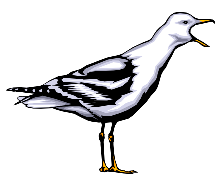
FLORIDA BIRD ENVIRONMENTAL ASSESSMENT

REDUCING BIRD DAMAGE IN THE STATE OF FLORIDA
(Final)



PREPARED BY:

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

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ACRONYMS

AI	Avian Influenza
AP	Atlantic Population
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BCR	Bird Conservation Region
CBC	Christmas Bird Count
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DNC	4,4'-dinitrocarbanilide
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAC	Florida Administrative Code
FDA	Food and Drug Administration
FDACS	Florida Department of Agriculture a and Consumer Services
FWC	Florida Fish and Wildlife Conservation Commission
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Fiscal Year
HDP	2-hydroxy-4,6-dimethylpyrimidine
INAD	Investigational New Animal Drug
LD	Median Lethal Dose
LC	Median Lethal Concentration
MANEM	Mid-Atlantic/New England/Maritime
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NAP	North Atlantic Population
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWRC	National Wildlife Research Center
SJBP	Southern James Bay Population
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USC	United States Code
USAF	United States Air Force
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WS	Wildlife Services

CHAPTER 1: NEED FOR ACTION AND SCOPE OF ANALYSIS

1.1 INTRODUCTION

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS)[1] program in Florida continues to receive requests for assistance or anticipates receiving requests for assistance to resolve or prevent damage occurring to agricultural resources, natural resources, and property, including threats to human safety, associated with several bird species. Those bird species include Canada Geese (*Branta canadensis*), feral waterfowl[2], Blue-winged Teal (*Spatula discors*), Mallards (domestic/wild) (*Anas platyrhynchos*), Mottled Ducks (*Anas fulvigula*), Lesser Scaups (*Aythya affinis*), Bufflehead (*Bucephala albeola*), Wild Turkeys (*Meleagris gallopavo*), Rock Pigeons (*Columba livia*), Eurasian Collared-Doves (*Streptopelia decaocto*), Mourning Doves (*Zenaida macroura*), Common Nighthawks (*Chordeiles minor*), American Coots (*Fulica americana*), Black-necked Stilts (*Himantopus mexicanus*), Killdeer (*Charadrius vociferous*), Dunlins (*Calidris alpine*), Least Sandpipers (*Calidris minutilla*), Laughing Gulls (*Leucophaeus atricilla*), Ring-billed Gulls (*Larus delawarensis*), Herring Gulls (*Larus argentatus*), Black Terns (*Chlidonias niger*), Wood Storks (*Mycteria americana*), Double-crested Cormorants (*Phalacrocorax auritus*), Brown Pelicans (*Pelecanus occidentalis*), Great Blue Herons (*Ardea herodias*), Great Egrets (*Ardea alba*), Cattle Egrets (*Bubulcus ibis*), Black Vultures (*Coragyps atratus*), Turkey Vultures (*Cathartes aura*), Osprey (*Pandion haliaetus*), Swallow-tailed Kites (*Elanoides forficatus*), Mississippi Kites (*Ictinia mississippiensis*), Bald Eagles (*Haliaeetus leucocephalus*), Red-shouldered Hawks (*Buteo lineatus*), Red-tailed Hawks (*Buteo jamaicensis*), American Kestrels (*Falco sparverius*), Peregrine Falcons (*Falco peregrines*), Monk Parakeets (*Myiopsitta monachus*), American Crows (*Corvus brachyrhynchos*), Fish Crows (*Corvus ossifragus*), Purple Martin (*Progne subis*), Tree Swallows (*Tachycineta bicolor*), Barn Swallows (*Hirundo rustica*), American Robins (*Turdus migratorius*), European Starlings (*Sturnus vulgaris*), House Sparrows (*Passer domesticus*), Eastern Meadowlarks (*Sturnella magna*), Red-winged Blackbirds (*Agelaius phoeniceus*), Brown-headed Cowbirds (*Molothrus ater*), Common Grackles (*Quiscalus quiscula*), and Boat-tailed Grackles (*Quiscalus major*).

In addition to those species, WS could also receive requests for assistance to manage damage and threats of damage associated with several other bird species, but requests for assistance associated with those species would occur infrequently and/or requests would involve a small number of individual birds of a species. Damages and threats of damages associated with those species would occur primarily at airports where individuals of those species pose a threat of aircraft strikes. Appendix E contains a list of species that WS could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage.

This environmental assessment (EA) will assist in determining if the proposed cumulative management of bird damage could have a significant impact on the environment based on previous activities conducted by WS and based on the anticipation of conducting additional efforts to manage damage. WS' mission and directives[3] would be to provide assistance when the appropriate property owner or manager requests such assistance, within the constraints of available funding and workforce. Therefore, it is conceivable that additional damage management efforts could occur beyond those efforts conducted during previous

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[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 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353).

[2] Domestic waterfowl includes 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 Ducks, and Mallard-Muscovy hybrids.

[3] At the time of preparation, WS' Directives could be found at the following web address: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_WS_Program_Directives.

activities. Thus, this EA anticipates those additional efforts and the analyses would apply to actions that may occur in any locale and at any time within Florida as part of a coordinated program.

The analyses contained in this EA are based on information derived from WS' Management Information System, data from the United States Fish and Wildlife Service (USFWS), available documents (see Appendix A), interagency consultations, public involvement, and other environmental documents.

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 alternative approaches to meeting the need for action while addressing the identified issues. WS initially developed the issues and alternatives associated with bird damage management in consultation with the USFWS and the Florida Fish and Wildlife Conservation Commission (FWC). The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the FWC has the authority to manage wildlife populations in the State of Florida. To assist with identifying additional issues and alternatives to managing damage, WS will make this EA available to the public for review and comment prior to the issuance of a Decision[4].

WS has previously developed an EA that analyzed the need for action to manage damage associated with several bird species in Florida[5]. Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to manage bird damage in the state. This new EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Because this EA will re-evaluate those activities conducted under the previous EA to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued for this EA will supersede the previous EA that addressed the need to manage damage associated with birds.

This new EA will assist in determining if the proposed management of damage associated with birds could have a significant impact on the environment for both people and other organisms. This EA will analyze several alternatives to address the need for action and the identified issues and document the environmental consequences of the alternatives to comply with the National Environmental Policy Act (NEPA). In addition, this new EA will inform the public and coordinate efforts between WS, the USFWS, the FWC, and other entities.

1.2 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between people and wildlife. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety. Wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people. In general, people regard wildlife as providing economic, recreational, and aesthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to some people. However, activities associated with wildlife may result in economic losses to agricultural resources, natural resources, property, and threaten human safety. Therefore, an awareness of the varying perspectives and values are required to balance the needs of people and the needs of wildlife. When addressing damage or threats of damage caused by wildlife, wildlife damage

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

[5]See Section 1.7 of this EA for further discussion on the previous EA developed by WS to manage damage caused by birds.

management professionals must consider not only the needs of those people directly affected by wildlife damage but a range of environmental, sociocultural, and economic considerations as well.

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

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (The Wildlife Society 2015). The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management can occur from specific threats to resources. Those animals have no intent to do harm. They utilize habitats (*e.g.*, reproduce, walk, forage) where they can find a niche. If their activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or poses a threat to human safety, people often seek assistance with resolving damage or reducing threats to human safety.

The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to an individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where an individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, damage could also occur from a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person.

The need for action to manage damage and threats associated with birds in Florida arises from requests for assistance[6] received by WS to reduce and prevent damage from occurring to four major categories. Those four categories are 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 and Appendix E (see Table E-1) show the bird species associated with requests for assistance that WS could receive and the resource types those bird species could damage in Florida. In Florida, most requests for assistance that WS receives are associated with aircraft strike hazards at airports in the state. All of those bird species shown in Table 1.1 and discussed in Appendix E could pose a threat to aircraft when those bird species occur at or near air facilities. Bird

[6]WS would only conduct bird damage management after receiving a request for assistance. Before initiating bird damage activities, a Memorandum of Understanding, work initiation document, 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.

strikes can cause substantial damage to aircraft, which can require costly repairs. In addition, bird strikes can lead to the catastrophic failure of aircraft, which can pose a threat to the safety of people.

WS also receives requests for assistance to manage damage to many other resources. For example, WS could provide assistance with projects to reduce damage to structures from bird droppings or nesting materials. Those structures may range from a homeowner's wood siding to vast power substations and transmission lines to the roofs of buildings at railway transfer stations. Damage could also occur to agricultural resources, primarily from birds that consume livestock feed, feed on livestock, or pose disease risks to livestock. Similarly, threats to natural resources would primarily be associated with birds preying upon threatened or endangered species or competing with other wildlife species for resources.

