS' annual take of up to 100 American crows would represent 0.02% of the estimated statewide crow population. The take of crows under the depredation order by other entities is likely to be a small contributor to the cumulative take of crows annually. Although some take is likely to occur, take is not expected to reach a high magnitude. Similarly, the take of crows during the annual hunting season is likely of low magnitude when compared to the statewide population. Given that the number of American crows observed during statewide surveys are showing increasing trends (NAS 2010, Sauer et al. 2011), the population of crows have not declined since those population estimates were calculated and have likely remained at least stable despite the take of crows by WS and other entities under the depredation order and during the annual hunting season.

Fish Crow Biology and Population Impacts

Fish crows are commonly found on the barrier islands, coastal plain, and present but less common in the other parts of South Carolina (Fussell 1994, Hamel 1992). Inland from the coast, fish crows are generally found in large river drainages, although they may feed in woods or fields a few miles from water (Kaufman 1996). Hamel (1992) specifies viable inland habitats as lake shores, pinewoods, and occasionally in towns, residential, or other urban areas. Difficulty in identifying this species probably has led to an underestimate of its range, both current and historic. Although the fish crow is slimmer and has a narrower beak and smaller legs, it is difficult to distinguish from the American crow (Fussell 1994).

Crows often form mixed species roosts which can contain both American crows and fish crows. Fish crows are often confused with American crows with the only reliable distinction between the two species being vocal (Mcgowan 2001). Given the similar physical appearance of the two species, estimating the number of individual fish crows or American crows in a roost or flock of crows based on visual cues can be difficult. Isolating and distinguishing the vocalizations of an individual crow for species identification in a mixed species flock of crows can also be difficult.

Fish crows are not as abundant as American crows and are not as widely distributed across the State. American crows can be found throughout the State while fish crows are most commonly found in the eastern portion of South Carolina. Although fish crows and American crows form mixed species flocks, most flocks of crows or crow roosts encountered is the State consists primarily of American crows. Based on previous requests for assistance with American crows and in anticipation of requests to disperse urban crow roosts, up to 100 fish crows could be taken by WS annually under the proposed action. Although not as abundant in the State, fish crows could be present in flocks of crows addressed by WS. The number of fish crows observed during the BBS has been increasing in the State since 1966 estimated at 4.3% annually, which is statistically significant (Sauer et al. 2011). The number of fish crows observed during the CBC has shown a generally steady trend since 1966 (NAS 2010). Rich et al. (2004) estimated the statewide population of fish crows at 63,000 birds based on BBS data.

Between FY 2005 and FY 2011, no fish crows were lethally taken by WS to alleviate damage nor were any fish crows known to have been dispersed using non-lethal methods by WS. Like American crows, fish crows can be harvested during the regulated hunting season. In addition, fish crows can be lethally taken without a depredation permit from the USFWS when causing or about to cause damage or posing a risk to human safety (see 50 CFR 21.43). Therefore, the number of fish crows lethally taken annually under the depredation order and during the annual hunting season is currently unknown.

If up to 100 fish crows were lethally taken annually by WS, WS' take would represent 0.2% of the estimated statewide population of fish crows. Similar to American crows, the number of fish crows taken annually to alleviate damage or taken during the annual hunting season in the State is currently unknown. However, given the relative abundance of fish crows when compared to the abundance of American

crows and given the more specific habitat preferences of fish crows, the number of fish crows taken or harvested annually is likely to represent a small portion of the total take of crows in the State.

WS anticipates that the take of fish crows would be limited and would most likely occur in conjunction with requests for assistance to manage damage associated with urban crow roosts where American crows and fish crows occur in mixed species flocks. The limited take that could occur by WS under the proposed action could be considered of low magnitude when compared to the statewide breeding population. WS does not anticipate taking fish crows annually based on the lack of activities associated with fish crows previously. However, fish crows could be addressed during management activities under the proposed action to address urban crow roosts.

Horned Lark Biology and Population Impacts

Horned larks have a large distribution, from the Arctic south to central Asia and Mexico with outlying populations in Morocco and Colombia (Beason 1995). A common, widespread bird of the open country, the horned lark prefers short, sparsely vegetated prairies, deserts, and agricultural lands. Adults eat primarily weed and grass seeds, but they feed insects to their young. Horned larks can be found throughout the United States, including South Carolina.

The open areas found at airports makes the habitat ideal for horned larks to forage and nest while providing ample perching areas. Most requests for assistance to reduce threats associated with horned larks occur at airports in South Carolina. Horned larks found on and adjacent to airport property can pose a hazard to aircraft from being struck causing damage to the aircraft and potentially threatening passenger safety.

As reported by the BBS, populations of horned larks in South Carolina have increased since 1966 at an estimated rate of 6.4% annually, which is a statistically significant increase (Sauer et al. 2011). In the United States, BBS data indicates horned larks are showing a declining trend estimated at -1.7% annually since 1966, which is statistically significant (Sauer et al. 2011). CBC data from 1966 through 2010 shows a steady trend for horned larks wintering in South Carolina (NAS 2010). The Partners in Flight landbird database estimated the population of horned larks in South Carolina to be 7,000 birds (Rich et al. 2004).

Since FY 2005, a total of 905 horned larks have been dispersed and 35 have been lethally taken by WS to alleviate damage pursuant to depredation permits. Based on the number of requests received to alleviate the threat of damage associated with horned larks and the number of horned larks addressed previously to alleviate those threats, WS anticipates that up to 100 horned larks could be taken annually in the State to alleviate the threat of damage.

Based on the estimated population, WS' take of up to 100 horned larks would represent 1.4% of the estimated population. Although take could occur by other entities when authorized by the USFWS through the issuance of a depredation permit, the take of horned larks would not likely reach a magnitude where adverse effects to horned larks populations would occur from take to alleviate damage or threats.

The permitting of the take by the USFWS and the SCDNR through the issuance of depredation permits pursuant to the MBTA ensures cumulative take of meadowlarks would be considered as part of population management objectives for meadowlarks.

Eastern Meadowlark Biology and Population Impacts

The eastern meadowlark epitomizes the open habitats of the eastern United States, where the conspicuous nature and call of the meadowlark is easily recognizable (Lanyon 1995). Eastern meadowlarks can be found throughout the eastern United States but their range can be highly dependent on the weather. In South Carolina, eastern meadowlarks can be found year-round in the open, grassy areas of the State where they feed on primarily invertebrates and some plant material, such as weed seeds, grains, and some fruits (Lanyon 1995).

The open areas found at airports makes the habitat ideal for meadowlarks to forage and nest while providing ample perching areas. Most requests for assistance to reduce threats associated with meadowlarks occur at airports in South Carolina. Meadowlarks found on and adjacent to airport property can pose a hazard to aircraft from being struck causing damage to the aircraft and potentially threatening passenger safety.

As reported by the BBS, populations of eastern meadowlarks in South Carolina have decreased since 1966 at an estimated rate of -4.5% annually, which is statistically significant (Sauer et al. 2011). In the United States, BBS data indicates meadowlarks are showing a statistically significant declining trend estimated at -3.2% annually since 1966 (Sauer et al. 2011). CBC data from 1966 through 2010 shows a declining trend for meadowlarks wintering in South Carolina (NAS 2010). The Partners in Flight landbird database estimated the population of eastern meadowlarks in South Carolina to be 52,000 birds (Rich et al. 2004).

From FY 2005 through FY 2011, a total of 910 meadowlarks were dispersed by WS using non-lethal methods. During FY 2008, WS employed non-lethal methods to disperse 530 meadowlarks within the State at airports. No meadowlarks were lethally taken by WS to alleviate damage between FY 2005 and FY 2011 (see Table 4.12). No take of meadowlarks has occurred by other entities in the State between 2005 and 2010, while data for 2011 is currently unavailable. Based on the number of requests received to alleviate the threat of damage associated with meadowlarks and the number of meadowlarks addressed previously to alleviate those threats, WS anticipates that up to 25 meadowlarks could be taken annually in the State to alleviate the threat of damage. WS also anticipates that meadowlarks will continue to be addressed using primarily non-lethal harassment methods, with lethal methods employed to reinforce the use of non-lethal methods to prevent habituation.

Table 4.12 – Number of meadowlarks addressed in South Carolina from 2005 to 2011

		Take by Entity	
Fiscal Year	**Dispersed by WS**	**WS' Take**	**Other Entities**
2005	0	0	0
2006	0	0	0
2007	85	0	0
2008	530	0	0
2009	250	0	0
2010	0	0	0
2011	45	0	N/A[†]
TOTAL	**910**	**0**	**0**

[†]data is currently unavailable

Based on the estimated population, WS' take of up to 25 meadowlarks would represent 0.1% of the estimated population. Although take could occur by other entities when authorized by the USFWS

through the issuance of a depredation permit, the take of meadowlarks would not likely reach a magnitude where adverse effects to meadowlarks populations would occur from take to alleviate damage or threats.

The permitting of the take by the USFWS and the SCDNR through the issuance of depredation permits pursuant to the MBTA ensures cumulative take of meadowlarks would be considered as part of population management objectives for meadowlarks.

Additional Target Species

Target species, in addition to those species analyzed previously, have been lethally taken in small numbers by WS and have included no more than 20 individuals and/or no more than 10 nests of the following species: great egrets, little-blue heron, green herons, black-crowned night-heron, white ibis, Atlantic brant, mute swans, feral geese, feral ducks, wood ducks, American wigeon, American black duck, blue-winged teal, Northern shoveler, Northern pintail, green-winged teal, canvasback, lesser scaup, greater scaup, hooded merganser, common merganser, ruddy duck, Northern harrier, sharp-shinned hawk, red-shouldered hawk, red-tailed hawks, American kestrels, American coot, black-bellied plovers, semipalmated plover, greater yellowlegs, lesser yellowlegs, spotted sandpipers, upland sandpiper, solitary sandpiper, semipalmated sandpiper, western sandpipers, least sandpiper, pectoral sandpiper, buff-breasted sandpiper, lesser black-backed gulls, great black-backed gulls, common snipe, royal tern, common terns, great horned owls, barred owls, common nighthawk, chimney swift, belted kingfisher, downy woodpeckers, hairy woodpeckers, Northern flickers, blue jays, tree swallow, Northern rough-winged swallow, bank swallow, cliff swallow, barn swallow, American robin, gray catbirds, Northern mockingbird, Northern cardinal, red-winged blackbird, common grackle, boat-tailed grackles, brown-headed cowbirds, purple finch, and the house finch.

Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, no more than 20 individuals of any of those species could be taken annually by WS in the State. In addition, up to 10 nests of those species could be destroyed annually by WS in the State to alleviate damage or discourage nesting in areas where damages are occurring. 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 from take under the MBTA and the 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 and the SCDNR permitting processes. 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. In addition, any take of the above species in accordance with an issued federal and state permit would be reported to the USFWS and the SCDNR annually.

Mute swans, feral geese, and feral ducks are not afforded protection under the MBTA and are considered non-native species in South Carolina. The take of those species can occur without the need for a depredation permit from the USFWS or the SCDNR. However, the limited take of those species is not expected to reach a level where the populations of those species would be adversely affected by WS' activities under the proposed action.

Atlantic brant, wood ducks, American wigeon, American black ducks, blue-winged teal, Northern shovelers, Northern pintails, green-winged teal, canvasbacks, lesser scaup, greater scaup, hooded mergansers, common mergansers, ruddy ducks, American coots, and common snipe maintain sufficient population densities to allow for annual harvest seasons. The proposed take of up to 20 individuals of

those species, including up to 10 nests, under the proposed action would be a minor component of the annual take of those species during the regulated hunting seasons.

The following species of birds that could be addressed by WS under the proposed action have been designated by the SCDNR as threatened or endangered: peregrine falcon (Threatened), bald eagle (Threatened), Cooper's hawk (Vulnerable) and loggerhead shrike (Vulnerable). The complete list of the species listed as Endangered or threatened in South Carolina by the SCDNR can be found in Appendix D. None of those species are federally listed by the USFWS and/or the National Marine Fisheries Service pursuant to the ESA.

State-listed species are separated into three categories: Highest Conservation Need, High Conservation Need, and Moderate Conservation Need. Identification of priority rankings was accomplished by the SCDNR through consideration of the data available using the following criteria:

- State and federal protection status: endangered, threatened, rare or special concern
- South Carolina Natural Heritage Program state rank: S1 through S5
- Degree of exploitation/harvest: high, medium or low
- Availability of past or current funding to address species challenges
- Feasibility measure: the likelihood that conservation activities in South Carolina can make a difference for this species
- Knowledge of the species' population status: status mostly known, slightly known, or unknown
- Knowledge of species' distribution in the state: distribution mostly known, slightly known, or unknown
- Knowledge of limiting factors affecting the species: limiting factors mostly known, slightly known, or unknown
- Population status (trend): population decreasing, stable, or increasing

The peregrine falcon, bald eagle, Cooper's hawk, and loggerhead shrike are species that could be found at or near airports where those species represent strike hazards to aircraft. As state threatened species, WS would address requests for assistance associated with peregrine falcons and bald eagles using non-lethal harassment methods only to disperse those species from areas where they pose strike risks to aircraft at or near airports. No lethal take of those species would occur by WS under the proposed action alternative. As discussed previously, harassment of bald eagles to alleviate strike risks would only occur when permitted by the USFWS pursuant to the Bald and Golden Eagle Protection Act. Non-lethal methods are generally regarded has posing no adverse effects since birds are dispersed to other areas but are unharmed. 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 populations of bald eagles or peregrine falcons.

WS anticipates continuing to use primarily non-lethal harassment methods to address loggerhead shrikes and Cooper's hawks at or near airports to reduce the risks of aircraft striking those species. However, WS could be requested to lethally remove individuals of those species on a limited basis when those individuals represent immediate threats of being struck by aircraft. The take of those species would only occur by WS when permitted by the USFWS and only at take levels allowed under those depredation permits. In addition, the take of those species would only occur when authorized by the SCDNR. Based on previous requests for assistance, WS does not anticipate taking more than two Cooper's hawk or two loggerhead shrikes annually to alleviate strike risks at airports in the State. The permitting of the take by the USFWS and the SCDNR ensures the take of those species occurs within population management objectives for those species and is conducted pursuant to federal and state laws and regulations.

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.[11] 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 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

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

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.

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 through Technical Assistance Only

Bird populations in the State would not be directly impacted by WS from a program implementing technical assistance only. However, persons experiencing damage or threats from birds may implement methods based on WS' recommendations. Under a technical assistance only alternative, WS would recommend and demonstrate for use both non-lethal and lethal methods legally available for use to resolve bird damage. Methods and techniques recommended would be based on WS' Decision Model using information provided from the requestor or from a site visit. Requestors may implement WS' recommendations, implement other actions, or take no action. However, those persons requesting assistance are likely those people that would implement damage abatement methods in the absence of WS' recommendations.

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

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

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct bird damage management activities in the State. WS would have no direct involvement with any aspect of addressing damage caused by birds and would provide no technical assistance. No take of birds by WS would occur in the State. Birds could continue to be

lethally taken to resolve damage and/or threats occurring either through depredation permits, under the blackbird and cormorant depredation orders, during the regulated hunting seasons, or in the case of non-native species, take can occur anytime using legally available methods. Management actions taken by non-federal entities would be considered the *environmental status quo*.

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

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

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

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

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

The potential adverse 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.

Personnel from WS are experienced and trained in wildlife identification and to select the most appropriate methods for taking targeted animals and excluding non-target species. To reduce the likelihood of capturing non-target wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that are as specific to target species as possible, and determine placement of methods to avoid exposure to non-targets. SOPs to prevent and reduce any potential adverse impacts on non-targets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize non-target take during program activities, the potential for adverse impacts to non-target exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety. However, from FY 2005 through FY 2011, no non-targets have been lethally taken by WS during bird damage management activities.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected; therefore, non-target species excluded from areas may potentially be adversely impacted if the area excluded is large enough. Auditory and visual dispersal methods used to reduce damage or threats caused by birds are also likely to disperse non-targets in the immediate area the methods are employed. Therefore, non-targets may be permanently dispersed from an area while employing non-lethal dispersal techniques. However,

like target species, the potential impacts on non-target species are expected to be temporary with target and non-target species often returning after the cessation of dispersal methods. 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 non-target populations in the State under any of the alternatives.

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

Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage are intended to elicit fright responses in wildlife. When employing those methods to disperse or harass target species, any non-targets in the vicinity of those methods when employed are also likely dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species also excludes access to non-target species.

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 impacts on non-target species when used according to label requirements. Most repellents for birds are derived from natural ingredients that pose a very low risk to non-targets when exposed to or when ingested. Two chemicals commonly registered with the EPA as bird repellents are methyl anthranilate and anthraquinone. Methyl anthranilate naturally occurs in grapes and is used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants like aloe and is also used to make dye. Both products claim to be unpalatable to many bird species. Several products are registered for use to reduce bird damage containing either methyl anthranilate or anthraquinone. Formulations containing those chemicals are liquids that are applied directly to susceptible resources. Methyl anthranilate applied to alleviate goose damage was effective for about four days depending on environmental conditions which was a similar duration experienced when applying anthraquinone as geese continued to feed on treated areas (Cummings et al. 1995, Dolbeer et al. 1998). Dolbeer et al. (1998) found that geese tended to loaf on anthraquinone treated turf, albeit at lower abundance, but the quantity of feces on treated and untreated turf was the same, thus the risk of damage was unabated. Mesurol is applied directly inside eggs that are of a similar appearance to those being predated on by crows. Therefore, risks to non-target would be restricted to those wildlife species that would select for

the egg baits. However, adherence to the label requirements of mesurol would ensure threats to non-targets would be minimal. Similarly, when used in accordance with the label requirements, the use of Avitrol would also not adversely affect non-targets based on restrictions on baiting locations.

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

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

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

A common concern regarding with 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.

Once sites are baited, sites are monitored daily to further observe for non-target feeding activity. If non-targets are observed feeding on bait, those sites are abandoned. By acclimating target bird species to a feeding schedule, baiting can occur at specific times to ensure bait placed is quickly consumed by target bird species, especially when large flocks of target species are present. The acclimation period allows for treated bait to be present only when birds are conditioned to be present at the site and provides a higher likelihood that treated bait is consumed by the target species which makes it unavailable to non-targets. In addition, with many blackbird species, including crows, when present in large numbers, tend to exclude non-targets from a feeding area due to their aggressive behavior and by the large number of

conspecifics present at the location. Therefore, risks to non-target species from consuming treated bait only occurs when treated bait is present at a bait location. WS would retrieve all dead birds to the extent possible following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

DRC-1339 Primary Hazard Profile - DRC-1339 was selected for reducing bird damage because of its high toxicity to blackbirds (DeCino et al. 1966, West et al. 1967, Schafer, 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})[12] 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, quails (*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 derived acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine acute toxicity to pesticides has many views (Lipnick et al. 1995). The use of small sample sizes was the preferred method of screening for toxicity beginning as early as 1948 to minimize the number of animals involved (Dixon and Mood 1948). In 1982, the EPA established standardized methods for testing for acute toxicity that favored larger sample sizes (EPA 1982). More recently, regulatory agencies have again begun to debate the appropriate level of sample sizes in determining acute toxicity based on a growing public concern for the number of animals used for scientific purposes.

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment (ECOFRAM) was established by 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).

[12] 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.

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

DRC-1339 is rapidly metabolized and excreted and does not bioaccumulate which probably accounts for its low secondary hazard profile (Schafer, Jr. 1991, USDA 1997). For example, cats, owls and magpies would be at risk only after exclusively eating DRC-1339-poisoned starlings for 30 continuous days (Cunningham et al. 1979). Studies using the American kestrel as a surrogate species show that secondary hazards to raptors are small, and these birds are not put at risk by DRC-1339 baiting (USDA 1997). The risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999).

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

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

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

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

would have to ingest several treated baits (either from cached bait or from the bait site) to obtain a lethal dose which could vary by the species.

DRC-1339 is typically very unstable in the environment and degrades quickly when exposed to sunlight, heat, and ultraviolet radiation. The half-life of DRC-1339 in biologically active soil was estimated at 25 hours with the identified metabolites having a low toxicity (EPA 1995). DRC-1339 is also highly soluble in water, does not hydrolyze, and photodegrades quickly in water with a half-life estimated at 6.3 hours in summer, 9.2 hours in spring sunlight, and 41 hours during winter (EPA 1995). DRC-1339 binds tightly with soil and is considered to have low mobility (EPA 1995). Given the best environmental fate information available and the unlikelihood of a non-target locating enough treated bait(s) sufficient to produce lethal effects, the risks to non-targets from crows caching treated bait would be low. When baiting, treated baits are mixed with untreated bait to minimize non-target hazards directly at the bait site and to minimize the likelihood of target species developing bait aversion. Since treated bait is diluted, often times up to 1 treated bait for every 25 untreated baits, the likelihood of a crow selecting treated bait and then caching the bait is further reduced.

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

The proposed bird damage management could benefit many other wildlife species that are impacted by 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 and fish crows often feed on the eggs, nestlings, and fledglings of other bird species. Fish crows are known to feed heavily on colonial waterbird eggs (Mcgowan 2001). This alternative has the greatest possibility of successfully reducing bird damage and conflicts to wildlife species since all available methods could possibly be implemented or recommended by WS.

Birds could still be lethally taken during the regulated harvest season, through depredation orders, and through the issuance of depredation permits under this alternative. Impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives since no lethal take would occur. Non-lethal methods would be available under all the alternatives analyzed. WS' involvement in the use of or recommendation of non-lethal methods would ensure non-target impacts are considered under WS' Decision Model. Impacts to non-targets under this alternative from the use of and/or the recommendation of non-lethal methods are likely to be low.

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. Minimization measures and 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 South Carolina as determined by the USFWS and the National Marine Fisheries Services was obtained and reviewed during the development of this EA. Appendix C contains the list of species currently listed in the State along with common and scientific names. Consultation with the USFWS under Section 7 of the ESA concerning potential impacts of WS' programmatic activities on T&E species was conducted as part of the development of WS' programmatic FEIS (USDA 1997). WS obtained a BO from the USFWS addressing WS' programmatic activities. For the full context of the BO, see Appendix F of WS' programmatic FEIS (USDA 1997).

Based on a review of those T&E species listed in the State during the development of the EA, WS determined that activities conducted pursuant to the proposed action would not likely adversely affect those species listed in the State by the USFWS and the National Marine Fisheries Services nor their critical habitats. As part of the development of the EA, WS consulted with the USFWS under Section 7 of the ESA. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species currently listed in the State or their critical habitats (T. McCoy, USFWS, pers. comm. 2012).

State Listed Species – The current list of State listed species as endangered or threatened by the State as determined by the SCDNR was obtained and reviewed during the development of the EA (see Appendix D). Based on the review of species listed in the State, WS has determined that the proposed activities would not adversely affect those species currently listed by the State. The SCDNR has concurred with WS' determination for State listed species (E. Cope, SCDNR, pers. comm. 2012).

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

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

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

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

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

If requestors are provided technical assistance but do not implement any of the recommended actions, the potential impacts to non-targets would be lower compared to the proposed action. If those persons requesting assistance implement recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-targets would be similar to the proposed action. Methods or techniques not implemented as recommended or used inappropriately would likely increase potential impacts to non-targets. Therefore, the potential impacts to non-targets, including T&E species would be variable under a technical assistance only alternative.

Those persons requesting assistance are those likely to use lethal methods since a damage threshold has been met for that individual requestor that has triggered seeking assistance to reduce damage. The potential impacts on non-targets by those persons experiencing damage would be highly variable. People whose bird damage problems were not effectively resolved by non-lethal control methods would likely resort to other means of legal or illegal lethal control. This could result in less experienced persons implementing control methods and could lead to greater take of non-target wildlife than the proposed action. When those persons experiencing damage caused by wildlife reach a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species that often results in loss of both target and non-target wildlife (USDA 1997, White et al. 1989, USFWS 2001, FDA 2003). The use of illegal toxicants by those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate take of wildlife species.

The ability to reduce negative impacts caused by birds to wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions. It would be expected that this alternative would have a greater chance of reducing damage than Alternative 3 since WS would be available to provide information and advice.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not be directly involved with bird damage management activities in the State. Therefore, no direct impacts to non-targets or T&E species would occur by WS under this alternative. Birds would continue to be taken during the regulated harvest season, under depredation permits issued by USFWS and the SCDNR, under the depredation order for blackbirds and cormorants, and the control order for Muscovy ducks. No depredation permit is required to take non-native species. Risks to non-targets and T&E species would continue to occur from those persons 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.

The ability to reduce damage and threats of damage caused by birds would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to non-targets and T&E species would be similar across the alternatives since most of those methods described in Appendix B are available across the alternatives. If those methods available are applied as

intended, risks to non-targets would be minimal to non-existent. If methods available are applied incorrectly or applied without knowledge of bird behavior, risks to non-target wildlife would be higher under this alternative. If frustration from the lack of available assistance causes those persons experiencing bird damage to use methods that are not legally available for use, risks to non-targets would be higher under this alternative. People have resorted to the use of illegal methods to resolve wildlife damage that have resulted in the lethal take of non-target wildlife (*e.g.*, White et al. 1989, USDA 1997, USFWS 2001, FDA 2003).

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

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

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

The cooperator requesting assistance is made aware through a MOU, cooperative service 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.

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

Although hazards to human safety from non-lethal methods exist, those methods are generally regarded as safe when used by trained individuals who are experienced in their use. Risks to human safety from the use of non-lethal methods were considered low when evaluated in a formal risk assessment in WS' programmatic FEIS (USDA 1997). Risks to human safety associated with non-chemical methods such as resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, and cage traps were considered low based on their use profile for alleviating damage associated with wildlife (USDA 1997). Although some risk of fire and bodily harm exists from the use of pyrotechnics, lasers, and propane cannons, when used appropriately and in consideration of those risks, they can be used with a high degree of safety.

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 SCDNR. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. 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. However, at the time this EA was developed, the commercially

available product containing the same active ingredient as DRC-1339 for use to manage damage associated with blackbirds and starlings at livestock and poultry operations was not registered for use in the State.

WS' employees who conducted bird damage management activities are knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge is incorporated into the decision-making process inherent with the WS' Decision Model that is applied when addressing threats and damage caused by birds. When employing lethal methods, WS' employees considered risks to human safety when employing those methods based on location and method. Risks to human safety from the use of methods is likely greater in urban areas when compared to rural areas that are less densely populated. Consideration is also give 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 is likely 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 have also been identified as a potential issue. Live-capture traps are typically set in situations where human activity is minimal to ensure public safety. Traps rarely cause serious injury and are triggered through direct activation of the device. Live-capture traps available for birds are typically walk-in style traps where birds enter but are unable to exit. Therefore, human safety concerns associated with live traps used to capture birds require direct contact to cause bodily harm. If left undisturbed, risks to human safety would be minimal. A formal risk assessment of live-capture methods determined risks to human safety associated with the use patterns of those methods was low (USDA 1997).

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

Certain safety issues due 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 are deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues are considered before the use of firearms are deemed appropriate. All methods, including firearms, must be agreed upon with the cooperator to ensure the safe use of methods. A risk assessment conducted during the development of WS' programmatic FEIS, determined the risks to human safety from the use of firearms was low based on the use profile of the method (USDA 1997).

All WS' personnel who handle and administered 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. All euthanasia would occur in the absence of the public to further minimize risks. SOPs are further described in Chapter 3 of this EA.

The recommendation of repellents or the use of those repellents registered for use to disperse birds in the State could occur under the proposed action as part of an integrated approach to managing bird damage. Those chemical repellents that would be available to recommend for use or 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. Risks to human safety associated with the use or recommendation of repellents is addressed under the technical assistance only alternative (Alternative 2) and 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 South Carolina but will be evaluated in this assessment as a repellent that could be employed under the proposed action if the product becomes available. Mesurol is mixed with water and once mixed, placed inside raw eggs that are similar in size and appearance to the eggs of the species being protected. Treated eggs are placed in the area where the protected species are known to nest at least three weeks prior to the onset of egg-laying to condition crows to avoid feeding on eggs. Methiocarb is a carbamate pesticide that acts as a cholinesterase inhibitor. Crows ingesting treated eggs become sick (*e.g.*, regurgitate, become lethargic) but recover. Human safety risks associated with the use of mesurol occur primarily to the mixer and handler during preparation. WS' personnel with follow all label requirements, including the personal protective equipment required to handle and mix bait. When used according to label requirements, the risks to human safety from the use of mesurol would be minimal.

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

Locations where treated bait may be placed are determined based on product label requirements (*e.g.*, distance from water, specific location restrictions), the target bird species use of the site (determined through prebaiting and an acclimation period), on non-target use of the area (areas with non-target activity are not used or abandon), and based on human safety (*e.g.*, in areas restricted or inaccessible by the public

or where warning signs have been placed). Once appropriate locations are determined, treated baits are placed in feedings stations or are broadcast using mechanical methods (ground-based equipment or hand spreaders) and by manual broadcast (distributed by hand) per label requirements. Once baited using the diluted mixture (treated bait and untreated bait) when required by the label, locations are monitored for non-target activity and to ensure the safety of the public. After each baiting session, all uneaten bait is retrieved. Through prebaiting, target birds can be acclimated to feed at certain locations at certain periods of time. By acclimating birds to a feeding schedule, baiting can occur at specific times to ensure bait placed is quickly consumed by target bird species, especially when large flocks of target species are present. The acclimation period allows for treated bait to be placed at a location only when target birds are conditioned to be present at the site and provides a higher likelihood that treated bait is consumed by the target species which makes it unavailable for potential exposure to humans. To be exposed to the bait, someone would have to approach a bait site and handle treated bait. If the bait has been consumed by target species or is removed by WS, then treated bait is no longer available and human exposure to the bait could 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 in the State during the development of this assessment occurred from November 1 until March 1 the following calendar year with no daily take limit and no possession limit (SCDNR 2011*b*). Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur in the State during the period of time when crows can be harvested. Although baiting could occur in rural areas of State during those periods of time, most requests for assistance to manage crow damage during the period of time when crows can be harvested in the State occur in urban areas associated with urban crow roosts. Crows using urban communal roost locations often travel long distances to forage before returning to the roost location during the evening.

When managing damage associated with urban crow roosts, the use of DRC-1339 would likely occur at known forage areas (where crows from a roost location are known to travel to) or could occur near the roost location where crows have be conditioned to feed through the use of prebaiting. Crows, like other blackbirds, often stage (congregate) in an area prior to entering a roost location. The staging behavior of exhibited by blackbirds occurs consistently and can be induced to occur consistently at a particular location through the use of prebaiting since blackbirds often feed prior to entering a roost location. Prebaiting can also induce feeding at a specific location as crows exit a roost location in the morning by providing a consistent food source. Baiting with DRC-1339 treated baits most often occurs during the winter when the availability of food is limited and crows can be conditioned to feed consistently at a location by providing a consistent source of food. Given the range in which the death of sensitive bird species occurs, crows that consume treated bait could fly long distances. Although not specifically

known for crows, sensitive bird species that ingest a lethal dose of DRC-1339 treated bait generally die within 24 to 72 hours after ingestion (USDA 2001). Therefore, crows that ingest a lethal dose of DRC-1339 at the bait site could die in other areas besides the roost location or the bait site.