Table 1.1 – Primary bird species addressed by WS in Florida and the resource types damaged

	Resource*					Resource			
Species	**A**	**N**	**P**	**H**	**Species**	**A**	**N**	**P**	**H**
Canada Geese	X	X	X	X	**Cattle Egrets**	X	X	X	X
Feral Waterfowl	X	X	X	X	**Black Vultures**	X		X	X
Blue-winged Teal			X	X	**Turkey Vultures**	X		X	X
Mallards	X		X	X	**Osprey**	X	X	X	X
Mottled Ducks	X		X	X	**Swallow-tailed Kites**			X	X
Lesser Scaup			X	X	**Mississippi Kites**	X	X	X	X
Bufflehead			X	X	**Bald Eagles**			X	X
Wild Turkeys	X		X	X	**Red-shouldered Hawks**	X	X	X	X
Rock Pigeons	X	X	X	X	**Red-tailed Hawks**	X	X	X	X
Eurasian Collared-Doves		X	X	X	**American Kestrels**	X	X	X	X
Mourning Doves			X	X	**Peregrine Falcons**		X	X	X
Common Nighthawks			X	X	**Monk Parakeets**		X	X	X
American Coots	X		X	X	**American Crows**	X	X	X	X
Black-necked Stilt			X	X	**Fish Crows**	X	X	X	X
Killdeer			X	X	**Purple Martin**			X	X
Dunlins			X	X	**Tree Swallows**			X	X
Least Sandpipers			X	X	**Barn Swallows**	X		X	X
Laughing Gulls	X	X	X	X	**American Robins**	X		X	X
Ring-billed Gulls	X	X	X	X	**European Starlings**	X	X	X	X
Herring Gulls	X	X	X	X	**House Sparrows**	X	X	X	X
Black Terns			X	X	**Eastern Meadowlarks**			X	X
Wood Storks			X	X	**Red-winged Blackbirds**	X		X	X
Double-crested Cormorants	X	X	X	X	**Brown-headed Cowbirds**	X	X	X	X
Brown Pelicans			X	X	**Common Grackles**	X		X	X
Great Blue Herons	X	X	X	X	**Boat-tailed Grackles**	X		X	X
Great Egrets	X	X	X	X					

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

Some of the species addressed in this EA are gregarious (*i.e.*, form large flocks), especially during the fall and spring migration periods or during the breeding season. Although damage and threats can occur throughout the year, damage or the threat of damage is often highest during those periods when birds are concentrated into large flocks, such as migration periods, and during winter months when food sources are limited. For some bird species, high concentrations of birds occur 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 can also increase the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines. The following subsections of the EA provide additional information regarding the need to manage bird damage.

Need to Resolve Bird Damage to Agricultural Resources

Agriculture is an important industry in Florida. During 2012, the National Agricultural Statistics Service (NASS) reported over 9.5 million acres were devoted to agricultural production in Florida with a market value of agricultural products sold estimated at nearly $7.7 billion (NASS 2012). The top three farm commodities for sales were fruit/nut products, vegetable products, and landscaping products (*e.g.*, nursery, greenhouse, floriculture, sod) which together, accounted for nearly 78% of the agricultural products sold in the state (NASS 2012). The cattle inventory in the state in 2012 was nearly 1.7 million head (NASS 2012). There were also nearly 22 million poultry in the state during 2012 (NASS 2012). The production value of field and other crops grown in Florida accounted for nearly $1 billion (NASS 2012). A variety of crops are grown including potatoes, peanuts, hay, cotton, corn, soybeans, wheat, and sugarcane. The market value of aquaculture products was estimated at $88.4 million in 2012 (NASS 2012). The aquaculture industry in the state raises a variety of freshwater and marine organisms including aquatic plants, catfish, tilapia, bass, trout, salmon, baitfish, alligators, crustaceans, mollusks, ornamental fish, and sport/game fish. Over 1/2 million pounds of catfish were sold in Florida during 2012 with the value of catfish production valued at nearly $700,000.

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.*, pigeons). 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 1.1 and Appendix E, many of the bird species addressed in this EA have been identified as causing damage to or posing threats to agricultural resources in Florida.

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 Florida are alligators, aquatic plants, catfish, mollusks, ornamental fish, shellfish, and tilapia (Florida Department of Agriculture and Consumer Services 2016). The sale of ornamental fish accounts for nearly half of the total aquaculture sales in the state (Florida Department of Agriculture and Consumer Services 2016).

Of those birds shown in Table 1.1 associated with damage to agriculture, of primary concern to aquaculture facilities in Florida are Double-crested Cormorants, Ospreys, herons, egrets, and to a lesser extent waterfowl, Red-tailed Hawks, Anhingas, gulls, kingfishers, crows, and Common Grackles.

Double-crested Cormorants can feed on fish that people raise for human consumption, and on fish commercially raised for bait and restocking in Florida. 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. The frequency at which Double-crested Cormorants occur at a given aquaculture facility can be a function of many interacting factors, such as the size of the regional and local cormorant population, the number, size, and distribution of aquaculture facilities, and the size distribution, density, health, and species composition of fish populations at facilities. Other factors may include the number, size, and distribution of wetlands in the immediate area, the size distribution, density, health, and species composition of free-ranging fish populations in the surrounding landscape, the number, size, and distribution of suitable roosting habitat, and the variety, intensity and distribution of local damage abatement activities.

Double-crested Cormorants are adept at seeking out the most favorable foraging and roosting sites. As a result, cormorants rarely distribute 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, some aquaculture producers in a region suffer little or no economic damage from cormorants, while others experience exceptionally high predation.

In addition to cormorants, Great Blue Herons can also 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 predation concern (Glahn et al. 1999*a*). Glahn et al. (1999*a*) found that 80% of the aquaculture facilities surveyed in the northeastern United States perceived birds as posing an economic threat due to predation, which coincided with 81% of the facilities surveyed having birds present on aquaculture ponds. Great Blue Herons occurred at 90% of the sites surveyed by Glahn et al. (1999*a*). Loss of trout in ponds with herons present ranged from 9.1% to 39.4% in Pennsylvania with an estimated loss in production ranging from $8,000 to nearly $66,000 (Glahn et al. 1999*b*). The stomach contents of Great Blue Herons collected at trout producing facilities in the northeastern United States contained almost exclusively trout (Glahn et al. 1999*b*).

In addition to cormorants and herons, other bird species have also been identified as causing damage or posing threats to aquaculture facilities. In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities, including egrets, Mallards, 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 their 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 fingerlings 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 were 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 (Bierregaard et al. 2016). 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). A study conducted in Pennsylvania during 1985 and 1986 found crows consumed a mean of 11,651 trout per year per site from ten trout hatcheries (Parkhurst et al. 1992). Because 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 Parkhurst et al. (1992) estimated at 145,035 fish captured per year per site.

Also of concern at 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 impoundments, the introduction of a disease could result in substantial economic losses. Although 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 may be a possible source of transmission of Spring Viraemia of Carp, Viral Hemorrhagic Septicaemia, and Infectious Pancreatic Necrosis in Europe, which are fish viruses capable of causing severe damage (European Inland Fisheries Advisory Commission 1989). Viral Hemorrhagic Septicaemia and Infectious Pancreatic Necrosis now occur in North America (Price and Nickum 1995). Spring Viraemia of Carp also occurs in North America (USDA 2003). Peters and Neukirch (1986) found the Infectious Pancreatic Necrosis virus in the fecal droppings of herons when herons fed on trout infected with Infectious Pancreatic Necrosis. Olesen and Vestergard-Jorgensen (1982) found herons could transmit the Viral Hemorrhagic Septicaemia (Egtved virus) from beak to fish when the beaks of herons were contaminated with the virus. However, Eskildsen and Vestergard-Jorgensen (1973) found the Egtved virus did not pass through the digestive tracks into the fecal droppings of Black-headed Gulls (*Chroicocephalus ridibundus*) when artificially inserted into the esophagus of the gulls.

Birds may also be 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 occurred within the intestines and rectal areas of Great Blue Herons and Double-crested Cormorants from aquaculture facilities in Mississippi (Taylor 1992). However, because Enteric Septicemia of Catfish is 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, nematodes, trematodes, and other parasites that 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, such as 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. Fish-eating birds can target fish that are diseased and less likely to escape predation at aquaculture facilities (Price and Nickum 1995, Glahn et al. 2002). Because birds have the mobility to move from one impoundment or facility to another, the threat of disease transmission is a concern given the potential economic loss that could occur 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 Florida. 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. Birds also defecate while feeding increasing the possibility of disease transmission through livestock directly contacting or consuming fecal droppings. Birds can 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.