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

In summary, nearly all of the DRC-1339 ingested by sensitive species is metabolized or excreted quickly, normally within a few hours. Residues of DRC-1339 have been found in the tissues of birds consuming DRC-1339 at very high dosage rates that exceed current acute lethal dosages achieved under the label requirements of DRC-1339. Residues of DRC-1339 ingested by birds appear to be primarily located in the gastrointestinal tract of birds.

As stated previously, to pose of risks to human safety, a hunter would have to harvest a crow that has ingested DRC-1339 and then, ingest tissue of the crow containing residue. Very little information is available on the acute or chronic toxicity of DRC-1339 on people. However, based on the information available, risks to human safety would be extremely low based on several factors. First, a hunter would have to harvest a crow that had ingested DRC-1339. As stated previously, the use of DRC-1339 primarily occurs to address damage associated with urban roosts. Hunting and discharging a firearm is prohibited in most municipal areas. Therefore, a crow would have to ingest treated bait and then travel to an area (typically outside of the city limit) where hunting was allowed. WS would not recommend hunting as a damage management tool in those general areas where DRC-1339 was actively being applied. Secondly, to pose a risk to human safety the crow would have to be consumed and the tissue consumed would have to contain chemical residues. Although no information is currently available on the number of people that might consume crows in South Carolina, very few, if any, people are likely consuming crows harvested in the State or elsewhere. Crows are primarily harvested for recreational purposes and to alleviate damage in the State and are not harvested for subsistence. Thirdly, the tissue consumed would have to contain chemical residues of DRC-1339. Current information indicates that the majority of the chemical is excreted within a few hours of ingestion. The highest concentration of the chemical occurs in the gastrointestinal tract of the bird which is discarded and not consumed. Although residues have been detected in the tissues that might be consumed (*e.g.*, breast meat) in some bird species that have consumed DRC-1339, residues appear to only be detectable when the bird has consumed a high dose of the chemical that far exceeds the LD_{50} for that species and would not be achievable under normal

baiting procedures. 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.

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

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

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

Of additional concern with the use of immobilizing drugs and reproductive inhibitors is the potential for human consumption of meat from waterfowl that have been immobilized using alpha chloralose or have consumed nicarbazin. Since waterfowl are harvested during a regulated harvest season and consumed, the use of immobilizing drugs and potentially reproductive inhibitors is of concern. The intended use of immobilizing drugs is to live-capture 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 of time established between when the animal consumed treated bait to when it is safe to consume the meat of the animal by humans. Withdrawal periods are not well defined for free-ranging wildlife species for all drugs. In compliance with FDA use restrictions, the use of alpha

chloralose is prohibited for 30 days prior to and during the hunting season on waterfowl and other game birds that could be hunted. In the event that WS is requested to immobilize waterfowl or use nicarbazin either during a period of time when harvest of waterfowl is occurring or during a period of time where a withdrawal period could overlap with the start of a harvest season, WS would not use immobilizing drugs or nicarbazin. In those cases, other methods would be employed.

The recommendation by WS that birds be harvested during the regulated hunting season which is established by the SCDNR 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 SCDNR for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of birds would not increase those risks.

No adverse effects to human safety have occurred from WS' use of methods to alleviate bird damage in the State from FY 2005 through FY 2011. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, is considered low.

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

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

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

The use of chemical methods would also be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage birds in the State. Most repellents require ingestion of the chemical to achieve the desired affects on target species. Repellents that require ingestion are intended to discourage foraging on vulnerable resources and to disperse birds from areas where the repellents are applied. The active ingredients of repellents that are currently registered for use to disperse birds include methyl anthranilate and polybutene. Another common active ingredient in repellents intended to disperse other bird species contain the active ingredient anthraquinone. Currently, no repellents are currently registered for use to disperse birds in the

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

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

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

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

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

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management alternative, WS would not be involved with any aspect of managing damage associated with birds in the State, including technical assistance. Due to the lack of involvement in managing damage caused by birds, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage from birds from conducting damage management activities in the absence of WS' assistance. Many of the methods discussed in Appendix B would be available to those persons experiencing damage or threats and could

be used to take birds if permitted by the USFWS and/or the SCDNR. The direct burden of implementing permitted methods would be placed on those experiencing damage.

Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Since most non-chemical methods available for bird damage management involve the live-capture or harassment of birds, those methods are generally regarded as posing minimal risks to human safety. Habitat modification and harassment methods are also generally regarded as posing minimal risks to human safety. Though some risks to safety are likely to occur with the use of pyrotechnics, propane cannons, and exclusion devices, those risks are minimal when those methods are used appropriately and in consideration of human safety. The only methods that would be available under this alternative that would involve the direct lethal taking of birds are shooting and nest destruction. Under this alternative, shooting and nest destruction would be available to those persons experiencing damage or threats of damage when permitted by the USFWS and/or the SCDNR. Firearms, when handled appropriately and with consideration for safety, pose minimal risks to human safety.

Similar to the technical assistance only alternative, DRC-1339, alpha-chloralose, and mesurol would not be available under this alternative to those persons experiencing damage or threats from birds. Chemical methods that would be available to the general public would include repellents and if a person obtained the appropriate restricted use pesticide license, a product with the same active ingredient as DRC-1339, if registered in the State, could be applied. Since most methods available to resolve or prevent bird damage or threats are available to anyone, the threats to human safety from the use of those methods are similar between the alternatives. However, methods employed by those persons not experienced in the use of methods or are not trained in their proper use, could increase threats to human safety. Overall, the methods available to the public, when applied correctly and appropriately, pose minimal risks to human safety.

Issue 4 - Effects on the Aesthetic Values of Birds

People often enjoy viewing, watching, and knowing birds exist as part of the natural environment and gain aesthetic enjoyment in such activities. Those methods available to alleviate damage are intended to disperse and/or remove birds. Non-lethal methods are intended to exclude or make an area less attractive which disperses birds to other areas. Similarly, lethal methods are intended to remove those birds identified as causing damage or posing a threat of damage. The effects on the aesthetic value of birds as it relates to the alternatives are discussed below.

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

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of birds to resolve damage and threats. In some instances where birds are dispersed or removed, the ability of interested persons to observe and enjoy those birds would likely temporarily decline.

Even the use of exclusionary devices can lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant has been removed or made unavailable, the wildlife would likely disperse to other areas where resources are more vulnerable.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of birds to address or prevent damage and threats. The goal under the proposed action is to respond to requests for assistance and to manage those birds responsible for the resulting damage. Therefore, the ability to view and enjoy birds would still remain if a reasonable effort is made to locate

birds outside the area in which damage management activities occurred. Those birds removed by WS are those that could be removed by the person experiencing damage.

All activities are conducted where a request for assistance has been received and only after agreement for such services have been agreed upon by the cooperator. Some aesthetic value would be gained by the removal of birds and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high bird densities.

Since those birds removed by WS under this alternative could be removed with a depredation permit issued by the USFWS, under depredation orders, under control orders, without the need for a permit (non-native species), or the regulated hunting seasons, WS' involvement in taking those birds would not likely be additive to the number of birds that could be taken in the absence of WS' involvement.

WS' take of birds from FY 2005 through FY 2011 has been of low magnitude compared to the total mortality and populations of those species. WS' activities are not likely additive to the birds that would be taken in the absence of WS' involvement. Although birds removed by WS are no longer present for viewing or enjoying, those birds would likely be taken by the property owner or manager if WS was not involved in the action since take by the property owner or manager could occur under a depredation permit, under depredation orders for blackbirds and cormorants, control order for Muscovy ducks, during the regulated hunting seasons, or if the birds are non-native, take could occur without the need for a permit. Given the limited take proposed by WS under this alternative when compared to the known sources of mortality of birds, WS' bird damage management activities conducted pursuant to the proposed action would not adversely affect the aesthetic value of birds. The impact on the aesthetic value of birds and the ability of the public to view and enjoy birds under the proposed action would be similar to the other alternatives and is likely low.

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

If those persons seeking assistance from WS were those persons likely to conduct bird damage management activities in the absence of WS' involvement, then technical assistance provided by WS would not adversely affect the aesthetic value of birds in the State similar to Alternative 1. Birds could be lethally taken under this alternative by those entities experiencing bird damage or threats which would result in localized reductions in the presence of bird at the location where damage was occurring. The presence of birds where damage was occurring would be reduced where damage management activities are conducted under any of the alternatives. Even the recommendation of non-lethal methods is likely to result in the dispersal of birds from the area if those non-lethal methods recommended by WS are employed by those persons receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of birds since any activities conducted to alleviate bird damage could occur in the absence of WS' participation in the action, either directly or indirectly.

Under this alternative, the effects on the aesthetic values of birds would be similar to those addressed in the proposed action. When people seek assistance with managing damage either from WS or another entity, the damage level has often reached an unacceptable economic threshold for that particular person. Therefore, in the case of bird damage, the social acceptance level of those birds has reached a level where assistance is requested and those persons are likely to apply methods or seek those entities that would apply those methods based on recommendations provided by WS or by other entities. Based on those recommendations, methods are likely to be employed by the requestor that would result in the dispersal and/or removal of birds responsible for damage or threatening safety. If those birds causing damage are dispersed or removed by those persons experiencing damage based on recommendations by WS or other entities, the potential effects on the aesthetic value of those birds would be similar to the proposed action alternative.

The impacts on aesthetics from a technical assistance program would only be lower than the proposed action if those individuals experiencing damage are not as diligent in employing those methods as WS would be if conducting an operational program. If those persons experiencing damage abandoned the use of those methods then birds would likely remain in the area and available for viewing and enjoying for those persons interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities occurs is not such that birds would be dispersed or removed from such large areas that opportunities to view and enjoy birds would be severely limited.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of birds in the State. Those persons experiencing damage or threats from birds would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. The degree to which damage management activities would occur in the absence of assistance by any agency is unknown but likely lower compared to damage management activities that would occur where some level of assistance was provided. Birds could still be dispersed or removed under this alternative by those persons experiencing damage or threats of damage. The potential impacts on the aesthetic values of birds could be similar to the proposed action if similar levels of damage management activities are conducted by those persons experiencing damage or threats or is provided by other entities. If no action is taken or if activities are not permitted by the USFWS or the SCDNR, then no impact on the aesthetic value of birds would occur under this alternative.

Since birds could continue to be taken under this alternative, despite WS' lack of involvement, the ability to view and enjoy birds would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of birds dispersed or taken since WS' has no authority to regulate take or the harassment of birds in the State. The USFWS and the SCDNR with management authority over birds would continue to adjust all take levels based on population objectives for those bird species in the State. Therefore, the number of birds lethally taken annually through hunting and under the depredation permits and orders are regulated and adjusted by the USFWS and the SCDNR.

Those persons experiencing damage or threats would continue to use those methods they feel appropriate to resolve bird damage or threats, including lethal take. WS' involvement in bird damage management is therefore, not additive to the birds that could be taken in the State. The impacts to the aesthetic value of birds would be similar to the other alternatives.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

The issue of humaneness and animal welfare concerns associated with methods available for use to manage bird damage has been raised. As described previously, most of those methods available for use to manage bird damage would be available under any of the alternatives, when permitted by the USFWS and the SCDNR. The humaneness of methods available for use in South Carolina, as the use of those methods relates to the alternatives, is discussed below.

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

Under the proposed action, WS would integrate methods using WS' Decision Model as part of technical assistance and direct operational assistance. Methods available under the proposed action could include non-lethal and lethal methods integrated into direct operational assistance conducted by WS. Under this alternative, non-lethal methods would be used by WS which are generally regarded as humane. Non-

lethal methods would include resource management methods (*e.g.*, crop selection, limited habitat modification, modification of human behavior), exclusion devices, frightening devices, reproductive inhibitors, immobilizing chemicals, cage traps, nets, and repellents.

As discussed previously, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering.

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

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

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

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

If birds are to be live-captured by WS, WS' personnel would be present on-site during capture events or methods would be checked frequently to ensure birds captured are addressed timely and to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, lethal methods could also be employed to resolve requests for assistance to resolve or prevent bird damage and threats. Lethal methods would include shooting, DRC-1339, and euthanasia after birds are live-captured. WS' use of euthanasia methods under the proposed action would follow those required by WS' directives (WS Directive 2.430) and recommended by the AVMA for use on free-ranging wildlife under field conditions (AVMA 2007).

The euthanasia methods being considered for use under the proposed action for live-captured birds are cervical dislocation and carbon dioxide. The AVMA guideline on euthanasia lists cervical dislocation and carbon dioxide as an acceptable method of euthanasia for free-ranging birds which can lead to a humane death (AVMA 2007). The use of cervical dislocation or carbon dioxide for euthanasia would occur after the animal has been live-captured and away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2007). WS' personnel that employ firearms to address bird damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

Although the mode of action of DRC-1339 is not well understood, it appears to cause death primarily by nephrotoxicity in susceptible species and by central nervous system depression in non-susceptible species (Decino et al. 1966, Westberg 1969, Schafer, Jr. 1984). DRC-1339 causes irreversible necrosis of the kidney and the affected bird is subsequently unable to excrete uric acid with death occurring from uremic poisoning and congestion of major organs (Decino et al. 1966, Knittle et al. 1990). The external appearances and behavior of starlings that ingested DRC-1339 slightly approve the LD_{50} for starlings appeared normal for 20 to 30 hours, but water consumption doubled after 4 to 8 hours and decreased thereafter. Food consumption remained fairly constant until about 4 hours before death, at which time starlings refused food and water and became listless and inactive. The birds perched with feathers fluffed as in cold weather and appeared to doze, but were responsive to external stimuli. As death nears, breathing increased slightly in rate and became more difficult; the birds no longer responded to external stimuli and became comatose. Death followed shortly thereafter without convulsions or spasms (DeCino et al. 1966). Birds ingesting a lethal dose of DRC-1339 become listless and lethargic, and a quiet death normally occurs in 24 to 72 hours following ingestion. This method appears to result in a less stressful death than which probably occurs by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternatives. Certain formulations of DRC-1339 to manage damage caused by certain species of birds are only available to WS' personnel for use. A similar product containing the same active ingredient is commercially available as a restricted use pesticide for use to manage damage associated with blackbirds and starlings but at the time this document was developed was not registered for use in South Carolina.

The chemical repellent under the tradename Avitrol acts as a dispersing agent when birds ingest treated particles which causes them to become hyperactive (see discussion in Appendix B). Their distress calls generally alarm the other birds and cause them to leave the site. Only a small number of birds need to be affected to cause alarm in the rest of the flock. The affected birds generally die. In most cases where Avitrol is used, only a small percentage of the birds are affected and killed by the chemical with the rest being dispersed. In experiments to determine suffering, stress, or pain in affected animals, Rowsell et al. (1979) tested Avitrol on pigeons and observed subjects for clinical, pathological, or neural changes indicative of pain or distress. None were observed. Conclusions of the study were that the chemical met the criteria for a humane pesticide.

Research and development by WS has improved the selectivity and humaneness of management techniques. Research is continuing to bring new findings and products into practical use. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations where non-lethal damage management methods are not practical or effective. Personnel from WS are experienced and professional in their use of management methods. Consequently, management methods are implemented in the most humane manner possible under the constraints of current technology. Those methods discussed in Appendix B to alleviate bird damage and/or threats in the State, except for DRC-1339, alpha chloralose, and mesurol, could be used under any

of the alternatives by those persons experiencing damage regardless of WS' direct involvement. Therefore, the issue of humanness associated with methods would be similar across any of the alternatives since those methods could be employed. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. SOPs that would be incorporated into WS' activities to ensure methods are used by WS as humanely as possible are listed in Chapter 3.

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

The issues of humaneness of methods under this alternative are likely to be perceived to be similar to humaneness issues discussed under the proposed action. This similarity is derived from WS' recommendation of methods that some consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the requester employing those methods. Therefore, by recommending methods and thus a requester employing those methods, the issue of humaneness would be similar to the proposed action.

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

Those persons requesting assistance would be directly responsible for the use and placement of methods and if monitoring or checking of those methods does not occur in a timely manner, captured wildlife could experience suffering and if not address timely, could experience distress. The amount of time an animal is restrained under the proposed action would be shorter compared to a technical assistance alternative if those requesters implementing methods are not as diligent or timely in checking methods. Similar to Alternative 3, it is difficult to evaluate the behavior of individual people and what may occur under given circumstances. Therefore, only the availability of WS' assistance can be evaluated under this alternative since determining human behavior can be difficult. If those persons seeking assistance from WS apply methods recommended by WS through technical assistance as intended and as described by WS, then those methods would be applied as humanely as possible to minimize pain and distress. If those persons provided technical assistance by WS apply methods not recommended by WS or do not employ methods as intended or without regard for humaneness, then the issue of method humaneness would be of greater concern since pain and distress of birds would likely be higher.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, the issues of the humaneness of methods would not be considered by WS. WS would have no involvement in any aspect of bird damage management in the State. Those persons experiencing damage or threats associated with birds could use those methods legally available and permitted by the USFWS, the SCDNR, and federal, State, and local regulations. Those methods would likely be considered inhumane by those persons who would consider methods proposed under any alternative as inhumane. The issue of humaneness would likely be directly linked to the methods legally available to the general public since methods are often labeled as inhumane by segments of society no matter the entity employing those methods. A method considered inhumane, would still be perceived as

inhumane regardless of the person or entity applying the method. However, even methods generally regarded as being a humane method could be employed in inhumane ways if employed by those persons inexperience in the use of those methods or if those persons are not as diligent in attending to those methods.

The efficacy and therefore, the humaneness, of methods would be based on the skill and knowledge of the person employing those methods. A lack of understanding of the target species or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the general public to use to resolve damage and threats caused by birds. Therefore, those methods considered inhumane would continue to be available for use under this alternative. If those persons experiencing bird damage apply those methods considered to be humane methods as intended and in consideration of the humane use of those methods, then the issue of method humaneness would be similar across the alternatives. If persons employ humane methods in ways that are inhumane, the issue of method humaneness could be greater under this alternative if those persons experiencing bird damage are not provided with information and demonstration on the proper use of those methods. However, the level at which people would apply humane methods inhumanely under this alternative based on a lack of assistance is difficult to determine and could just as likely be similar across the alternatives.

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

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. Migratory bird hunting seasons are established under frameworks developed by the USFWS and implemented in the State by the SCDNR. Those species addressed in this EA that have established hunting seasons include: American crows, fish crows, wild turkeys, mallards, blue-winged teal, green-winged teal, American coots, American black ducks, common mergansers, hooded mergansers, canvasbacks, Northern pintails, Northern shovelers, ruddy ducks, greater scaup, lesser scaup, American wigeons, wood ducks, common snipe, mourning doves, and Atlantic brant. 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 SCDNR in published reports.

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

WS' bird damage management activities would primarily be conducted on populations in areas where hunting access is restricted (*e.g.*, airports) or has been ineffective (*e.g.*, urban areas). The use of non-lethal or lethal methods often disperses birds from areas where damage is occurring to areas outside the damage area which could serve to move birds from those less accessible areas to places accessible to hunters.

The magnitude of take addressed in the proposed action would be low when compared to the mortality of birds from all known sources. When WS' proposed take of those bird species considered harvestable was included as part of the known mortality of those species from 2005 through 20111 and compared to the estimated populations of those species, the impact on those species' population was consistent with management goals set by the USFWS and SCDNR. The USFWS and/or the SCDNR would determine the number of birds taken annually by WS through the issuance of depredation permits and by regulating take through the depredation orders and control orders.

Bird damage management activities conducted by WS would occur after consultation and approval by the USFWS. With oversight by the USFWS, the number of birds allowed to be taken by WS would not limit the ability of those persons interested to harvest those bird species during the regulated season. All take by WS would be reported to the USFWS annually to ensure take by WS is incorporated into population management objectives established for the populations of those bird species. Based on the limited take proposed by WS and the oversight of by the USFWS, WS' take of birds annually under the proposed action would have no effect on the ability of those persons interested to harvest birds during the regulated harvest season.

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

Under the technical assistance only alternative, WS would have no direct impact on bird populations in the State. If WS recommends the use of non-lethal methods and those non-lethal methods are employed by those persons experiencing damage, birds are likely to be dispersed from the damage area to areas outside the damage area which could serve to move those birds from those less accessible areas to places accessible to hunters. Although lethal methods could be recommend by WS under a technical assistance only alternative, the use of those methods could only occur after the property owner or manager received a depredation permit from the USFWS, under depredation orders, or take could occur during the regulated hunting season. WS' recommendation of lethal methods could lead to an increase in the use of those methods. However, the number of birds allowed to be taken under a depredation permit, under depredation orders, control orders, and during the regulated hunting seasons is determined by the USFWS and/or the SCDNR. Therefore, WS' recommendation of shooting or hunting under this alternative would not limit the ability of those persons interested to harvest birds during the regulated season since the USFWS and SCDNR determines the number of birds that may be taken during the hunting season, under depredation permits, under depredation orders, and under control orders.

Alternative 3 – No Bird Damage Management Conducted by WS

WS would have no impact on the ability to harvest birds under this alternative. WS would not be involved with any aspect of bird damage management. The USFWS and the SCDNR would continue to regulate populations through adjustments of the allowed take during the regulated harvest season and the continued use of depredation orders and depredation permits.

4.2 CUMULATIVE IMPACTS OF THE PROPOSED ACTION BY ISSUE

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

Under Alternative 1 and Alternative 2, WS would address damage associated with birds either by providing technical assistance (Alternative 2) or by providing technical assistance and direct operational assistance (Alternative 1) in the State. WS would be the primary agency conducting direct operational bird damage management in the State under Alternative 1 and Alternative 2. However, other federal, State, and private entities could also be conducting bird damage management in the State. The take of native migratory bird species requires a depredation permit from the USFWS pursuant to the MBTA, which requires permit holders to report all take occurring under the permit. Take of cormorants and blackbirds can occur under depredation orders without the need for a depredation permit. Muscovy ducks can be lethally taken pursuant to a control order. Mute swans, feral ducks, and feral geese can be lethally

taken without the need for a depredation permit since they are considered non-native species. Several species of birds addressed in this assessment can be harvested during the annual regulated harvest season.

WS does not normally conduct direct damage management activities concurrently with such agencies or other entities in the same area, but may conduct bird damage management activities at adjacent sites within the same time frame. In addition, commercial pest control companies may conduct bird damage management activities in the same area. The potential cumulative impacts analyzed below could occur either as a result of WS' damage management program activities over time, or as a result of the aggregate effects of those activities combined with the activities of other agencies and private entities. Through ongoing coordination and collaboration between WS, the USFWS, and the SCDNR, activities of each agency and the take of birds would be available. Bird damage management activities in the State would be monitored to evaluate and analyze activities to ensure they are within the scope of analysis of this EA.

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

Evaluation of activities relative to target species indicated that program activities would likely have no cumulative adverse effects on bird populations when targeting those species responsible for damage. WS' actions would be occurring simultaneously, over time, with other natural processes and human generated changes that are currently taking place. These activities include, but are not limited to:

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

All those factors play a role in the dynamics of bird populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. The actions taken to minimize or eliminate damage are constrained as to scope, duration, and intensity for the purpose of minimizing or avoiding impacts to the environment. WS uses the Decision Model to evaluate damage occurring, including other affected elements and the dynamics of the damaging species; to determine appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992, USDA 1997). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over bird population, the USFWS and the SCDNR can adjust take levels, including the take of WS, to ensure population objectives for birds are achieved. Consultation and reporting of take by WS would ensure the USFWS and the SCDNR considers any activities conducted by WS.

WS' take of birds in South Carolina from FY 2005 through FY 2011 was of a low magnitude when compared to the total known take and the populations of those species. The USFWS and the SCDNR considers all known take when determining population objectives for birds and can adjust the number of birds that can taken during the regulated hunting season and the number of birds taken for damage management purposes to achieve the population objectives. Any take by WS would occur at the discretion of the USFWS and the SCDNR. Any bird population declines or increases would be the collective objective for bird populations established by the USFWS and the SCDNR through the regulation of take. Therefore, the cumulative take of birds annually or over time by WS would occur at the desire of the USFWS and the SCDNR as part of management objectives for birds in the State.

No cumulative adverse impacts on target and non-target wildlife are expected from WS' bird damage management actions based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

Bird damage management activities are conducted by WS only at the request of a cooperator to reduce damage that is occurring or prevent damage from occurring and only after methods to be used are agreed upon by all parties involved. WS would monitor activities to ensure any potential impacts are identified and addressed. WS works closely with state and federal resource agencies to ensure damage management activities are not adversely impacting bird populations and that WS' activities are considered as part of management goals established by those agencies. Historically, WS' activities to manage birds in South Carolina have not reached a magnitude that would cause adverse impacts to bird population in the State.

SOPs built into the WS program

SOPs are designed to reduce the potential negative effects of WS' actions on birds, and are tailored to respond to changes in wildlife populations which could result from unforeseen environmental changes. This would include those changes occurring from sources other than WS. Alterations in programs are defined through SOPs and implementation is insured through monitoring, in accordance with the WS' Decision Model (Slate et al. 1992, USDA 1997).

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

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

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

release. SOPs are intended to ensure take of non-target wildlife is minimal during the use of methods to capture target wildlife.

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

Chemical methods available for use under the proposed action are repellents, nicarbazin, mesurol, alpha-chloralose, and DRC-1339 which are described in Appendix B. Except for repellents that are applied directly to the affected resource, all chemical methods are employed using baits that are highly attractive to target species and used in areas where exposure to non-targets are minimal. The use of those methods requires an acclimation period and monitoring of potential bait sites for non-target activity. All chemicals would be used according to product label which ensure that proper use would minimize non-target threats. WS' adherence to Directives and SOPs governing the use of chemicals also ensures non-target hazards are minimal.

All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according with WS' Directives and relevant federal, state, and local regulations. The amount of chemicals used or stored by WS would be minimal to ensure human safety. Based on this information, WS' use of chemical methods, as part of the proposed action, will not have cumulative impacts on non-targets.

All label requirements of DRC-1339 would be followed to minimize non-target hazards. As required by the label, all potential bait sites are pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets are observed feeding on the pre-bait, the plots are abandoned and no baiting would occur at those locations. Once sites are baited, sites are monitored daily to further observe for non-target feeding activity. If birds are observed feeding on bait, those sites are abandoned. WS will retrieve all dead birds to the extent possible, following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

Only those repellents registered for use in the State would be used or recommended by WS as part of an integrated approach to managing damage and threats associated with birds. The recommendation and/or use of repellents would also follow all label instructions approved by the EPA. Repellents are registered in accordance with the FIFRA through a review process administered by the EPA. The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. Repellents available for use to disperse birds from areas of application must be registered with the EPA according to the FIFRA. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents that are registered for use by the EPA in accordance to the FIFRA and are applied according to label requirements, no adverse effects to non-targets are expected.

The active ingredient in numerous commercial repellents is methyl anthranilate which is a derivative of grapes and used as a flavoring in food and as a fragrance in cosmetics. Other repellents available contain the active ingredient polybutene, which when applied, creates a sticky surface which is intended to prevent perching. Although not registered for use to disperse birds in South Carolina, other bird repellents registered contain the active ingredient anthraquinone, which is a naturally occurring plant extract. Characteristics of these chemicals and potential use patterns indicate that no significant cumulative impacts related to environmental fate are expected from their use in WS' programs in South Carolina when used according to label requirements.

The use of immobilizing chemicals, reproductive inhibitors, and euthanasia methods are essentially selective for target species since identification of an individual is made prior to the application of the method. Immobilizing chemicals and reproductive inhibitors are applied using hand baiting which targets individuals or groups of target species in which the birds have been acclimated to feeding on the bait in a certain location. With immobilizing drugs and reproductive inhibitors, all unconsumed bait must be retrieved after each application which further limits non-target exposure. With immobilizing chemicals, the applicator is present on-site at all times to retrieve sedated birds which allows for constant monitoring for non-targets in the area of application. Euthanasia methods require the target bird species to be restrained before application which allows for any non-targets to be released if captured. Therefore, the use of those methods would not impact non-target species.

The methods described in Appendix B all have a high level of selectivity and can be employed using SOPs to ensure minimal impacts to non-targets species. No non-targets were taken by WS during bird damage management activities from FY 2005 through FY 2011. Based on the methods available to resolve bird damage and/or threats, WS does not anticipate the number of non-targets taken to reach a magnitude where declines in those species' populations would occur. Therefore, take under the proposed action of non-targets would not cumulatively impact non-target species. WS' has reviewed the T&E species listed by the USFWS and the National Marine Fisheries Services and has determined that bird damage management activities proposed by WS would not likely adversely affect T&E species. Cumulative impacts would be minimal on non-targets from any of the alternatives discussed**.**

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

All non-chemical methods described in Appendix B are used within a limited time frame, are not residual, and do not possess properties capable of inducing cumulative adverse impacts on human health and safety. All non-chemical methods are used after careful consideration of the safety of those persons employing methods and to the public. Capture methods would be employed where human activity is minimal to ensure the safety of the public, whenever possible. Capture methods also require direct contact to trigger ensuring that those methods, when left undisturbed would have no effect on human safety. All methods are agreed upon by the requesting entities which are made aware of the safety issues of those methods when entering into a MOU, cooperative service agreement, or other comparable document between WS and the cooperating entity. SOPs also ensure the safety of the public from those methods used to capture or take wildlife. A formal risk assessment conducted by APHIS determined that WS' non-chemical methods, when used as intended, poses a low risk to human safety (USDA 1997). Firearms used to alleviate or prevent damage, though hazards do exist, are employed to ensure the safety of employees and the public.

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

Repellents have been available for use to disperse birds from areas of application are available. All repellents must be registered with the EPA according to the FIFRA. Many of the repellents currently available for use have active ingredients that are naturally occurring and are generally regarded as safe. Although some hazards exist from the use of repellents, hazards occur primarily to the handler and applicator. When repellents are applied according to label requirements, no adverse effects to human safety are expected.

Chemical methods available for use under the proposed action are repellents, reproductive inhibitors, immobilizing drugs, and euthanizing chemicals described in Appendix B. Repellents are commercially available to the public and can be applied over large areas to discourage birds from feeding in an area.

The active ingredients of those repellents available for birds are methyl anthranilate and anthraquinone. Methyl anthranilate, which has been classified by the FDA as a product that is "*generally recognized as safe*", is a naturally occurring chemical found in grapes, and is synthetically produced for use as a grape food flavoring and for perfume (see 21 CFR 182.60). The EPA exempts methyl anthranilate from the requirement of establishing a tolerance for agricultural applications (see 40 CFR 180.1143). The final ruling published by the EPA on the exemption from the requirement of a tolerance for methyl anthranilate concludes with reasonable certainty that no harm would occur from cumulative exposure to the chemical by the public, including infants and children, when applied according to the label and according to good agricultural practices (see 67 FR 51083-51088). Based on the use patterns of methyl anthranilate and the conclusions of the FDA and the EPA on the toxicity of the chemical, WS' use of methyl anthranilate and the recommendation of the use the chemical would not have cumulative impacts.