Although damage and disease threats to livestock operations can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks, such as during migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can occur during the breeding season where suitable nesting habitat exists, such as Barn Swallows. Of primary concern to livestock feedlots and dairies in Florida are European Starlings, House Sparrows, Rock Pigeons, Red-winged Blackbirds, Grackles, Cowbirds, and to a lesser extent American 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 and Otis 1981, Glahn 1983, Glahn and Otis 1986). Starlings damage an estimated $800 million worth of agricultural resources per year (Pimentel et al. 2000). Diet rations for cattle contain all of the nutrients and fiber that cattle need, and are so thoroughly mixed that cattle are unable to select any single component over others. Livestock feed and rations are often formulated to ensure proper health of the animal. Higher fiber roughage in livestock feed is often supplemented with corn, barley, and other grains to ensure weight gain and in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs is most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered, which can negatively affect the health and production of livestock. The removal of this high-energy source by European Starlings is believed to reduce milk yields and weight gains, which is economically critical (Feare 1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, freezing temperatures, and the number of livestock on feed.

The economic significance of feed losses to starlings and blackbirds has been demonstrated by Besser et al. (1968), who concluded that the value of losses in feedlots near Denver, Colorado was $84 per 1,000 starlings during the winter in 1967. Forbes (1990) reported European Starlings consumed up to 50% of their body weight in feed each day. Glahn and Otis (1981) reported losses of 4.8 kg of pelletized feed consumed per 1,000 bird minutes. Glahn (1983) reported that 25.8% of farms in Tennessee experienced starling depredation problems of which 6.3% experienced considerable economic loss. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily Brown-headed Cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000. Depenbusch et al. (2011) estimated that feed consumption by European Starlings increased the daily production cost by $0.92 per animal.

Damage and threats to livestock operations can also occur from the risk of or actual transmission of diseases from birds to livestock. Agricultural areas provide ideal habitat for many bird species, which can be attracted in large numbers to those locations. Large concentrations of birds feeding, roosting, or loafing in these areas increases the possibility of and the concern over the transmission of diseases from birds to livestock. This concern can have far-reaching implications (Daniels et al. 2003, Fraser and Fraser 2010, Miller et al. 2012). Birds feeding alongside livestock in open livestock feeding areas or feeding on stored livestock feed can leave fecal deposits, which can be consumed by livestock. Fecal matter can also be deposited in sources of water for livestock, which increases the likelihood of disease transmission and can contaminate other surface areas where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carry infectious diseases which can be excreted in fecal matter and pose not only a risk to individual livestock operations, but can be a source of transmission to other livestock operations as birds move from one area to another.

A number of diseases that affect livestock have been associated with Rock Pigeons, European Starlings, and House Sparrows (Weber 1979, Carlson et al. 2010). Pigeons, starlings, and House Sparrows have been identified as carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981). Weber (1979) also reported pigeons, starlings, and House Sparrows as carriers of several viral, fungal, protozoal, and rickettsial diseases that are known to infect livestock and pets. Numerous studies have focused on starlings and the transmission of *Escherichia coli* (LeJeune et al. 2008, Gaukler et al. 2009, Cernicchiaro et al. 2012). LeJeune et al. (2008) found that starlings could play a role in the transmission of *E. coli* between dairy farms. Carlson et al. (2011*b*) found *Salmonella enterica* in the gastrointestinal tract of starlings at cattle feedlots in Texas and suggested starlings could contribute to the contamination of cattle feed and water. Salmonella contamination levels can be directly related to the number of European Starlings present (Carlson et al. 2011*a*, Carlson et al. 2011*b*). Poultry operations can be highly susceptible to diseases spread by wild birds, including those from starlings and House Sparrows. This includes salmonella, campylobacter, and clostridium (Craven et al. 2000).

Contamination of livestock facilities through fecal accumulation by various bird species has been identified as an important concern. Numerous diseases are spread through feces, with salmonellois and *E. coli* being two diseases of concern. Salmonellosis is an infection with bacteria called *Salmonella* and numerous bird species have been documented as reservoirs for this bacterium (Friend and Franson 1999, Tizard 2004). *E. coli* is a fecal coliform bacteria associated with the fecal material of warm-blooded animals. Multiple studies have found that birds can be an important source of *E. coli* contamination of both land and water sources (Fallacara et al. 2001, Kullas et al. 2002, Hansen et al. 2009, Silva et al. 2009). Multiple species have been documented as carrying dangerous strains of *E. coli*, including gulls, geese, pigeons, and starlings (Pedersen and Clark 2007). European Starlings have also been found to harbor various strains of *E. coli* (Gaukler et al. 2009), including O157:H7, a strain that has been documented as causing human mortalities (LeJeune et al. 2008, Cernicchiaro et al. 2012). Salmonella transmission by gulls to livestock can also be a concern (Williams et al. 1977, Johnston et al. 1979, Coulson et al. 1983). Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. Pedersen and Clark (2007) did an extensive review of the literature and found Canada Geese, gulls, pigeons, House Sparrows, cowbirds, grackles, blackbirds and starlings have the potential to play a role in the direct transmission of *E. coli* and *S. enterica* among cattle at feedlots and dairies and from livestock operation to livestock operation. Migratory birds are capable of spreading diseases over a larger area, and domestic species might serve as reservoirs within farm operations. 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.

Although it is difficult to document, there is a strong association of wild birds and the contamination of food and water sources at livestock facilities. The potential for introduction of *E. coli* or salmonella to a livestock operation or the transmission of these pathogens between sites by wild birds is a strong possibility (Pedersen and Clark 2007).

Starlings and gulls, as well as other species, have been documented as transferring species-specific diseases, such as transmittable gastroenteritis (Faulkner 1966, Gough et al. 1979). Many bird species that use barn areas, pastures, manure pits, or carcass disposal areas can directly or indirectly pick-up a disease and transfer it to another farm or to healthy animals at the same farm. In some cases, if carcasses were not disposed of correctly, then scavenging birds, such as vultures and crows, could infect healthy animals through droppings or by the transfer of disease carrying particles on their bodies. Due to the ability of those bird species to move large distances and from one facility to another, farm-to-farm transmission can be an important concern.

Waterfowl, including ducks, geese, and swans, can also be a concern to livestock producers. Fraser and Fraser (2010) provided a review of disease concerns to livestock from Canada Geese, and highlighted 50 bacteria, viral, fungal diseases, and parasites that can infect livestock, including swine, cattle, and poultry. Waterfowl droppings in and around livestock ponds can affect water quality and can be a source of a number of different types of bacteria. The transmission of diseases through drinking water is one of the primary concerns for a safe water supply for livestock. Bacteria levels for livestock depend on the age of the animal because adults may be more tolerant of bacteria than young animals (Mancl 1989). The bacteria guidelines for livestock water supplies are <1000 fecal coliform/100 ml for adult animals and < 1 fecal coliform/100 ml for young animals (Mancl 1989). Salmonella causes shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, salmonella can kill cattle and calves. Additionally, the contamination of feed by waterfowl through droppings in pastures, crops, or harvested grasses can also be a method of disease transmission to livestock (Fraser and Fraser 2010).

Wild and domestic waterfowl, as well as a variety of other bird species, are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2010). Avian influenza (AI) circulates among these birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006). However, the potential for AI to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). Although low pathogenic strains of AI are often found in wild birds (Stallknecht 2003, Pedersen et al. 2010), high pathogenic strains have also been found to exist in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). The ability for wild birds to carry these highly pathogenic strains increases the potential for transmission to domestic poultry facilities, which are highly susceptible to high pathogenic strains of AI (Nettles et al. 1985, Gauthier-Clerc et al. 2007, Pedersen et al. 2010). The potential impacts from a severe outbreak of high pathogenic AI in domestic poultry could be devastating, and possibly cripple the multi-billion dollar industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

Any disease introduction into domestic poultry could have economic impacts that are far-reaching. Some diseases that could affect the poultry industry in Florida and might originate in wild bird species include exotic Newcastle disease, chlamydiosis, high-pathogenic AI, low-pathogenic AI, salmonellosis, and pasteurellosis (Clark and McLean 2003). A single outbreak of high-pathogenic AI in 1984 cost the poultry industry $63 million in destroyed or sick birds and clean-up costs, and the price of poultry food products rose in the six months following the outbreak (Hahn and Clark 2002). When adjusted for inflation, those costs would be the equivalent to nearly $1 billion in 2003 (Clark 2003). Similarly, a low-pathogenic strain of AI virus was isolated in Virginia in March 2002. The control and containment efforts cost $13 million in destruction of flocks, $50 million in paid indemnities, and an overall cost of $129 million to the industry in an effort to minimize the trade impacts (Hahn and Clark 2002). Genetic evidence and documented temporal associations between AI prevalence in wild waterfowl and poultry flocks suggests that wild waterfowl can be a source of infection to poultry (Clark 2003, Clark and Hall 2006). In samples of over 260,000 wild birds, the prevalence of low-pathogenic AI across the United States in 2007 and 2008 was 9.7 and 11%, respectively and the prevalence of high-pathogenic AI in the same years was 0.5 and 0.06%, respectively (Deliberto et al. 2009). The majority of those wild birds were dabbling ducks, geese, swans, and shorebirds (Deliberto et al. 2009).