Additional repellents contain the active ingredient anthraquinone. Overall, the EPA considers the toxicological risk from exposure to anthraquinone to be negligible (EPA 1998). The EPA also considers the primary cumulative exposure is most likely to occur to handlers and/or applicators from dermal, oral, and inhalation exposure but consider the exposure risks, when appropriate measures are taken, to be negligible (EPA 1998). Therefore, the EPA concluded that cumulative effects were not expected from any common routes of toxicity (EPA 1998). Based on the known use patterns and the conclusions of the EPA, no cumulative effects are expected from WS' use of anthraquinone or the recommendation of the use of anthraquinone.

DRC-1339 may be used by WS or recommended by WS for use to manage damage or threats associated with birds in South Carolina. DRC-1339 has been evaluated for possible residual effects which might occur from buildup of the chemical in soil, water, or other environmental sites. DRC-1339 is formulated on baits and placed in areas only after pre-baiting has occurred and in only those areas where non-targets are not present or would not be exposed to treated baits. Baits treated with DRC-1339 are placed on platforms or other hard surfaces where they seldom come into contact with soil, surface water, and/or ground water. All uneaten bait is recovered and disposed of according to EPA label requirements.

DRC-1339 exhibits a low persistence in soil or water, and bioaccumulation of the chemical is unlikely (USDA 1997). Additionally, the relatively small quantity of DRC-1339 that could potentially be used in bird damage management programs in South Carolina, the chemical's instability which results in degradation of the product, and application protocols used in WS' programs further reduces the likelihood of any environmental accumulation. The use of DRC-1339 under the proposed action and in other bird damage management activities is not expected to increase to a level that adverse effects would occur from the cumulative use of the chemical. Based on potential use patterns, the chemical and physical characteristics of DRC-1339, and factors related to the environmental fate, no cumulative impacts are expected from the lethal chemical components used or recommended by the WS program in South Carolina.

The immobilizing drug alpha chloralose is only available to WS for use to capture waterfowl. To capture waterfowl, alpha chloralose tablets are inserted into a dough ball made out of bread and/or the powder form is formulated onto whole kernel corn or mixed and used with bread baits. After an acclimation period where waterfowl are habituated to feeding on certain bait, being fed at a certain time, and at a certain location, treated baits are substituted for the pre-bait. As required by WS' use of alpha chloralose under the INAD, all unconsumed bait must be retrieved. Since target wildlife are habituated to feed at a certain location and a certain time on a similar pre-bait, a general estimate of the needed bait can be determined and bait is readily consumed by target species which limits the amount of time bait is exposed. Application of alpha chloralose is limited in duration given that baiting ceases once the target birds are removed. Through acclimation, the majority of target birds can be conditioned to feed at a certain time and location which allows for the majority of target birds to be removed after an initial

application of alpha chloralose treated baits. Some follow-up baiting could occur to remove any remaining waterfowl that were not captured during the initial baiting efforts. 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. Given the use patterns of alpha chloralose described, no cumulative impacts from the use of alpha chloralose to capture waterfowl are expected.

WS' personnel are required to attend training courses and be certified in the application of alpha chloralose to ensure proper care and handling, to ensure the proper doses are administered, and to ensure human safety.

Direct application of chemical methods to target species would ensure that there are no cumulative impacts to human safety. All chemical methods would be tracked and recorded to ensure proper accounting of used and unused chemicals occurs. All chemicals would be stored and transported according to FDA and DEA regulations, including the directives of the cooperating agencies. The amount of chemicals used or stored by WS and cooperating agencies would be minimal to ensure human safety. Based on this information, the use of chemical methods as part of the proposed action by WS and cooperating agencies would not have cumulative impacts on human safety.

The only euthanasia chemical proposed for use by WS is carbon dioxide, which is an approved method of euthanasia for birds by the AVMA. Carbon dioxide is naturally occurring in the environment ranking as the fourth most abundant gas in the atmosphere. However, in high concentrations carbon dioxide causes hypoxia due to the depression of vital centers and is considered a moderately rapid form of euthanasia (AVMA 2007). Carbon dioxide is commercially available as a compressed bottled gas. Carbon dioxide is a colorless, odorless, non-flammable gas used for a variety of purposes, such as in carbonated beverages, dry ice, and fire extinguishers. Although some hazards exist from the inhalation of high concentrations of carbon dioxide during application for euthanasia purposes, when use appropriately, the risks of exposure are minimal. Since carbon dioxide is a common gas found in the environment, the use of and/or recommending the use of carbon dioxide for euthanasia purposes with not have cumulative impacts.

WS has received no reports or documented any adverse effects to human safety from WS' bird damage management activities conducted from FY 2005 through FY 2011. No cumulative adverse effects from the use of those methods discussed in Appendix B are expected given the use patterns of those methods for resolving bird damage in the State.

Issue 4 - Effects on the Aesthetic Values of Birds

The activities of WS would result in the removal of birds from those areas where damage or threats were occurring. Therefore, the aesthetic value of birds in those areas where damage management activities were being conducted would be reduced. However, for some people, the aesthetic value of a more natural environment would be gained by reducing bird densities, including the return of native plant species that may be suppressed or killed by accumulations of fecal dropping by high bird densities found under roost areas.

Some people experience a decrease in aesthetic enjoyment of wildlife because they feel that overabundant species are objectionable and interfere with their enjoyment of wildlife in general. Continued increases in numbers of individuals or the continued presence of birds may lead to further degradation of some people's enjoyment of any wildlife or the natural environment. The actions of WS could positively affect the aesthetic enjoyment of wildlife for those people that are being adversely affected by the target species identified in this EA.

Bird population objectives are established and enforced by the USFWS and the SCDNR through the regulating of take during the statewide hunting season after consideration of other known mortality factors. Therefore, WS has no direct impact on the status of the bird population since all take by WS occurs at the discretion of the USFWS and the SCDNR. Since those persons seeking assistance could remove birds from areas where damage is occurring without a permit from the USFWS or the SCDNR, WS' involvement would have no effect of the aesthetic value of birds in the area where damage was occurring. When damage caused by birds has occurred, any removal of birds by the property or resource owner would likely occur whether WS was involved with taking the birds or not.

Therefore, the activities of WS are not expected to have any cumulative adverse effects on this element of the human environment if occurring at the request of a property owner and/or manager.

Issue 5 - Humaneness and Animal Welfare Concerns of Methods

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

All methods not requiring direct supervision during employment (*e.g.*, live traps) would be checked and monitored to ensure any wildlife confined or restrained are addressed in a timely manner to minimize distress of the animal. All euthanasia methods used for live-captured birds would be applied according to AVMA guidelines for free-ranging wildlife. Shooting would occur in limited situations and personnel would be trained in the proper use of firearms to minimize pain and suffering of birds taken by this method.

WS employs methods as humanely as possible by applying measures to minimize pain and that allow wildlife captured to be addressed in a timely manner to minimize distress. Through the establishment of SOPs that guide WS in the use of methods to address damage and threats associated with birds in the State, the cumulative impacts on the issue of method humaneness are minimal. All methods would be evaluated annually to ensure measures and SOPs are adequate to ensure those methods continue to be used to minimize suffering and that wildlife captured are addressed in a timely manner to minimize distress.

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

As discussed in this EA, the magnitude of WS' bird take for damage management purposes from FY 2005 through FY 2011 was low when compared to the total take of birds and when compared to the estimated statewide population. Since all take of birds is regulated by the USFWS and the SCDNR, the take of birds by WS that would occur annually and cumulatively would occur pursuant to bird population objectives established in the State.

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. Migratory bird hunting seasons are established under frameworks developed by the USFWS and implemented in the State by the SCDNR. Those species addressed in this EA that have established hunting seasons include: American crows, fish crows, wild turkeys, mallards, blue-winged teal, green-winged teal, American coots, American black ducks, common mergansers, hooded mergansers, canvasbacks, Northern pintails, Northern shovelers, ruddy ducks, greater scaup, lesser scaup, American wigeons, wood ducks, common snipe, mourning doves, and Atlantic brant.

With oversight of bird take, the USFWS and the SCDNR maintains the ability to regulate take by WS to meet management objectives for birds in the State. Therefore, the cumulative take of birds is considered as part of the USFWS and the SCDNR objectives for bird populations in the State.

CHAPTER 5 - LIST OF PREPARERS AND PERSONS CONSULTED

5.1 LIST OF PREPARERS/REVIEWERS

Robert Byrd, District Supervisor	USDA-APHIS-Wildlife Services
Ryan Wimberly, Environmental Management Coordinator	USDA-APHIS-Wildlife Services
Noel Myers, State Director	USDA-APHIS-Wildlife Services

5.2 LIST OF PERSONS CONSULTED

Jay Herrington, Field Supervisor	USFWS
Derrell Shipes, Chief, Statewide Projects, Research and Surveys	SCDNR

APPENDIX A
LITERATURE CITED

Adams, C. E., K. J. Lindsey, and S. J. Ash. 2006. Urban Wildlife Management. Taylor and Francis Group, New York, New York. 311 pp.

Aderman, A. R., and E. P. Hill. 1995. Locations and numbers of double-crested cormorants using winter roosts in the Delta region of Mississippi. Colonial Waterbirds 18 (Spec. Pub. 1):143-151.

Alderisio, K. A., and N. Deluca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (*Larus delawarensis*) and Canada geese (*Branta canadensis*). Applied and Environmental Microbiology 65:5628–5630.

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.

AVMA. 1987. Panel report on the colloquium on recognition and alleviation of animal pain and distress. Journal of the American Veterinary Medical Association. 191:1186-1189.

AVMA. 2007. AVMA guidelines on euthanasia. American Veterinary Medical Association. http://www.avma.org/issues/animal_welfare/euthanasia.pdf. Accessed on February 2, 2009.

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. 178 pp.

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. 2003. Mute swan management plan, 2003-2013. Atlantic Flyway Technical Section. Snow Goose, Brant, and Swan Committee. July 2003.

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

Avery, M. L., J. S. Humphrey, and D. G. Decker. 1997. Feeding deterrence of anthraquinone, anthracene, and anthrone to rice-eating birds. Journal of Wildlife Management 61:1359-1365.

Avery, M. L., E. A. Tillman, and J. S. Humphrey. 2008. Effigies for dispersing urban crow roosts. Pp. 84-87 *in* R.M. Timm and M.B. Madon, eds. Proc. 23rd Vertebr. Pest Conf., University of California-Davis.

Avery, M. L., J. S. Humphrey, T. S. Daughtery, J. W. Fischer, M. P. Milleson, E. A. Tillman, W. E. Bruce, and W. D. Walter. 2011. Vulture flight behavior and implications for aircraft safety. Journal of Wildlife Management 75:1581-1587.

Beason, R. C. 1995. Horned lark (*Eremophila alpestris*). 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/195.

Beaver, B. V., W. Reed, S. Leary, B. McKiernan, F. Bain, R. Schultz, B. T. Bennett, P. Pascoe, E. Shull, L. C. Cork, R. Franis-Floyd, K. D. Amass, R. Johnson, R. H. Schmidt, W. Underwood, G. W. Thorton, and B. Kohn. 2001. 2000 Report of the AVMA Panel on Euthanasia. J. Am. Vet. Med. Assoc. 218:669-696.

Bedard, J., A. Nadeau, and M. Lepage. 1999. Double-crested cormorant culling in the St. Lawrence River Estuary: Results of a 5 year program. Pp. 147-154 *in* M.E. Tobin, ed. Symposium on Double-crested Cormorants: Population Status and Management Issues in the Midwest. USDA Tech. Bull. No. 1879.

Beeton A. M., and L. Wells. 1957. A bronzed grackle (*Quiscalus quiscula*) feeding on live minnows. Auk 74:263–264.

Belant, J. L. 1993. Nest-site selection and reproductive biology of roof- and island-nesting herring gulls. Transactions of the North American Wildlife Natural Resources Conference 58:78-86.

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. Journal of Wildlife Management 60:923-928.

Bent, A. C. 1921. Life histories of North American gulls and terns. U. S. National Museum Bulletin 113. 345 pp.

Besser, J. F. 1964. Baiting starlings with DRC-1339 at a large cattle feedlot, Ogden, Utah, January 21 - February 1, 1964. U. S. Fish and Wildl. Serv., Denver Wildl. Res. Ctr., Denver, CO. Suppl. Tech. Rep. Work Unit F9.2.

Besser, J. F. 1985. A grower's guide to reducing bird damage to U.S. agricultural crops. Bird Damage Research Rep. No. 340. U. S. Fish and Wildl. Serv. 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. Journal of Wildlife Management 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. Journal of Wildlife Management 32:179-180.

Bishop, R. C. 1987. Economic values defined. Pp. 24 -33 *in* D. J. Decker and G. R. Goff, eds. Valuing wildlife: economic and social perspectives. Westview Press, Boulder, CO. 424 pp.

Blackwell, B. F., R. A. Dolbeer, and L. A. Tyson. 2000. Lethal control of piscivorous birds at aquaculture facilities in the northeast United States: effects on populations. North American Journal of Aquaculture 62:300-307.

Blackwell, B. F., G. E. Bernhardt, and R. A. Dolbeer. 2002. Lasers as non-lethal avian repellents. Journal of Wildlife Management 66:250-258.

Blandespoor, H. D., and R. L. Reimink. 1991. The control of swimmer's itch in Michigan: past, present and future. Michigan Academ. XXIV, p. 7-23.

Blokpoel, H., and W. C. Scharf. 1991. The ring-billed gull in the Great Lakes of North America. Acta Congr. Int. Ornithol. 20:2372-2377.

Blokpoel, H., and G. D. Tessier. 1986. The ring-billed gull in Ontario: a review of a new problem species. Occasional Paper Number 57. Canadian Wildlife Service. Ottawa, Ontario. 34 pp.

Blokpoel, H., and G. D. Tessier. 1992. Control of ring-billed gulls and herring gulls nesting at urban and industrial sites in Ontario, 1987-1990. Proceedings of the Eastern Wildlife Damage Conference 5:51-57.

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

Booth, T. W. 1994. Bird Dispersal Techniques. Pp. E-19 - E-24 *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.

Boyd, F. L., and D. I. Hall. 1987. Use of DRC-1339 to control crows in three roosts in Kentucky and Arkansas. Third Eastern Wildlife Damage Control Conference 3:3-7.

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

Buckley, N. J. 1999. Black vulture (*Coragyps atratus*) *in* A. Poole and F. Gill, eds. The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Buehler, D. A. 2000. Bald eagle (*Haliaeetus leucocephalus*) *in* A. Poole and F. Gill, eds. The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Bunn, A. G., W. Klein, and K. L. Bildstein. 1995. Time-of-day effects on the numbers and behavior of non-breeding raptors seen on roadside surveys in eastern Pennsylvania. J. Field Ornithol. 66:544–552.

Burger, J. 1996. Laughing gull (*Larus atricilla*) *in* A. Poole and F. Gill, eds. The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Butler, R.W. 1992. A review of the biology and conservation of the great blue heron (*Ardea herodias*) in British Columbia. Can. Wildl. Serv. Tech. Rep. No. 154, Delta, B.C.

Butterfield J., J. C. Coulson, S. V. Kearsey, P. Monaghan, J. H. McCoy, and G. E. Spain. 1983. The herring gull, *Larus argentatus*, as a carrier of *Salmonella*. Journal of Hygiene, Camb. 91:429-436.

California Department of Fish and Game. 1991. Final environmental document - bear hunting. Title 14 Calif. Code of Regs. Calif. Dept. of Fish and Game, State of California, April 25, 1991. 337 pp.

Caudell J., and S. Shwiff. 2006. Cost effectiveness of OvoControl G for managing nuisance Canada goose (*Branta canadensis*) populations. Twelfth Wildlife Damage Management Conference April 9-12, 2007

Chipman, R. B., T. L. Devault, D. Slate, K. J. Preusser, M.S. Carrara, J. W. Friers, and T. P. Alego. 2008. Non-lethal methods to reduce to reduce conflicts with winter urban crow roosts in New York: 2002-2007. Pp. 88-93 *in* R.M. Timm and M.B. Madon, eds. Proc. 23rd Vertebr. Pest Conf., University of California-Davis.

Clark, L., and J. Hall. 2006. Avian influenza in wild birds: status as reservoirs, and risk to humans and agriculture. Ornithological Monographs 60:3-29.

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. Journal of Wildlife Management 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., W. C. Pitt, K. K. Kessler, T. J. Dubow, and W. A. Sanborn. 1995. Review of human injuries, illnesses and economic-based losses caused by wildlife in the United States. Wildl. Soc. Bull. 23:407-414.

Converse, K. A., and J. J. Kennelly. 1994. Evaluation of Canada goose sterilization for population control. Wildl. Soc. Bull. 22:265-269

Cooper, J. A., and T. Keefe. 1997. Urban Canada goose management: Policies and procedures. Tran. N. AM. Wildl. Nat. Resour. Conf. pp. 412-430.

Courchamp, F., R. Woodroffe, and G. Roemer. 2003. Removing protected populations to save endangered species. Science 302:1532.

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.

Cramp, S., and K. E. L Simmons. 1977. Birds of the Western Palearctic, Vol. 1. Oxford University Press, Oxford, United Kingdom. 1,830 pp.

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. Journal of Field Ornithology 76:27-32.

Cummings, J. L., P. A. Pochop, J. E. Davis, Jr., and H. W. Krupa. 1995. Evaluation of Rejex-It AG-36 as a Canada goose grazing repellent. Journal of Wildlife Management 59:47-50.

Cummings, J. L., Glahn, J. E., Wilson, E. A., Davis Jr., J. E., Bergman, D. L., Harper, G.A., 1992. Efficacy and non-target hazards of DRC-1339 treated rice baits used to reduce roosting populations of depredating blackbirds in Louisiana. National Wildlife Research Control Report 481. 136 pp.

Cunningham, D. J., E. W. Schafer, Jr., and L. K. McConnell. 1981. DRC-1339 and DRC-2698 residues in European Starlings: preliminary evaluation of their effects on secondary hazard potential. Proc. Bird Control Semin. 8:31-37.

Cunningham, D. J., E.W. Schafer, Jr., and L.K. McConnell. 1979. DRC-1339 and DRC-2698 residues in starlings: preliminary evaluation of their secondary hazard potential. Proceedings of the Bird Control Seminar 8 (1979), pp. 31–37.

Cuthbert, F. J., L. R. Wires, and J. E. McKearon. 2002. Potential impacts of nesting double-crested cormorants on great blue herons and black-crowned nightherons in the U.S. Great Lakes Region. J. Great Lakes Res. 28: 145-154.

Darden T. 1974. Common grackle preying on fish. Wilson Bull. 86: 85–86.

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

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.

Decker, D. J., T. L. Brown, and W. F. Siemer. 2001. Human dimensions of wildlife management. The Wildlife Society, Bethesda, Maryland. 447 pp.

Decino, T. J., D. J. Cunningham, and E. W. Schafer, Jr. 1966. Toxicity of DRC-1339 to European starlings. Journal of Wildlife Management 30:249-253.

DeHaven, R.W., and J. L. Guarino. 1969. A nest box trap for European starlings. Bird Banding 40:49-50.

Dimmick, C. R., and L. K. Nicolaus. 1990. Efficiency of conditioned aversion in reducing depredation by crows. J. of Applied Ecology 27:200-209.

Dixon, W. J., and A. M. Mood. 1948. A method for obtaining and analyzing sensitive data. Journal of the American Statistical Association 43:109-126.

Dolbeer, R. A. 1997. Feathered and furry fod - a serious problem at U. S. airports. Bird Strike Briefing, National Aerospace FOD Prevention Conf., 24-26 June 1997, Seattle WA. USDA / Wildl. Serv., National Wildl. Res. Ctr., Ohio Field Sta., 6100 Columbus Ave., Sandusky, OH 44870 USA.

Dolbeer, R. A. 1998. Population dynamics: the foundation of wildlife damage management for the 21st century. Pp. 2-11 *in* Barker, R. O. and Crabb, A. C., Eds. Eighteenth Vertebrate Pest Conference (March 2-5, 1998, Costa Mesa, California). University of California at Davis, Davis, California.

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

Dolbeer, R. A., and S. E. Wright. 2008. Wildlife strikes to civil aircraft in the United States,1990–2007. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Serial Report 14.Washington, D.C., USA.

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. Journal of Wildlife Management 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, eds., The Birds of North America, The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

Eisenmann, E. 1963. Is the black vulture migratory? Wilson Bull. 75:244-249.

Eisemann, J. D., P. A. Pipas, and J. L. Cummings. 2003. Acute and chronic toxicity of compound DRC-1339 (3-chloro-4-methylaniline hydrochloride) to birds. Pages 24-28 in G. M. Linz, editor. Proceedings of symposium on management of North American blackbirds. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National WildlifeResearch Center, Fort Collins, Colorado, 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). USEPA, Prevention, Pesticides and Toxic Substances. EPA-738-F-96-003. 4 pp.

EPA. 1998. Anthraquinone Fact Sheet. United States Environmental Protection Agency. http://www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_122701.htm. Accessed November 12, 2010.

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

EPA. 2005. Pesticide Fact Sheet: Nicarbazin – Conditional Registration. United States Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, DC 20460.

Eskildsen, U. K., and P. E. Vestergard-Jorgensen. 1973. On the possible transfer of trout pathogenic viruses by gulls. Rivista Italiana di Piscicultura e Ittiopatologia 8:104–105.

European Inland Fisheries Advisory Commission. 1989. Report of the EIFAC Working Party on prevention and control of bird predation in aquaculture and fisheries operations. EIFAC Tech. Pap. 51, Rome.

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

Feare, C., A. J. Isaacson, P. A. Sheppard, and J. M. Hogan. 1981. Attempts to reduce starling damage at dairy farms. Protection Ecol. 3:173-181.

Felsenstein, W. C., R. P. Smith, and R. E. Gosselin. 1974. Toxicological studies on the avicide 3-chloro-ptoluidine. Toxicology and Applied Pharmacology 28:110-1125.

Fenlon, D. R. 1981. Seagulls (*Larus* spp.) as vectors of salmonellae: an investigation into the range of serotypes and numbers of salmonellae in gull faeces. Journal of Hyg., Camb. 86:195-202

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

Ford, H. S. 1967. Winter starling control in Idaho, Nevada, Oregon. Proceedings: Third Vertebrate Pest Conference 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.

Fussell, J. O. 1994. A Birder's Guide to Coastal North Carolina. The University of North Carolina Press, 554 pp.

Gabrey, S. W. 1997. Bird and small mammal abundance at four types of waste-management facilities in northeast Ohio. Landscape and Urban Planning 37:223-233.

Gallien, P., and M. Hartung. 1994. Escherichia coli O157:H7 as a food borne pathogen. Pp 331-341 *in* Handbook of zoonoses. Section A: bacterial, rickettsial, chlamydial, and mycotic. G. W. Beran and J. H.Steele, eds. CRC Press. Boca Raton.

Gamble, L. R., K. M. Johnson, G. Linder, and E. A. Harrahy. 2003. The Migratory Bird Treaty Act and concerns for nontarget birds relative to spring baiting with DRC-1339. Pp 8-12 *in* G.M. Linz, ed. Management of North American blackbirds. National Wildlife Research Center, Fort Collins, Colorado.

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. 1986. Factors influencing blackbird and European Starling damage at livestock feeding operations. Journal of Wildlife Management 50:15-19.

Glahn, J. F., and E. A. Wilson. 1992. Effectiveness of DRC-1339 baiting for reducing blackbird damage to sprouting rice. Proc. East. Wildl. Damage Cont. Conf. 5:117-123.

Glahn, J. F., 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 Cont. Conf. 3:194-203.

Glahn, J. F., E. A. Wilson, and M. L. Avery. 1990. Evaluation of DRC- 1339 baiting program to reduce sprouting rice damage caused by spring roosting blackbirds. National Wildlife Research Control Report 448. 25 pp.

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. North American Journal of 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. Proceedings of the 9th Wildlife Damage Management Conference 9:34-35.

Glahn, J. F., B. Dorr, J. B. Harrel, and L. Khoo. 2002. Foraging ecology and depredation management of great blue herons at Mississippi catfish farms. Journal of Wildlife Management 66:194–201.

Gorenzel, W. P., and T. P. Salmon. 1993. Tape-recorded calls disperse American crows from urban roosts. Wildl. Soc. Bull. 21:334-338.

Gorenzel, W. P., and T. P. Salmon. 1995. Characteristics of American crow urban roosts in California. Journal of Wildlife Management 59:638-645.

Gorenzel, W. P., T. P. Salmon, G. D. Simmons, B. Barkhouse, and M. P. Quisenberry. 2000. Urban crow roosts – a nationwide phenomenon? Proc. Wildl. Damage Manage. Conf. 9:158-170.

Gorenzel, W. P., B. F. Blackwell, G. D. Simmons, T. P. Salmon, and R.A. Dolbeer. 2002. Evaluation of lasers to disperse American crows, Corvus brachyrhynchos, from urban night roosts. International Journal of Pest Management 48:327–331.

Graczyk, T. K., M. R. Cranfield, R. Fayer, J. Tout, and J. J. Goodale. 1997. Infectivity of *Cryptosporidium parvum* oocysts is retained upon intestinal passage through a migratory waterfowl species (Canada goose, *Branta canadnsis*). Tropical Med. International Heal. 2:341-347.

Graczyk, T. K., R. Fayer, J. M. Trout, E. J. Lewis, C. A. Farley, I. Sulaiman, and A. A. Lal. 1998. *Giardia* sp. cysts and infectious *Cryptosporidium parvum* oocysts in the feces of migratory Canada geese (*Branta canadensis*). Applied and Environmental Microbiology 64:2736-2738.

Graves, G. E., and W. F. Andelt. 1987. Prevention and control of woodpecker damage. Service in Action, Colo. St. Univ. Coop. Ex. Serv. Publ. no 6.516. Ft. Collins, Colo. 2 pp.

Hamel, P. B. 1992. The land manager's guide to the birds of the South. Chapel Hill, NC: The Nature Conservancy. 437 pp.

Hamilton, Jr., W. J. 1951. The food of nestling bronzed grackles, *Quiscalus quiscula versicolor*, in central New York. Auk 68:213-217.

Harris, H. J., Jr., J. A. Ladowski, and D. J. Worden, 1981. Water-quality problems and management of an urban waterfowl sanctuary. Journal of Wildlife Management 45:501–507.

Hatch, J. J. 1995. Changing populations of double-crested cormorants. Colonial Waterbirds 18 (Spec. Publ. 1): 8–24.

Hatch, J. J. 1996. Threats to public health from gulls (Laridae). Journal of Environmental Health Research 6:5-16.

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

Hayman, P., J. Marchant, and T. Prater. 1986. Shorebirds: an identification guide to the waders of the world. Houghton Mifflin Company, Boston, Massachusetts. 412 pp.

Hebert, C. E., J. Duffe, D. V. C. Weseloh, E. M. T. Senese, G. D. Haffner. 2005. Unique island habitats may be threatened by double-crested cormorants. Journal of Wildlife Management 69:57-65.

Henny, C. J. 1990. Mortality. Pp. 140 - 151 *in* I. Newton, P. Olsen, and T. Pyrzalowski, eds., Birds of Prey. Facts on File, New York, New York. 240 pp.

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

Hicks, R. E. 1979. Guano deposition in an Oklahoma crow roost. The Condor 81:247-250.

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

Holler, N. R., and E. W. Schafer, Jr. 1982. Potential secondary hazards of Avitrol baits to sharp-shinned hawks and American kestrels. Journal of Wildlife Management 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. http://www.waterbirdconservation.org/. Accessed May 12, 2010.

Jackson, J. A., and B. J. S. Jackson. 1995. The double-crested cormorant in the south-central United States: habitat and population changes of a feathered pariah. Colonial Waterbirds 18 (Spec. Publ. 1): 118-130.

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

Jarvie, S. H. Blokpoel, and T. Chipperfield. 1999. A geographic information system to monitor nest distributions of double-crested cormorants and black-crowned night-herons at shared colony sites near Toronto, Canada. Pp 121-129 *in* (M.E. Tobin, Tech. Coord.). Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.:U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

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

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

Johnston, W. S., G. K. MacLachlan, and G. F. Hopkins. 1979. The possible involvement of seagulls (*Larus* spp.) In the transmission of salmonella in dairy cattle. Veterinary Record 105:526-527.

Johnston, J. J., D. B. Hurlbut, M. L. Avery, and J. C. Rhyans. 1999. Methods for the diagnosis of acute 3-chloro-p-toluidine hydrochloride poisoning in birds and the estimation of secondary hazards to wildlife. Environ. Toxicology and Chemistry. 18:2533-2537.

Jones, F., P. Smith, and D. C. Watson. 1978. Pollution of a water supply catchment by breeding gulls and the potential environmental health implications. Journal of the Institute of Water Engineering Science 32:469-482.

Kassa, H., B. Harrington, and M. S. Bisesi. 2001. Risk of occupational exposure to *Cryptosporidium, Giardia,* and *Campylobacter* associated with the feces of giant Canada geese. Appl. Occup. And Env. Hygiene 16:905-909.

Kaufman, K. 1996. Lives of North American Birds. Boston: Houghton Mifflin Company. 704 pp.

Keefe, T. 1996. Feasibility study on processing nuisance Canada geese for human consumption. Minnesota Department of Natural Resources, Section of Wildlife. 7 pp + 4 appendixes.

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.

Kennamer, M.C. 2010. Eastern wild turkey (*Meleagris gallopavo silvestris*). National Wild Turkey Federation. Bulletin No. 1. http://www.nwtf.org/conservation/bulletins/bulletin_01.pdf. Accessed September 20, 2010.

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

Kirk, D. A., and M. J. Mossman. 1998. Turkey Vulture (*Cathartes aura*) *in* A. Poole and F. Gill, editors. The Birds of North America, No. 339. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C., USA.

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

Klimstra, J. D., and P. I. Padding. 2010. Atlantic Flyway harvest and population survey data book. U.S. Fish and Wildlife Service, Laurel, Maryland.

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.

Korfanty, C., W. G. Miyasaki, and J. L. Harcus. 1999. Review of the population status and management of double-crested cormorants in Ontario. Pp 131-145 *in* M.E. Tobin, Tech. Coord. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 09 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.: USDA, APHIS.

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.

Lanyon, Wesley E. 1995. Eastern meadowlark (*Sturnella magna*). 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/160.

Leck, C.F. 1984. The status and distribution of New Jersey's birds. New Brunswick, New Jersey, Rutgers University Press.

Lemmon, C.R., G. Burgbee, and G.R. Stephens. 1994. Tree damage by nesting double-crested cormorants in Connecticut. Connecticut Warbler 14:27-30.

Lewis, H. F. 1929. The Natural History of the Double-crested Cormorant. Ph.D. Dissertation, Cornell University, Ithaca, New York.

Link, W. A., and J. R. Sauer. 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. Journal of Wildlife Management 60:935-945.

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, eds., Field Guide to Wildlife Diseases: General Field Procedures and Diseases Migratory Birds. 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.