Newcastle disease is a contagious viral disease that can infect birds, which is caused by the virulent avian paramyxovirus serotype 1. More than 230 species of birds have been determined to be susceptible to natural or experimental infections with avian paramyxoviruses, but in most cases were asymptomatic. In wild birds, the effects appear to vary depending on the species of bird and the virulence of the particular strain of avian paramyxovirus. Newcastle disease can cause high rates of mortality in some bird populations, such as Double-crested Cormorants, but often show little effect on other species (Glaser et al. 1999), although poultry have been found to be highly susceptible (Docherty and Friend 1999, Alexander and Senne 2008). Other species may carry avian paramyxoviruses, including pigeons, which because of their use of agricultural settings and possible interactions with livestock, may pose a risk of transmission (Kommers et al. 2001).

Although birds may be carriers of diseases (vectors) that are transmissible to livestock, the rate that transmission occurs is unknown but is likely to be low. Because 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 because birds are known vectors of many diseases transmittable to livestock.

Certain bird species are also known to prey upon livestock, which can result in economic losses to livestock producers. In Florida, direct damage to livestock occurs primarily from vultures, but can also include raptors. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. During 2010, the NASS reported livestock owners lost 11,900 head of cattle and calves from vultures in the United States valued at $4.6 million (NASS 2011). While both Turkey Vultures and Black Vultures can harass expectant cattle, damages primarily occur from black vultures. Vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported that Black Vultures targeted the eyes and rectal area of vulnerable livestock. During a difficult birth, vultures can harass the mother and peck at the half-expunged calf. This predation behavior often results in serious injury to livestock, which can cause livestock to die from those injuries or require the livestock be euthanized due to the extent of the injuries.

In a study conducted by Milleson et al. (2006), Florida ranchers were surveyed to the extent and severity of cattle losses associated with vultures. Respondents of the survey reported that 82.4% of all livestock lost attributed to vultures were newborn calves, which exceeds the reported predation of all other livestock species and livestock age classes (Milleson et al. 2006). Ranchers reported during the survey period a total loss of 956 calves, 25 yearlings (cattle), and 101 adult cattle with a total value estimated at $316,570 and a mean value lost estimated at $2,595 (Milleson et al. 2006). Predation associated with vultures was reported to occur primarily from November through March, but predation could occur throughout the year (Milleson et al. 2006).

Economic losses can also result from raptors, particularly Red-tailed Hawks, feeding on domestic fowl, such as chickens and waterfowl (Hygnstrom and Craven 1994). Free-ranging fowl or fowl allowed to range outside of confinement 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 and compaction of soil by waterfowl, consumption of cover crops used to prevent erosion and condition soil, damage to fruits associated with feeding, and fecal contamination. In 2012, the sale of fruits, tree nuts, and berries along with vegetables, melons, and potatoes accounted for nearly 42% of the total market value of agricultural commodities in the state. Other crop commodities harvested in 2012 include potatoes, peanuts, hay, cotton, corn, soybeans, wheat, and sugarcane (NASS 2012). Damage to agricultural crops in Florida occurs primarily from European Starlings, American Crows, Red-winged Blackbirds, grackles, cowbirds, parakeets, woodpeckers, and American Robins.

Several studies have shown that European Starlings can pose a great economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, Feare 1984). Starlings and sparrows can also have a detrimental impact on agricultural food production by feeding at vineyards, orchards, gardens, crops, and feedlots (Weber 1979). For example, starlings feed on numerous types of fruits such as, cherries, figs, blueberries, apples, apricots, grapes, nectarines, peaches, plums, persimmons, strawberries, and olives (Weber 1979). Starlings were also found to damage ripening corn (Johnson and Glahn 1994) and are known to feed on the green, milk, and dough stage kernels of sorghum (Weber 1979). Additionally, starlings may pull sprouting grains, especially winter wheat, and feed on planted seed (Johnson and Glahn 1994). Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits, and localized damage can be considerable because sparrows often feed in large flocks on a small area (Fitzwater 1994).

Wildlife damage to apples, grapes, and blueberries has been estimated at $41 million annually, with most of the damage attributed to birds (USDA 1999). Fruit and nut crops can be damaged by crows, robins, Red-winged Blackbirds, grackles, parakeets, cowbirds, and American Crows. In 2012, Florida ranked third in the United States in the production of fruits, tree nuts, and berries with a market value estimated at nearly $2 million (NASS 2012). During 1999, Tillman et al. (2000) estimated that fruit losses caused by birds in three lognan fruit orchards ranged from 4% to 64% representing a production loss of $536 to $18,182 per hectare. Damage to lognan fruit was primarily attributed to Common Grackles and Monk Parakeets (Tillman et al. 2000). The following year, Tillman et al. (2000) estimated damage associated with grackles and Monk Parakeets ranged from 1% to 28% with a loss in production ranging from $259 to $17,623 per hectare. Bird damage was also documented occurring to lychee fruit in Florida (Tillman et al. 2000).

Besser (1985) estimated bird damage to grapes, cherries, and blueberries exceeded $1 million 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 may also cause damage to blueberries (Besser 1985). Damage to blueberries typically occurs from birds plucking and consuming the berry or from knocking the berries from the bushes (Besser 1985). During a survey conducted in 15 states and British Columbia, Avery et al. (1992) found that 84% of respondents to the survey considered bird damage to blueberries to be "*serious*" or "*moderately serious*". Respondents of the survey identified starlings, robins, and grackles as the primary cause of damage (Avery et al. 1992). However, House Finches, crows, Cedar Waxwings, gulls, Northern Mockingbirds, and Blue Jays were also identified as causing damage to blueberries (Avery et al. 1992). Avery et al. (1992) estimated bird damage to blueberry production in the United States cost growers $8.5 million in 1989.

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

Bird damage to sweet corn can also result in economic losses to producers. Damage to sweet corn caused by birds can make the ear of corn unmarketable because the damage is unsightly to the consumer (Besser 1985). Large flocks of Red-winged Blackbirds 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. Birds will puncture the kernel to ingest the contents. Once punctured, the area of the ear damaged often discolors and is susceptible to disease introduction into the ear (Besser 1985). Damage usually begins at the tip of the ear as the husk is ripped and pulled back but can occur anywhere on the ear (Besser 1985).

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985). Damage to sprouting corn occurs primarily from grackles and crows but Red-winged Blackbirds are also known to cause damage to sprouting corn (Stone and Mott 1973). Additionally, starlings may pull sprouting grains and feed on planted seed (Johnson and Glahn 1994). Damage to sprouting corn is likely localized and highest in areas where breeding colonies of grackles exist in close proximity to agricultural fields planted with corn (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 breeding colony of grackles.

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. Canada Geese and other waterfowl can graze a variety of crops, including alfalfa, barley, beans, corn, soybeans, wheat, rye, oats, spinach, and peanuts (Cleary 1994, Atlantic Flyway Council 2011). For example, a single intense grazing event by Canada Geese in fall, winter, or spring can reduce the yield of winter wheat by 16% to 30% (Fledger et al. 1987), and reduce growth of rye plants by more than 40% (Conover 1988). However, some research has reported that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985). Associated costs with agricultural damage involving waterfowl include costs to replant grazed crops, implementing wildlife damage management practices, purchasing replacement food sources, and decreased yields.

Need to Resolve Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.1 can be closely associated with human habitation and often exhibit gregarious roosting or flocking behavior (*i.e*., found together in large numbers), such as vultures, waterfowl, crows, martins, swallows, starlings, House Sparrows, grackles and cowbirds. The close association of those bird species with human activity can pose threats to human safety from disease transmission and threaten the safety of air passengers if birds were struck by aircraft. In addition, excessive droppings can be aesthetically displeasing, accumulations of nesting material can pose a fire risk in buildings and on electrical transmission structures, and aggressive behavior, primarily from waterfowl and raptors, can pose risks to human safety.

Threat of Disease Transmission

Birds can play a role in the transmission of zoonotic diseases (*i.e*., diseases that can be transmitted between humans and animals) (Conover 2002). However, few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to people or domestic animals from transmission of those diseases (Clark and McLean 2003). Study of this issue is complicated by the fact that some disease-causing agents associated with birds may also be contracted from other sources. Although many people are concerned about disease transmission from birds, the probability of contracting a disease indirectly (when no physical contact occurs) is believed to be small. However, direct contact with birds, nesting material, fecal droppings, or the inhalation of fecal particles from accumulations of droppings increases the likelihood of disease transmission.

The gregarious behavior of bird species can lead to accumulations of fecal droppings, which could pose 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 people may come in direct contact with fecal droppings. Fecal droppings in and around water resources can affect water quality and can be a source of a number of different types of pathogens and contaminants. For example, Fleming et al. (2001) reviewed the impacts of Canada Geese on water quality by addressing pathogens and nutrient loading and identified a number of hazards that are associated with geese. Waterbird excrement can contain coliform bacteria, streptococcus bacteria, *Salmonella*, toxic chemicals, and nutrients, which can compromise water quality, depending on the number of birds, the amount of excrement, and the size of the water body. Elevated contaminant levels associated with breeding and/or roosting concentrations of birds and their potential effects on water supplies can be concerns.

Birds may also play a role in the transmission of encephalitis, West Nile virus, psittacosis, and histoplasmosis to people. Birds may play a direct and indirect role in transmission of *E. coli* and *S. enterica* to people through contact with infected livestock feces, watering troughs, and agriculture fields fertilized with manure slurries (Pedersen and Clark 2007). For example, as many as 65 different diseases transmittable to people or domestic animals have been associated with pigeons, European Starlings, and House Sparrows (Weber 1979). Public health officials and residents at such sites express concerns for human health related to the potential for disease transmission where fecal droppings accumulate. 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 people (Weeks and Stickley 1984).

In Florida, crows, blackbirds, and starlings can form large communal roosts of the kind associated with disease organisms, such as *H. capsulatum* (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. For example, two siblings contracted pneumonia in Arkansas during 2011, and additional family members suffered from respiratory disease, after burning bamboo that was harvested from a Red-winged Blackbird roost (Haselow et al. 2014). The children were transferred to a high-level care center and treated with antifungal medicines before they remarkably improved. They remained on antifungal medication for months. *H. capsulatum* remains in the soil and can be contracted several years after a roost is abandoned (Clark and McLean 2003). 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.

Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by people, livestock, and pets that can be associated with accumulations of bird droppings. Waterfowl, herons, and Rock Pigeons are the most commonly infected wild birds in North America (Locke 1987). Pigeons are most commonly associated with the spread of Ornithosis to people. Ornithosis is a virus that is spread through infected bird droppings when viral particles become airborne after infected bird droppings are disturbed.

Waterfowl may affect human health through the distribution and incubation of various pathogens and through nutrient loading. For instance, a foraging Canada Goose defecates between 5.2 and 8.8 times per hour (Bedard and Gauthier 1986). Kear (1963) recorded a maximum fecal deposition rate for Canada Geese of 0.39 pounds per day (dry weight). Public swimming beaches, private ponds, and lakes can be affected by goose droppings. There are several pathogens involving waterfowl that may be contracted by people; however, the Centers for Disease Control and Prevention (CDC) states the risk of infection is likely low (CDC 1998). The primary route of infection would be through incidental contact with contaminated material. Direct contact with fecal matter would not be a likely route of disease unless ingested directly. Although intentional contact with feces is not likely, transmission can occur when people unknowingly contact and ingest contaminated material. Therefore, the risk to human health from waterfowl zoonoses is low and a direct link of transmission from waterfowl to humans can be difficult to determine. Linking the transmission of diseases from waterfowl to people can be especially difficult because many pathogens occur naturally in the environment and pathogens can be attributed to contamination from other sources. However, the presence of disease causing organisms in waterfowl feces can increase the risk of exposure and transmission of zoonoses wherever people may encounter large accumulations of feces from waterfowl. Fleming et al. (2001) reviewed the impacts of Canada Geese on water quality by addressing pathogens and nutrient loading and identified a number of hazards that are associated with geese.

Cryptosporidium and *Giardia* are intestinal parasites that infect a wide range of vertebrate hosts, including birds. In people, those organisms can cause persistent diarrhea for 1 to 3 weeks. One of the most common modes of transmission of those parasites is consumption of feces-contaminated water. It is estimated that 80 to 96% of surface waters in the United States are contaminated with *Cryptosporidium* and *Giardia* (Hansen and Ongerth 1991, Moore et al. 1994). Kuhn et al. (2002) found that cryptosporidium was present in 49% and giardia in 29% of wild duck species. Graczyk et al. (1998) found cysts of both parasites in Canada Geese from Maryland. With increases in waterfowl populations and their use of drinking water reservoirs there is an increased potential for contamination from these parasites and therefore an increased human health risk due to the ability of the cysts to survive most water treatment programs (Brown et al. 1999).

Cryptosporidiosis is an illness caused by *Cryptosporidium* spp. Many species of *Cryptosporidium* can infect people and animals. A person can be infected by drinking contaminated water or by direct contact with the fecal material of infected animals (CDC 2015). Exposure can occur from swimming in lakes, ponds, streams, and pools, and from swallowing water while swimming (Colley 1995, CDC 2015). *Cryptosporidium* can cause gastrointestinal disorders (CDC 2015) and can produce life-threatening infections, especially in people with compromised or suppressed immune systems (Roffe 1987, Graczyk et al. 1998). Cryptosporidiosis has been recognized as a disease with implications for human health (Smith et al. 1997). Canada Geese in Maryland were shown with molecular techniques to disseminate infectious *C. parvum* oocysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) found that *Cryptosporidium* was the most common infectious organism found in 77.8% of sample sites comprised primarily of parks and golf courses indicating that occupational exposure to this pathogen is very plausible although the risk to humans is relatively low.

Giardiasis (*Giardia lambia*) is an illness caused by a microscopic parasite that has become recognized as one of the most common causes of waterborne disease in humans in the United States during the last 15 years (CDC 2012). Giardiasis is contracted by swallowing contaminated water or putting anything in your mouth that has touched the fecal matter of an infected animal or person. Symptoms of giardiasis include diarrhea, cramps, and nausea (CDC 2012). Canada Geese in Maryland were shown with molecular techniques to disseminate infectious *Giardia* spp. cysts in the environment (Graczyk et al. 1998). Kassa et al. (2001) also found *Giardia* in goose feces at numerous urban sites.

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, but it can also affect Canada Geese. Avian botulism is the most common disease of waterfowl. Increased numbers of Canada Geese using recreational areas increases the risk to the public (McLean 2003).

Salmonella (*Salmonella* spp.) may be contracted by people from handling materials soiled with bird feces (Stroud and Friend 1987). Several types of the Salmonella bacteria are carried by wild birds with varying degrees of impact on people and livestock. Salmonella has been isolated from the gastrointestinal tract of starlings (Carlson et al. 2011*b*). Friend and Franson (1999) reported relative rates of detection of *Salmonella* spp. in free ranging birds. *Salmonella* spp. isolates were frequent in songbirds, common in doves and pigeons, occasional in starlings, blackbirds and cowbirds, and infrequent in crows. Salmonella causes gastrointestinal illness, including diarrhea. 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*.

Chlamydiosis (*Chalmydiosis psitticai*) is a common infection in birds. However, when it infects people, the disease is referred to as psitticosis and can be transmitted to people via a variety of birds (Bonner et al. 2004). Canada Geese can transmit this disease to people and the agent is viable in goose eggs (Bonner et al. 2004). Severe cases of chlamydiosis have occurred among people handling waterfowl, pigeons, and other birds (Wobeser and Brand 1982, Locke 1987). Infected birds shed the bacteria through feces and nasal discharge (Locke 1987). Chlamydiosis can be fatal to humans if not treated with antibiotics. Humans normally manifest infection by pneumonia (Johnston et al. 2000). However, unless people are working with Canada Geese or involved in the removal or cleaning of bird feces, the risk of infection is quite low (Bradshaw and Trainer 1966, Palmer and Trainer 1969). Waterfowl, herons, and Rock Pigeons are the most commonly infected wild birds in North America (Locke 1987).