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.

Mason, J. R. 1989. Avoidance of methiocarb-poisoned apples by Red-winged Blackbirds. Journal of Wildlife Management 53:836-840.

Mason, J. R., and L. Clark. 1992. Non-lethal repellents: the development of cost-effective, practical solutions to agricultural and industrial problems. Proc. Vertebr. Pest Conf. 15:115-129.

Mason, J. R., 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.

Mcgowan, K. J. 2001. Fish Crow (*Corvus ossifragus*). 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/589.

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

Mitterling, L. A. 1965. Bird damage on apples. Proceedings of the American Society of 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. Journal of Applied Ecology 22:669-680.

Mott, D. F. 1985. Dispersing blackbird-starling roosts with helium-filled balloons. Proc. East. Wildl. Damage Conf. 2:156-162.

Mott, D. F., and C. P. Stone. 1973. Bird damage to blueberries in the United States. U.S. Bur. Sport Fisheries and Wildlife, Spec. Sci. Rept., Wildl. No. 172. 15 pp.

Mott, D. F., J. F. Glahn, P. L. Smith, D. S. Reinhold, K. J. Bruce, and C. A. Sloan. 1998. An evaluation of winter roost harassment for dispersing double-crested cormorants away from catfish production areas in Mississippi. Wildl. Soc. Bull. 26:584-591.

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. Ferns. 1982. The feeding ecology of five species of gulls (Aves: Larini) in the inner Bristol Channel. J. Zool. Lond 197:497-510.

Muller, L. I., R. J. Warren, and D. L. Evans. 1997. Theory and practice of immunocontraception in wild animals. Wildl. Soc. Bull. 25:504-514.

NASS. 2009. Census of Agriculture: South Carolina State and County Data. United States Department of Agriculture, National Agricultural Statistics Service. Volume 1, Geographic Area Series, Part 40. AC-07-A-40. Online: http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/South_Carolina/scv1.pdf.

NASS. 2011. Cattle death loss. United States Department of Agriculture, Agricultural Statistics Board, National Agricultural Statistics Service. 17 pp.

NAS. 2010. The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org. Accessed on November 15, 2011.

National Wild Turkey Federation. 2010. All about wild turkeys. http://www.nwtf.org/for_hunters/all_about_turkeys.html. Accessed September 23, 2010.

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.

Norton, R. L. 1986. Case of botulism in laughing gulls at a landfill in the Virgin Islands, Greater Antilles. Florida Field Naturalist 14:97-98.

Olesen, N. J., and P. E. Vestergard-Jorgensen. 1982. Can and do herons serve as vectors for Egtved virus? Bull. Eur. Assoc. Fish Pathol. 2:48.

Pacha, R. E., G. W. Clark, E. A. Williams, and A. M. Carter. 1988. Migratory birds of central Washington as reservoirs of *Campylobacter jejuni.* Can. J. Micro. 34:80-82.

Parkhurst, J. A., R. P. Brooks, and D. E. Arnold. 1987. A survey of wildlife depredation and control techniques at fish-rearing facilities. 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.

Parmalee, P. W., and B. G. Parmalee. 1967. Results of banding studies of the black vulture in eastern North America. Condor 69:146–155.

Patton, S. R. 1988. Abundance of gulls at Tampa Bay landfills. Wilson Bulletin 100:431-442.

Peer, B. D., and E. K. Bollinger. 1997. Common Grackle (*Quiscalus quiscula*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/271.

Peoples, S. A., and A. Apostolou. 1967. A comparison between the metabolism of DRC-1339 in rabbits and in starlings. Progress report on starling control. University of California, Davis.

Peters, F., and M. Neukirch. 1986. Transmission of some fish pathogenic viruses by the heron, *Ardea cinerea*. Journal of Fish Diseases T986, 9:539–544.

Pochop, P. A. 1998. Comparison of white mineral oil and corn oil to reduce hatchability of ring-billed gull eggs. Proc. Vertebr. Pest Conf. 18:411-413.

Pochop, P. A., J. L. Cummings, J. E. Steuber, and C. A. Yoder. 1998. Effectiveness of several oils to reduce hatchability of chicken eggs. Journal of Wildlife Management 62:395-398.

Poole, A. F., R. O. Bierregaard, and M. S. Martell. 2002. Osprey (*Pandion haliaetus*). 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/683.

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

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*). Journal of Wildlife Disease 28:526-531.

Rabenhold, P. P., and M. D. Decker. 1989. Black and turkey vultures expand their ranges northward. The Eyas. 12:11-15.

Raftovich, R. V., K. A. Wilkins, S. S. Williams, H. L. Spriggs, and K. D. Richkus. 2011. Migratory bird hunting activity and harvest during the 2009 and 2010 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland. 68 pp.

Reilley, W. G., G.I . Forbes, G. M. Paterson, and J. C. M. Sharp. 1981. Human and animal salmonellosis in Scotland associated with environmental contamination, 1973-1979. Veterinary Record 108:553-555.

Reinhold, D. S., and C. A. Sloan. 1999. Strategies to reduce double-crested cormorant depredation at aquaculture facilities in Mississippi. Pp 99-105 *in* M.E. Tobin, ed. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997, Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, and T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, New York.

Robbins, C. S., and E. A. T. Blom. 1996. Atlas of the Breeding Birds of Maryland and the District of Columbia. University of Pittsburgh Press, Pittsburgh, Pennsylvania.

Robinson, M. 1996. The potential for significant financial loss resulting from bird strikes in or around an airport. Proc. Bird Strike Committee Europe 22:353-367.

Roffe, T. J. 1987. Avian tuberculosis. Pp. 95-99 *in* M. Friend and C. J. Laitman, eds. Field guide to wildlife diseases. 225 pp.

Rogers, J. G., Jr., and J. T. Linehan. 1977. Some aspects of grackle feeding behavior in newly planted corn. Journal of Wildlife Management 41:444-447.

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, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2011. The North American Breeding Bird Survey, Results and Analysis 1966 - 2010. Version 12.07.2011, USGS Patuxent Wildlife Research Center, Laurel, Maryland.

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

Schafer, E.W., Jr. 1981. Bird control chemicals - nature, modes of action, and toxicity. Pp 129-139 *in* CRC handbook of pest management in agriculture. Vol. 3. CRC Press, Cleveland, OH.

Schafer, E.W., Jr. 1984. Potential primary and secondary hazards of avicides. Proc. Vert. Pest Conf. 11:217-222.

Schafer, E.W., Jr. 1991. Bird control chemicals-nature, mode of action and toxicity. Pp 599-610 *in* CRC Handbook of Pest Management in Agriculture Vol. II. CRC Press, Cleveland, OH.

Schafer, E. W., Jr., and D. J. Cunningham. 1966. Toxicity of DRC-1339 to grackles and house finches. U. S. Fish and Wildl. Serv. Denver Wildlife Research Center, Typed Rept. 1 pp.

Schafer, E.W., Jr., R.B. Brunton, and N.F. Lockyer. 1974. Hazards to animals feeding on blackbirds killed with 4-aminopyrine baits. Journal of Wildlife Management 38:424-426.

Schafer, E.W., Jr., R.B. Brunton, D.J. Cunningham, and N.F. Lockyer. 1977. The chronic toxicity of 3-chloro-4-methyl benzamine HCl to birds. Archives of Environmental Contamination and Toxicology 6:241-248.

Scherer, N. M., H. L. Gibbons, K. B. Stoops, and M. Muller, 1995. Phosphorus loading of an urban lake by bird droppings. Lake and Reservoir Management 11:317–327.

Schmidt, R. 1989. Wildlife management and animal welfare. Trans. N.Amer. Wildl. And Nat. Res. Conf. 54:468-475.

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

Seamans, T. W. 2004. Response of roosting turkey vultures to a vulture effigy. Ohio Journal of Science 104:136-138.

Seamans, M. E., J. P. Ludwig, K. Stromborg, F. E. Ludwig II, and F. E. Ludwig. 2008. Annual survival of double-crested cormorants from the Great Lakes, 1979-2006.

Shieldcastle, M. C., and L. Martin. 1999. Colonial waterbird nesting on west sister island national wildlife refuge and the arrival of double-crested cormorants. Pp 115-119 *in* M.E. Tobin, Tech. Coord. Symposium on double-crested cormorants: Population status and management issues in the Midwest. 9 December 1997., Milwaukee, WI. Tech. Bull. 1879. Washington, D.C.: U.S. Department of Agriculture, Animal and Plant Health Inspection Service.

Shirota, Y. M., and S. Masake. 1983. Eyespotted balloons are a device to scare gray European Starlings. Appl. Ent. Zool. 18:545-549.

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. A. Wildl. Nat. Res. Conf 57:51-62.

Smith, J. A. 1999. Nontarget avian use of DRC-1339 treated plots during an experimental blackbird control program in eastern South Dakota. M.S. Thesis, South Dakota State University, Brookings, South Dakota.

Smith, A. E., S. R. Craven, and P. D. Curtis. 1999. Managing Canada geese in urban environments. Jack Berryman Institute Publication 16, and Cornell University Cooperative Extension, Ithaca, N.Y. 42 pp.

SCDNR. 2009. Consideration for holding a fall turkey season in South Carolina. South Carolina Department of Natural Resources. Rembert C. Dennis Building, 1000 Assembly Street, Columbia, South Carolina. 5 pp.

SCDNR. 2011*a*. 2011 South Carolina turkey harvest report. South Carolina Department of Natural Resources, Turkey Research and Management Project. Rembert C. Dennis Building, 1000 Assembly Street, Columbia, South Carolina. 19 pp.

SCDNR. 2011*b*. Rules and Regulations: Hunting and Fishing, July 1, 2011 – August 14, 2012. South Carolina Department of Natural Resources, Turkey Research and Management Project. Rembert C. Dennis Building, 1000 Assembly Street, Columbia, South Carolina. 54 pp.

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.

Stone, C. P., and D. F. Mott. 1973. Bird damage to ripening field corn in the United States, 1971. U.S. Bureau of Sport Fisheries and Wildlife, Wildlife Leaflet 505. 8 pp.

Stroud, R. K., and M. Friend. 1987. Salmonellosis. Pp 101-106 *In* Field Guide to Wildlife Diseases: 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. Journal of Wildlife Management 54:433-437.

Taylor, P. W. 1992. Fish-eating birds as potential vectors of *Edwardsiella ictaluri*. Journal of Aquatic Animal Health 4:240–243.

Telfair II, R. C. 1983. The Cattle Egret: a Texas focus and world view. Kleberg Studies in Natural Resources. Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas.

Telfair II, R. C. 2006. Cattle egret (*Bubulcus ibis*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/113.

Telfair II, R. C., and T. J. Bister. 2004. Long-term breeding success of the cattle egret in Texas. Waterbirds 27:69-78.

The Wildlife Society. 1992. 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., D. T. King, B. S. Dorr, and D. S. Reinhold. 2002. The effect of roost harassment on cormorant movements and roosting in the Delta region of Mississippi. Waterbirds 25:44-51.

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.

Tyson, L. A., J. L. Belant, F. J. Cuthbert, and D. V. Weseloh. 1999. Nesting populations of double-crested cormorants in the United States and Canada. Pp. 17-25. Symposium on Double-crested Cormorants: Population Status and Management Issues in the Midwest, December 9, 1997, M. E. Tobin, ed. USDA Technical Bulletin No. 1879. 164 pp.

United States Census Bureau. 2011. 2010 census state area measurements and internal point coordinates. http://www.census.gov/geo/www/2010census/statearea_intpt.html. Accessed January 10, 2012.

USDA. 1997. Animal Damage Control Program: Final Environmental Impact Statement (revised). USDA, APHIS, WS-Operational Support Staff, 4700 River Road, Unit 87, Riverdale, Maryland.

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

USDA. 2003. Tech Note: Spring viremia of carp. United States Department of Agriculture, Animal and Plant Protection Service, Veterinary Services. Riverdale, MD.

USDA. 2004. Environmental Assessment: Reducing pigeon, starling, and sparrow damage through an integrated wildlife damage management program in the State of South Carolina. 400 Northeast Drive, Suite L, Columbia, South Carolina 29203.

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. 2006. Environmental Assessment: Canada goose damage management in the State of South Carolina. 400 Northeast Drive, Suite L, Columbia, South Carolina 29203.

USDI. 1996. Restoring avian diversity to Monomoy National Wildlife Refuge. U.S. Fish and Wildlife Service. MA.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

USFWS. 2000. Bird conservation region descriptions. North American Bird Conservation Initiative. U.S. NABCI Committee. 44 pp.

USFWS. 2003. Final Environmental Impact Statement: Double-crested cormorant management. U.S. Dept. of the Interior, USFWS, Div. of Migratory Bird Management, 4401 N. Fairfax Drive MS 634, Arlington, VA 22203.

USFWS. 2005. Final Environmental Impact Statement: Resident Canada goose management. United States Fish and Wildlife Service, Division of Migratory Birds. Arlington, Virginia. http://www.fws.gov/migratorybirds/issues/cangeese/finaleis.htm. Accessed November 24, 2009.

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

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

USGS. 2005. Ospreys in Oregon and the Pacific Northwest. United States Geological Survey. http://fresc.usgs.gov/products/fs/fs-153-02.pdf. Accessed September 28, 2009.

Vauk-Hentzelt, E., W. Gunkel, and K. Klings. 1987. Microbial diseases in special consideration of Coli septicaemia *Escherichia coli* of gulls Laridae around the Isle Helgoland (German Bight). Global Trends in Wildlife Management, 18th IUGB Congress, Krakow, Poland, August, 1987. Swait Press, Krakow. Pp. 273-275.

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

Verbeek, N. A. and C. Caffrey. 2002. American Crow (*Corvus brachyrhynchos*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/647.

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

Vermeer, K., D. Power, and G. E. J. Smith 1988 Habitat selection and nesting biology of roof-nesting glaucous-winged gulls. Colon. Waterbirds 11:189-201.

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

Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Birds of New Jersey. New Jersey Audubon Society, Bernardsville, New Jersey. 704 pp.

Weber, W. J. 1979. Health Hazards from Pigeons, European Starlings, and English Sparrows. Thompson Publ. Fresno, Calif. 138 pp.

Weeks, R. J., and A. R. Stickley. 1984. Histoplasmosis and its relation to bird roosts: a review. Denver Wildl. Res. Ctr. Bird Damage Rpt. No. 330. U.S. Fish and Wildl. Serv. 23pp.

Weseloh, D.V., and P.J. Ewins. 1994. Characteristics of a rapidly increasing colony of double-crested cormorants (*Phalacrocorax auritus*) *in* Lake Ontario: population size, reproductive parameters, and band recoveries. Journal of Great Lakes Research 20:443–456.

Weseloh, D. V., and B. Collier. 1995. The rise of the Double-crested Cormorant on the Great Lakes : winning the war against contaminants. Great Lakes Fact Sheet. Canadian Wildlife Service, Environment Canada, Burlington, Ontario.

Weseloh, D.V ., P. J. Ewins, J. Struger, P. Mineau, C. A. Bishop, S. Postupalsky and J. P. Ludwig. 1995. Double- crested Cormorants of the Great Lakes: changes in population size, breeding distribution and reproductive output between 1913 and 1991. Colonial Waterbirds 18 (Special Publication):48-59.

West, R. R., and J. F. Besser. 1976. Selection of toxic poultry pellets from cattle rations by European Starlings. Proc. Bird Control Semin. 7:242-244.

West, R. R., J. F. Besser, and J. W. DeGrazio. 1967. Starling control in livestock feeding areas. Proc. Vertebr. Pest Conf. San Francisco, California.