Campylobacteriosis is an infectious disease caused by bacteria of the genus *Campylobacter*. *Campylobacter jejuni* is a bacterium usually associated with food-borne pathogens (Center for Food Safety and Applied Nutrition 2012). Findings have demonstrated that geese can be important carriers of *C. jejuni* (Pacha et al. 1988, Fallacara et al. 2004, Rutledge et al. 2013). French et al. (2009) examined *Campylobacter* occurrence at playgrounds and found that 6% of dry and 12% of fresh feces contained this bacteria, indicating that there is a risk of transmission to young children, a population with higher than average susceptibility. In the mid-Atlantic, Keller et al. (2011) found *Campylobacter* in multiple bird species, with gulls and crows having prevalence rates over 20%. Although it is unknown what role that wild birds play in the transmission of this bacterium, its presence in bird species, especially geese, crows, and gull species, which all have increased contact with people, increases the potential for transmission. In persons with compromised immune systems, *Campylobacter* occasionally spreads to the bloodstream and causes a serious life-threatening infection, but normally causes diarrhea and is one of the most common diarrhea illnesses in the United States (CDC 2014). Canada Geese have been found to be a carrier of *Campylobacter* and can spread the bacteria in their feces (Kassa et al. 2001).

E. coli are fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *E. coli* with the majority of serological types being harmless (Sterritt and Lester 1988). The serological type of *E. coli* that is best known is *E. coli* O157:H7, which is usually associated with cattle (Gallien and Hartung 1994). Recent research has demonstrated that Canada Geese can disseminate *E. coli* into the environment, which can elevate fecal coliform densities in the water column (Hussong et al. 1979, Alderisio and DeLuca 1999, Cole et al. 2005). Many communities monitor water quality at swimming beaches and lakes, but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, the beaches are often temporarily closed, which can adversely affect the enjoyment of those areas by the public, even though the serological type of the *E. coli* is unknown.

Unfortunately, linking the elevated bacterial counts to the frequency of waterfowl use and attributing the elevated levels to human health threats has been problematic until recently. Advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific animal species and link those animal sources of coliform bacteria to fecal contamination (Simmons et al. 1995, Jamieson 1998). For example, Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998, Alderisio and DeLuca 1999). In addition, fecal coliform bacteria counts coincided with the number of Canada Geese and gulls roosting at the reservoir. Cole et al. (2005) found that geese might serve as a vector of antimicrobial resistance genes, indicating that they not only harbor and spread zoonotic diseases like *E. coli* but also may spread strains that are resistant to current control measures. Financial costs related to human health threats involving birds may include testing of water for coliform bacteria, cleaning and sanitizing beaches regularly of feces, contacting and obtaining assistance from public health officials, and implementing non-lethal and lethal methods of wildlife damage management.

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

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, Quessey and Messier 1992). Transmission of bacteria from gulls to humans is difficult to document; however, Reilly 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*., see 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, pigeons, starlings, and House Sparrows 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, starlings, pigeons, and House Sparrows feeding on vegetable crops and livestock feed can potentially aid in the transmission of salmonella.

Wild and domestic waterfowl are the acknowledged natural reservoirs for a variety of AI viruses (Davidson and Nettles 1997, Pedersen et al. 2010). However, AI viruses can be found amongst a variety of other bird species (Alexander 2000, Stallknecht 2003). AI can circulate among those birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006). However, the potential for avian influenza to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). The most common strains of avian influenza found in wild birds are low pathogenic strains (Stallknecht 2003, Pedersen et al. 2010), but high pathogenic strains have also been found to exist in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). Although AI is primarily a disease of birds, there can be concerns over the spread of the H5N1 highly pathogenic strain that has shown transmission potential to humans with potential for mortalities (Gauthier-Clerc et al. 2007, Peiris et al. 2007, Majumdar et al. 2011). Outbreaks of other avian influenza strains have also shown the potential to be transmissible to people during severe outbreaks when people handle infected poultry (Koopmans et al. 2004, Tweed et al. 2004). A pandemic outbreak of avian influenza could have impacts on human health and economies (World Health Organization 2005, Peiris et al. 2007).

While transmission of diseases or parasites from birds to people has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Hatch 1996, Graczyk et al. 1997, Saltoun et al. 2000, Kassa et al. 2001). In some cases, infections may even be life threatening for people with suppressed or compromised immune systems (Roffe 1987, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting a disease from feces is believed to be small. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Several of the bird species addressed in this EA are closely associated with the activities of people and they often exhibit gregarious roosting and nesting behavior. This gregarious behavior can lead to accumulations of fecal droppings that could be considered a threat to human health and safety due to the close association of those species of birds with people. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where people may come in direct contact with fecal 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, the risk of disease transmission would be the primary reason people request assistance. 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 to Human Safety associated with 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. Bird strikes can cause catastrophic failure of aircraft systems (*e.g.*, ingesting birds into engines), which can cause the plane to become uncontrollable leading to crashes. 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. 2004). However, it is more common for wildlife-aircraft strikes to result in expensive repairs, flight delays, or aborted aircraft movements than in injury or loss of human life.

While bird strikes that result in human fatalities are rare, the consequences can be catastrophic. The worst strike on record for loss of human lives in the United States occurred in Boston during 1960 when 62 people were killed in the crash of an airliner that collided with a flock of European starlings (Terres 1980, Dolbeer and Wright 2008). In 1995, 24 lives were lost when a military aircraft struck a flock of Canada geese at Elmendorf, Alaska. In addition, a $190 million plane was lost (Dolbeer 1997). 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). Between 1990 and 2015, 25 human fatalities have occurred after aircraft struck birds in the United States (Dolbeer et al. 2016). Of those 25 fatalities involving bird strikes, 8 fatalities occurred after striking birds that were not identified, 8 fatalities occurred after strikes involving Red-tailed Hawks, 5 fatalities occurred after striking American White Pelican, 2 fatalities occurred from Canada Goose strikes, and fatality each occurred from Turkey Vultures and Brown Pelicans (Dolbeer et al. 2016). Since 1988, wildlife strikes have killed more than 262 people and destroyed over 247 aircraft globally (Dolbeer et al. 2016).

Injuries can also occur to pilots and passengers from bird strikes. Between 1990 and 2015, 229 bird strikes involving civil aircraft have caused 400 injuries to people in the United States, including strikes with vultures, waterfowl, gulls, raptors, egrets, pigeons, robins, doves, blackbirds, sparrows, and owls (Dolbeer et al. 2016). Between 1990 and 2015, 53 strikes involving waterfowl have resulted in injuries to 159 people, while 34 strikes involving vultures resulted in injuries to 42 people (Dolbeer et al. 2016).

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 people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension can occur, which can lead those species to exhibit threatening or abnormal behavior toward people. This behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can occur 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. Canada Geese aggressively defend their nests, nesting areas, and young, and may attack or threaten pets, children, and adults (Smith et al. 1999). This can be a threat because resident Canada Geese and feral waterfowl often nest in high densities in areas used by people for recreational purposes, such as 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 waterfowl on docks, walkways, and other areas of foot traffic. If fecal droppings occur in areas with foot traffic, slipping could occur resulting in injuries to people. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

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 aggressively defend their nests, nesting areas, and young, and may attack or threaten pets, children, and adults. In April 2012, a man drowned in Des Plains, Illinois when he was attacked by a Mute Swan that knocked him out of his kayak (Golab 2012).

Human safety concerns due to Monk Parakeets nesting on electrical utility poles and transmission structures also exist. Those concerns include the possible loss of power to critical care facilities, risk of injury to maintenance crews, and increased incentives to and risks of trespassing. Because of the trade in Monk Parakeets in the pet industry, it is common for people to trap Monk Parakeets and to sell them to pet shops and other individuals. Wild caught Monk Parakeets can be sold to pet owners and a number of electrocutions have occurred to individuals who have trespassed and climbed into substations to trap Monk Parakeets (Newman et al. 2004).

Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.1 and Appendix E, all of the bird species addressed in this EA can cause damage to property in Florida. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property can occur through direct damage to structures, through roosting behavior, and through their nesting activities. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. Woodpeckers can also cause direct damage to property when they excavate holes in buildings either for nesting purposes, attracting a mate, or to locate food, which can remove insulation and allows water and other wildlife to enter the building (Marsh 1994). 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.

Property Damage to Aircraft from Bird Strikes

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). Wildlife strikes pose increasing risks and economic losses to the aviation industry worldwide. Annual economic losses from wildlife strikes with civil aircraft are conservatively estimated to exceed $1.2 billion worldwide (Allan 2002). Direct costs include damage to aircraft, aircraft downtime, and medical expenses of injured personnel and passengers. Indirect costs can include lost revenue from the flight, cost of housing delayed passengers, rescheduling aircraft, and flight cancellations.

From 1990 to 2015, Federal Aviation Administration (FAA) records indicate total reported losses from bird strikes cost the civil aviation industry over $666 million in monetary losses and 632,361 hours of aircraft downtime (Dolbeer et al. 2016). These figures may be an underestimate of total damage because the number of actual bird strikes is likely to be much greater than that reported. An estimated 80% of civil bird strikes may go unreported (Linnell et al. 1999, Wright and Dolbeer 2005). Between 2004 and 2008, Dolbeer (2009) estimated the FAA received reports on only 39% of the actual aircraft strikes; therefore, 61% of aircraft strikes went unreported. However, Dolbeer et al. (2016) estimated that nearly 91% of civil wildlife strikes are now being reported. Not all reports provide notation as to whether or not there was damage and some strike reports to the FAA that indicate there was an adverse impact on the aircraft from the strike do not include a monetary estimate of the damage caused. Additionally, most reports indicating damage to aircraft report direct damages and do not include indirect damage, such as lost revenue, cost of putting passengers in hotels, rescheduling aircraft, and flight cancellations. Dolbeer et al. (2014) estimated that the actual annual costs to the United States civil aviation industry from wildlife strikes to be over 588,699 hours of aircraft downtime and $937 million in losses.

Birds can present a safety threat to aviation when those species occur in areas on and around airports. Species of birds that occur in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on airport property can result in aircraft strikes involving several individuals of a bird species, which can increase damage and increase the risks of catastrophic failure of the aircraft. A high percentage of bird strikes occur during peak migration periods, but dangerous situations can develop during any season. Aircraft are most vulnerable to bird strikes while at low altitudes, generally related to landing and taking off. From 1990 through 2015, approximately 73% 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. 2016).

From January 1990 through August 2016, the FAA (2017) has reports of aircraft striking up to 10,993 birds in Florida. In Florida, over 96% of the reported aircraft strikes from January 1990 through August 2016 involved birds (FAA 2017). Aircraft in Florida have struck at least 127 species of birds (FAA 2017).

DeVault et al. (2011) concluded that Snow Geese (*Anser caerulescens*), duck species, Canada Geese, Turkey Vultures, Double-crested Cormorants, Brown Pelicans, Sandhill Cranes (*Antigone canadensis*), and Wild Turkeys were among the top ten most hazardous birds to aircraft. Those hazards were based upon the number of strikes involving those birds, the amount of damage strikes involving those birds have caused to aircraft, the effect on the flight after the strike, and the body mass the bird (DeVault et al. 2011). Dolbeer et al. (2016) found the most common bird species involved in strikes reported to the FAA (when identification of the bird species occurred) from 1990 to 2015 were pigeons/doves (14%), followed by raptors (13%), gulls (12%), shorebirds (9%), and waterfowl (6%). Waterfowl were responsible for 29% of the damage occurring in which the bird type was identified (Dolbeer et al. 2016). When struck, 25% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight while 62% of the reported waterfowl strikes resulted in damage or negative effects on the flight compared to 40% of strikes involving raptors/vultures and 9% of strikes involving pigeons and doves (Dolbeer et al. 2015).

Since 1990, over $243 million in damage and economic losses to civil aircraft have been reported from strikes involving waterfowl (Dolbeer et al. 2016). Nearly 1,600 aircraft strikes have occurred in the United States since 1990 that involved Canada Geese with over $127 million in damages and economic losses to aircraft reported from those strikes (Dolbeer et al. 2016). Aircraft strikes involving herons, bitterns, and egrets have resulted in nearly $15 million in damages to aircraft (Dolbeer et al. 2016). In total, aircraft strikes involving birds has resulted in over $600 million in reported damages and economic losses to civil aircraft since 1990 in the United States (Dolbeer et al. 2016). Nationally, the resident Canada Goose population probably represents the single most serious bird threat to aircraft safety (Alge 1999, Seubert and Dolbeer 2004, Dolbeer and Seubert 2006).

Resident Canada Geese are of particular concern to aviation because of their large size (typically 8 to 15 pounds, which exceeds the four pound bird certification standard for engines and airframes); flocking behavior (which increases the likelihood of multiple bird strikes); attraction to airports for grazing; and year-around presence in urban environments near airports (Seubert and Dolbeer 2004). From 1990 through 2015, there were 1,584 reported strikes involving Canada Geese in the United States, including Florida, resulting in over $127 million in damage and associated costs to civil aircraft (Dolbeer et al. 2016). The threat that Canada Geese pose to aircraft safety was dramatically demonstrated in January 2009 when United States Airways Flight 1549 made an emergency landing in the Hudson River after ingesting multiple Canada Geese into both engines shortly after takeoff from New York's LaGuardia Airport (Wright 2014, Dolbeer et al. 2015). Although the aircraft was destroyed after sinking in the river, all 150 passengers and 5 crewmembers survived (Wright 2014). In addition to civil aviation, the United States Air Force (USAF) reports that Canada Geese have caused over $90 million in damage to aircraft (USAF 2016).

Raptors, as well as vultures, present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Of the total known birds struck in the United States from 1990 through 2015, raptors accounted for 13% of reported strikes and 21% of the damage (Dolbeer et al. 2016). Aircraft have struck numerous raptors and vultures in the state from January 1990 through August 2016, including American Kestrels, Bald Eagles, Northern Harriers, Osprey, Red-shouldered Hawks, Cooper's Hawks, Red-tailed Hawks, Sharp-shinned Hawk, Broad-winged Hawks, Peregrine Falcons, Mississippi Kites, Swallow-tailed Kites, Barred Owls, Black Vultures, and Turkey Vultures (FAA 2017). Raptors and vultures have a large body size making them capable of causing substantial damage to aircraft. Vultures are one of the most hazardous bird groups for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (DeVault et al. 2011, Dolbeer et al. 2016).

Starlings and blackbirds, when in large flocks or flight lines entering or exiting a winter roost at or near airports, present a safety threat to aviation. Starlings and blackbirds are particularly dangerous birds to aircraft during take-offs and landings because of their high body density and tendency to travel in large flocks of hundreds to thousands of birds (Seamans et al. 1995). Mourning Doves also present similar 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 increase the risks of bird-aircraft collisions. Gulls also present a strike risk to aircraft and are responsible for most of the damaging strikes reported in coastal areas. From January 1990 through August 2016, there have been 816 reports of aircraft striking gulls at airports in Florida (FAA 2017).

Other Property Damage Associated with Birds

Damage to property can occur from accumulations of droppings and feather debris associated with large concentrations of birds, such as blackbirds, cormorants, crows, gulls, pigeons, swallows, vultures, and waterfowl. Although damage and threats can occur throughout the year, damage can be 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 nest, roost, and/or loaf in the same areas often leave large accumulations of droppings and feather debris, which can be 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.

Canada Geese and other waterfowl species may cause damage to aircraft, landscaping, piers, yards, boats, beaches, shorelines, parks, golf courses, driveways, athletic fields, ponds, lakes, rafts, porches, patios, gardens, footpaths, swimming pools, playgrounds, school grounds, and cemeteries (Conover and Chasko 1985, Conover 1991, Atlantic Flyway Council 1999, Atlantic Flyway Council 2011, Cummings 2016). The presence of high numbers of waterfowl can cause damage by grazing on turf and by depositing fecal droppings. Economic damage can occur from the need to cleanup parking lots, public use areas, sidewalks, patios, and lawns at business, residential, and recreational locations. For example, costs can be associated with restoration of greens and other turf areas, cleanup of human use areas, and lost revenue from the loss of memberships at a golf course. Members and the club's management can also be concerned about the possible health hazards from exposure to fecal droppings. The accumulation of fecal matter from birds can also negatively affect landscaping and walkways, often at golf courses and water front property (Conover and Chasko 1985). 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).

Fecal droppings and the overgrazing of vegetation can be aesthetically displeasing (*e.g*. see Fitzwater 1994, Gorenzel and Salmon 1994, Johnson 1994, Johnson and Glahn 1994, Williams and Corrigan 1994). 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 geese, loss of customers or visitors irritated by walking in fecal droppings, repair of golf greens, and replacing grazed turf. The reoccurring presence of fecal droppings can lead to constant cleaning costs for property owners.

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 (Johnson and Glahn 1994). Electrical utility companies may have problems with birds and bird droppings causing power outages by shorting out transformers and substations. This can result in outage time for power companies and consumers. Damage can also occur from droppings entering into food items or contaminating surfaces used to prepare food items at manufacturing facilities and can introduce undesirable components into the materials used in manufacturing processes.

In addition to damage caused by the accumulation of droppings, damage can also occur in other ways. Electrical utility companies frequently have problems with birds and bird droppings causing power outages by shorting out transformers and substations. 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.

When gulls, European Starlings, House Sparrows, raptors, Rock Pigeons, swallows and other birds nest on or in buildings or other structures they transport large amounts of nest material and food debris to the area. Many bird species are colonial nesters meaning they nest together in large numbers. Many of the gull, egret, and heron species addressed in this EA nest in large colonies. Swallows can also nest in large colonies. For example, rooftop colonies of nesting gulls can 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 rooftops, 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).