Westberg, G. L. 1969. Comparative studies of the metabolism of 3-chloro-p-toluidine and 2-chloro-4-acetutoluidine in rats and chickens and methodology for the determination of 3-chloro-p-toluidine and metabolites in animal tissues. M.S. Thesis, University of California-Davis.

White, D. H., L. E. Hayes, and P. B. Bush. 1989. Case histories of wild birds killed intentionally with famphur in Georgia and West Virginia. Journal of Wild. Diseases 25:144-188.

Whoriskey, F. G., and G. J. FitzGerald. 1985. Nest sites of the threespine stickleback: can site characteristics alone protect the nest against egg predators and are nests a limiting resource? Can. J. Zool. 63:1991–1994.

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

Wiese, J. H. 1979. A study of the reproductive biology of herons, egrets, and ibis nesting on Pea Patch Island, Delaware. Delmarva Power and Light Co., Manomet Bird Observatory, Manomet, MA.

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.

Wires, L. R., F. J. Cuthbert, D. R. Trexel, and A. R. Joshi. 2001. Status of the double-crested cormorant (*Phalacrocorax auritus*) in North America. Report to the U.S. Fish and Wildlife Service, Arlington, Virginia, USA.

Wires, L. R., and F. J. Cuthbert. 2001. Prioritization of waterbird colony sites for conservation in the U.S. Great Lakes. Final Report to USFWS. Available at: http://www.waterbirds.umn.edu/F2-CWBPrior.pdf .

Wobeser, G., and C. J. Brand. 1982. Chlamydiosis in 2 biologists investigating disease occurrences in wild waterfowl. Wildlife Society Bulletin 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, British Columbia, Canada.

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.

Zottoli, S. J. 1976. Fishing behavior of Common Grackles. Auk 93: 640–642.

APPENDIX B

BIRD DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE

NON-LETHAL METHODS – NON-CHEMICAL

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 eye spot balloons, raptor effigies and silhouettes, mirrors, and moving disks can be effective but usually for only a short time before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Conover 1982, Shirota and Masake 1983, Schmidt and Johnson 1984, Mott 1985, Graves and Andelt 1987, Bomford 1990). Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988).

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 a lowering of the 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, 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, every other day, or as appropriate, to remove and euthanize excess birds and to replenish bait and water. Decoy traps and other cage/live traps, as applied and used by WS, pose no danger to pets or the public and if a pet is accidentally captured in such traps, it can be released unharmed.

Foot-hold traps can be effective in areas where a small resident crow population is present (Johnson 1994). No. 0 or 1 foot-hold traps with padded jaws would be used to trap individual birds in areas habitually used by crows. Traps would be monitored a minimum of twice each day and trapped birds euthanized by methods approved by the AVMA or a veterinarian.

Nest box traps may be used by WS for corrective damage management and are effective in capturing 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 in to 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 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.

Nest destruction is the removal of nesting materials during the construction phase of the nesting cycle. Nest destruction is generally only applied when dealing with a single bird or very few birds. This method is used to discourage birds from constructing nests in areas which may create nuisances for home and business owners. Heusmann and Bellville (1978) reported that nest removal was an effective but time-consuming method because problem bird species are highly mobile and can easily return to damage sites from long distances, or because of high populations. This method poses no imminent danger to pets or the public.

Egg addling/destruction is a method of suppressing reproduction in local nuisance bird populations by destroying egg embryos prior to hatching. Egg addling is conducted by vigorously shaking an egg numerous times which causes detachment of the embryo from the egg sac. Egg destruction can be accomplished in several different ways, but the most commonly used methods are manually gathering eggs and breaking them, or by oiling or spraying the eggs with a liquid which covers the entire egg and prevents the egg from obtaining oxygen (see *Egg oiling* below). Although WS does not commonly use egg addling or destruction, it is a valuable damage management tool and has proven effective in some applications.

Lure crops/alternate foods. 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 bird begins to broadcast distress vocalizations and display abnormal flying behavior, thereby frightening the remaining flock away.

Avitrol is a restricted use pesticide that can only be sold to certified applicators and is available in several bait formulations where only a small portion of the individual grains carry the chemical. It can be used during anytime of the year, but is used most often during winter and spring. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its availability for intake by organisms from water, is non-accumulative in tissues and rapidly metabolized by many species (Schafer, 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). A formal Risk Assessment found no probable risk is expected for pets and the public, based on low concentrations and low hazards quotient value for non-target indicator species tested on this compound (USDA 1997).

Methyl anthranilate (artificial grape flavoring used in foods and soft drinks for human consumption) could be used or recommended by WS as a bird repellent. Methyl anthranilate (MA) (artificial grape flavoring food additive) has been shown to be a promising repellent for many bird species, including waterfowl (Dolbeer et al. 1993). Cummings et al. (1995) found effectiveness of MA declined significantly after 7 days. Belant et al. (1996) found MA ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. MA is also under investigation as a potential bird taste repellent. MA may become available for use as a livestock feed additive (Mason et al. 1984, Mason et al. 1989). It is registered for applications to turf or to surface water areas used by unwanted birds. The material has been shown to be nontoxic to bees (LD_{50} > 25 micrograms/bee[13]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[14]), and of relatively low toxicity to fish and other invertebrates.

[13] 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.

[14] An LC_{50} is the dosage in milligrams of material per liter of air required to cause death in 50% of a test population of a species through inhalation.

Methyl anthranilate is naturally occurring in concord grapes and in the blossoms of several species of flowers and is used as a food additive and perfume ingredient (Dolbeer et al. 1992). It has been listed as "*Generally Recognized as Safe*" by the FDA (Dolbeer et al. 1992).

Water surface and turf applications of MA are generally considered expensive. For example, the least intensive application rate required by label directions is 20 lbs. of product (8 lbs. active ingredient) per acre of surface water at a cost of about $64/lb. with retreating required every 3-4 weeks. Cost of treating turf areas would be similar on a per acre basis. Also, MA completely degrades in about 3 days when applied to water which indicates the repellent effect is short-lived.

Another potentially more cost effective method of MA application is by use of a fog-producing machine (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, birds develop post-ingestional malaise (Mason 1989) and crows develop an aversion to consuming similar looking eggs (Dimmick and Nicolaus 1990). Repeated exposures may be necessary to develop and maintain aversion to threatened or endangered species eggs as the learning curve for crows can take from 23 days to 3 months (Dimmick and Nicolaus 1990, Avery and Decker 1994).

Treated areas will be posted with warning signs at access points to exclude people from endangered or threatened species nesting areas. Treated eggs are not placed in locations where threatened or endangered species may eat the treated eggs. Mesurol is highly toxic to birds and mammals and toxic to fish. It is also highly toxic to honey bees.

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 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 in USDA (1997) based on critical element screening; therefore, environmental fate properties of this compound were not rigorously assessed. However, the solubility and mobility are believed to be moderate and environmental persistence is believed to be low. Bioaccumulation in plants and animal tissue is believed to be low. Alpha-chloralose is used in other countries as an avian and mammalian toxicant. The compound is slowly metabolized, with recovery occurring a few hours after administration (Schafer, 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.

Contraception by inhibiting reproduction is one way of reducing some bird populations. However, in long-lived species like geese (Cramp and Simmons 1977) exclusive use of contraceptive methods may take a period of years to reduce local bird populations. Contraceptive methods are likely to be most valuable as a means of maintaining waterfowl populations at desired levels.

Canada geese have been successfully vasectomized to prevent production of young; this method is only effective if the female does not form a bond with a different male. In addition, vasectomies can only prevent the production of the mated pair. The ability to identify breeding pairs for isolation and to capture a male bird for vasectomizing becomes increasingly difficult as the number of birds increase (Converse and Kennelly 1994). Keefe (1996) estimated mechanical sterilization of a Canada goose to cost over $100 per bird.

The NWRC has been instrumental in the development and registration of a new product, nicarbazin (OvoControl-GTM; CAS 330-95-0/4, 4-dinitrocarbanilide (DNC, CAS 587-90-6)/ 2-hydroxy-4,6-dimethylpyrimidine (HDP, CAS 108-79-2) (1:1)), which is an infertility agent for Canada geese and Rock Pigeons in urban areas. Nicarbazin is available to certified pesticide applicators and is not restricted to use by WS. Use of baits containing nicarbazin would allow the numbers of small to moderate sized

groups of Canada geese and Rock Pigeons to be controlled by reducing the hatchability of eggs laid by treated birds without requiring the location of each individual nest to be determined (as is the case for egg oiling/addling/destruction).

Nicarbazin is thought to induce infertility in birds by two main mechanisms. Nicarbazin may disrupt the membrane surrounding the egg yolk, resulting in intermixing of egg yolk and white (albumin) components, creating conditions in which the embryo cannot develop. Nicarbazin may also inhibit incorporation of cholesterol into the yolk, a step that is necessary for yolk formation, thereby limiting energy for the developing embryo. If the yolk does not provide enough energy, the embryo will not completely form and the egg will never hatch. Nicarbazin bait must be consumed for several days to achieve blood levels that affect the hatchability of eggs that are forming. Nicarbazin is undetectable in the plasma of Canada Geese, Mallards, and chickens by 4-6 days after consumption of nicarbazin bait has stopped. The levels of active ingredient in the blood are reduced by half within one day after bait consumption stops. If the level of active ingredient falls by approximately one half its peak levels, no effects on egg formation can be seen. By two days after bait consumption has stopped, no effects on the egg being formed are seen. Consequently, the bait must be offered to the birds each day of the nesting period for best impact on reproduction.

In a field study conducted in Oregon (Yoder et al. 2005), use of nicarbazin reduced hatchability of eggs 35.6% ($P = 0.062$). When considering the success of individual nests at sites rather than flocks as a whole, percent hatchability was significantly reduced 50.7% ($P < 0.001$). The high degree of variability among Canada Geese in their movement patterns, nesting and habitat use complicates use of this product (VerCauteren and Marks 2004). The variability in goose behavior can make it difficult to get the required doses to the geese (see below). Under current label guidelines, the cost for nicarbazin (Ovocontrol®) applications exceeds the cost of other control methods (Cooper and Keefe 1997) until the goose population reaches a critical threshold of approximately > 80 birds (Caudell and Shwiff 2006).

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. Shooting can be relatively expensive because of the staff hours sometimes required (USDA 1997). It is selective for target species and may be used in conjunction with the use of spotlights, decoys, and calling. Shooting with shotguns, air rifles, or rim and center fire rifles is 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 SCDNR 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 South Carolina and are required to adhere to all certification requirements set forth in FIFRA and South Carolina 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 is the principal chemical method that would be used for bird damage management in the proposed action. 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 (USDA 1997). Secondary poisoning has not been observed with DRC-1339 treated baits, except crows eating gut contents of pigeons (Kreps 1974). During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1981). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds and starlings killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost nonexistent (Schafer, 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. Aquatic and invertebrate toxicity is low (USDA 1997). Appendix P of USDA (1997) contains a thorough risk assessment of DRC-1339 and the reader is referred to that source for a more complete discussion. That assessment concluded that no adverse effects are expected from use of DRC-1339.

APPENDIX C

Federally Listed Threatened and Endangered Species in South Carolina

Animals

Status in SC	Common Name	Species
E	Heelsplitter, Carolina	(*Lasmigona decorata*)
E	Manatee, West Indian	(*Trichechus manatus*)
T	Plover, piping	(*Charadrius melodus*)
T	Salamander, frosted flatwoods	(*Ambystoma cingulatum*)
T	Sea turtle, green	(*Chelonia mydas*)
E	Sea turtle, hawksbill	(*Eretmochelys imbricata*)
E	Sea turtle, Kemp's ridley	(*Lepidochelys kempii*)
E	Sea turtle, leatherback	(*Dermochelys coriacea*)
T	Sea turtle, loggerhead	(*Caretta caretta*)
E	Stork, wood	(*Mycteria americana*)
E	Sturgeon, shortnose	(*Acipenser brevirostrum*)
E	Warbler (=wood), Bachman's	(*Vermivora bachmanii*)
E	Whale, finback	(*Balaenoptera physalus*)
E	Whale, humpback	(*Megaptera novaeangliae*)
E	Whale, North Atlantic Right	(*Eubalaena glacialis*)
E	Woodpecker, red-cockaded	(*Picoides borealis*)

E: endangered T: threatened
Printed September 2011

Plants

Status in SC	Common Name	Species
T	Amaranth, seabeach	(*Amaranthus pumilus*)
T	Amphianthus, little	(*Amphianthus pusillus*)
E	Arrowhead, bunched	(*Sagittaria fasciculata*)
E	Chaffseed, American	(*Schwalbea americana*)
E	Coneflower, smooth	(*Echinacea laevigata*)
E	Dropwort, Canby's	(*Oxypolis canbyi*)
T	Gooseberry, Miccosukee	(*Ribes echinellum*)
E	Harperella	(*Ptilimnium nodosum*)
T	Heartleaf, dwarf-flowered	(*Hexastylis naniflora*)
E	Loosestrife, rough-leaved	(*Lysimachia asperulaefolia*)
T	Pink, swamp	(*Helonias bullata*)
E	Pitcher-plant, mountain sweet	(*Sarracenia rubra* ssp. *jonesii*)
T	Pogonia, small whorled	(*Isotria medeoloides*)
E	Pondberry	(*Lindera melissifolia*)
E	Quillwort, black spored	(*Isoetes melanospora*)
E	Sumac, Michaux's	(*Rhus michauxii*)
E	Sunflower, Schweinitz's	(*Helianthus schweinitzii*)
E	Trillium, persistent	(*Trillium persistens*)
E	Trillium, relict	(*Trillium reliquum*)

E: endangered T: threatened
Printed September 2011

APPENDIX D

Protected Wildlife Species of South Carolina

STATE LISTED THREATENED AND ENDANGERED SPECIES

The following species of resident wildlife are designated as state-listed endangered species:

Animals

Scientific Name	Common Name	Status
Acipenser brevirostrum	Shortnose Sturgeon	SE-Endangered
Ambystoma cingulatum	Flatwoods Salamander	SE-Endangered
Caretta caretta	Loggerhead	ST-Threatened
Charadrius wilsonia	Wilson's Plover	ST-Threatened
Clemmys guttata	Spotted Turtle	ST-Threatened
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	SE-Endangered
Elanoides forficatus	American Swallow-tailed Kite	SE-Endangered
Elassoma boehlkei	Carolina Pygmy Sunfish	ST-Threatened
Etheostoma collis	Carolina Darter	ST-Threatened
Eumeces anthracinus pluvialis	Southern Coal Skink	ST-Threatened
Falco peregrinus anatum	American Peregrine Falcon	ST-Threatened
Glyptemys muhlenbergii	Bog Turtle	ST-Threatened
Gopherus polyphemus	Gopher Tortoise	SE-Endangered
Haliaeetus leucocephalus	Bald Eagle	ST-Threatened
Hyla andersonii	Pine Barrens Treefrog	ST-Threatened
Mycteria Americana	Wood Stork	SE-Endangered
Myotis leibii	Eastern Small-footed Myotis	ST-Threatened
Myotis sodalist	Indiana Myotis	SE-Endangered
Picoides borealis	Red-cockaded Woodpecker	SE-Endangered
Plethodon websteri	Webster's Salamander	SE-Endangered
Pseudobranchus striatus	Dwarf Siren	ST-Threatened
Puma concolor couguar	Eastern Cougar	SE-Endangered
Rana capito	Gopher Frog	SE-Endangered
Sterna antillarum	Least Tern	ST-Threatened
Thryomanes bewickii	Bewick's Wren	ST-Threatened
Trichechus manatus	Florida Manatee	SE-Endangered
Vermivora bachmanii	Bachman's Warbler	SE-Endangered
Lasmigona decorate	Carolina Heelsplitter	SE-Endangered