Pigeons, starlings, and sparrows can cause economic damage to aircraft in hangars. Accumulations of fecal droppings on planes, helicopters, maintenance equipment, and hangar floors result in unscheduled maintenance to clean planes and buildings to protect painted surfaces from acidic fecal droppings and maintain a sanitary work environment. Furthermore, birds may build nests in engines of idle aircraft, which may cause engine damage or cause a fire.

Nesting material and feathers can also clog ventilation systems or fall onto or into equipment or goods (Gorenzel and Salmon 1994, Hygnstrom and Craven 1994). Electrical utility companies frequently have problems with bird nests causing power outages when they short out transformers and substations (Avery et al. 2002*a*, USGS 2005, Pruett-Jones et al. 2007). Nesting material can also create a fire hazard (Fitzwater 1994). Additionally, because the active nests of most species are protected under the MBTA, problems arise when birds nest in areas where new construction or maintenance is scheduled to occur (Coates et al. 2012).

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 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).

Monk Parakeets build large colonial nests from sticks in trees and on utility poles. Monk Parakeet nests can cause equipment damage, result in lost revenue from nest and bird caused power outages, increase operation and maintenance costs associated with nest removal and repair of damaged structures, and result in public safety concerns. Monk Parakeets nests can attract predators (including people) that also can cause outages. Problems with nesting on utility structures have been reported in Rhode Island, New York, New Jersey, Colorado, Florida, and Texas (Buhler et al. 2001, Nehls 2002, Newman et al. 2004). If their nests are built on light or electrical utility poles, the bulbs or transformers can overheat, causing fires and blackouts. The weight of a nest can cause its support, such as a tree or man-made structure, to collapse (Stafford 2003). For example, for a five-month period in 2001, 198 electrical outages related to Monk Parakeets were logged, which affected over 10,000 customers in two counties in South Florida (Newman et al. 2004). The frequency of outages increases during wet weather. These outages result from nesting material completing an electric circuit between two energized parts or an energized part and a grounded part of electrical equipment. In some cases, the nests get too large and complete an electric circuit. In other cases, individual parakeets can bring nesting materials that can result in completing a circuit. Fires can start in the nesting material causing damage to transformers and other utility equipment (Newman et al. 2004). Monk Parakeet nests, in their native range, can grow up to over 200 chambers, with some weighing up to 1,180 kg (2,600 lbs) (Burgio 2012). These nests can result in damage to ornamental trees when they become too heavy to support or because of increased susceptibility to wind damage resulting in broken branches. Falling nests can damage buildings, automobiles, and other property.

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

Other examples of property damage include Black Vultures tearing and consuming latex window caulking or rubber gaskets sealing windowpanes, 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. Birds, including wild turkeys, can also cause damage to windows, siding, vehicles, and other property when they mistake their reflection as another bird and attack the image. Additionally, woodpeckers also cause direct damage to property when they chisel holes in the wooden siding, eves, or trim of buildings (Evans et al. 1984, Marsh 1994). Woodpeckers can remove insulation from buildings, which can allow water and other wildlife to enter the building.

Need to Resolve Bird Damage Occurring to Natural Resources

Birds can also negatively affect natural resources through habitat degradation, competition with other wildlife, and through direct depredation on natural resources. Habitat degradation can occur when large concentrations of birds in a localized area negatively affect characteristics of the surrounding habitat, which 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.

For example, brood parasitism by Brown-headed Cowbirds has become a concern for many wildlife professionals where those birds are plentiful. Somewhat unique in their breeding habits, Brown-headed Cowbirds are known as brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds (Lowther 1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species. Young cowbirds often out-compete the young of the host species (Lowther 1993). Due to this, Brown-headed Cowbirds can have adverse effects on the reproductive success of other species (Lowther 1993) and can threaten the viability of a population or even the survival of a host species (Trail and Baptista 1993).

European Starlings and House Sparrows can be aggressive and often out-compete native species, destroying their eggs, and killing nestlings (Cabe 1993, Lowther and Cink 2006). Miller (1975) and Barnes (1991) reported European Starlings were responsible for a severe depletion of the Eastern Bluebird (*Sialia sialis*) population due to nest competition. Nest competition by European Starlings have been known to displace American Kestrels (Von Jarchow 1943, Nickell 1967, Wilmer 1987, Bechard and Bechard 1996), Red-bellied Woodpeckers (*Melanerpes carolinus*), Gila Woodpeckers (*Melanerpes uropygialis*) (Kerpez and Smith 1990, Ingold 1994), Northern Flickers (*Colaptes auratus*), Purple Martins (Allen and Nice 1952), and Wood Ducks (*Aix sponsa*) (Shake 1967, McGilvery and Uhler 1971, Grabill 1977, Heusmann et al. 1977). Weitzel (1988) reported nine native species of birds in Nevada had been displaced by starling nest competition, and Mason et al. (1972) reported European Starlings evicting bats from nest holes.

Crows and gulls will consume a variety of food items, including the eggs and chicks of other birds (Good 1998, Verbeek and Caffrey 2002, Pollet et al. 2012, Burger 2015, Nisbet et al. 2017). Those species in particular are among the most frequently reported avian predator of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). Predation is a naturally occurring event but can become a management concern when predation occurs on species experiencing severe population declines or during the restoration of waterbird breeding sites (Hunter et al. 2006). Fish eating birds, such as cormorants, egrets, herons, and osprey, also have the potential to impact fish and amphibian populations, especially those of T&E species. Impacts on the productivity and survivorship of rare or threatened wildlife can be severe when they become targets of avian predators. Some of the species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA) are preyed upon or otherwise could be adversely affected by certain bird species.

For example, Herring Gulls and Great Black-backed Gulls are aggressive predators on many species (Guillemette and Brousseau 2001, Hunter et al. 2006), including being major predators of tern, skimmers, and oystercatchers (Hunter et al. 2006). Studies conducted in Virginia found Herring Gulls and Great Black-backed Gulls to be efficient predators on tern and Black Skimmer (*Rynchops niger*) eggs, chicks, and fledglings (Becker 1995, O'Connell and Beck 2003). Fledgling success rates for Common Terns (*Sterna hirundo*) ranged from zero to 19% when nesting adjacent to a Herring Gull colony because gulls preyed on 44% to 94% of the chicks (Becker 1995). In another study, Herring Gulls preyed on 61% to 66% of Common Tern chicks in a colony (O'Connell and Beck 2003). Common Grackles, Red-winged Blackbirds, Northern Harriers, and American Kestrels are also known to feed on nesting colonial water birds and shorebirds, their chicks and/or eggs (Hunter and Morris 1976, Farraway et al. 1986, Rimmer and Deblinger 1990, Ivan and Murphy 2005, United States Army Corps of Engineers 2009).

Colonial nesting species can also compete with other bird species for nest sites. For example, gulls and cormorants can displace other colonial nesting birds (Gochfeld and Burger 1994, Hunter et al. 2006). Kress et al. (1983) found that efforts to remove Herring Gulls and Great Black-backed Gulls in the northeastern United States were successful in restoring tern nesting sites and increasing productivity at active tern nesting sites. The Southeastern United States Regional Waterbird Conservation Plan stated that Herring Gulls and Great Black-backed Gulls "*...have increased dramatically in the Southeast U.S. and* [Herring Gulls and Great Black-backed Gulls] *are considered to be important predators on other coastal nesting waterbirds*..." (Hunter et al 2006).

Additionally, degradation of vegetation due to the presence of colonial nesting birds can reduce nesting habitat for other birds (Jarvie et al. 1997, Shieldcastle and Martin 1999) and wildlife, including T&E species (Korfanty et al. 1999). In some cases, the establishment of colonial waterbird nesting colonies on islands has led to the complete denuding of vegetation within three to 10 years of areas being occupied (Lewis 1929, Lemmon et al. 1994, Weseloh and Ewins 1994, Bédard et al. 1995, Weseloh and Collier 1995, Weseloh et al. 1995, Korfanty et al. 1999, Hebert et al. 2005). Cormorants can have a negative effect on vegetation that provides nesting habitat for other birds (Jarvie et al. 1997, Shieldcastle and Martin 1999) and wildlife, including state and federally listed T&E species (Korfanty et al. 1999). Hebert et al. (2005) noted that ammonium toxicity caused by an accumulation of fecal droppings from Double-crested Cormorants might be an important factor contributing to the declining presence of vegetation on some islands in the Great Lakes. 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.

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 effect on many species, some colonial waterbirds such as pelicans and terns prefer sparsely vegetated substrates.

Damage to vegetation can also occur when birds strip leaves for nesting material or when the weight of many nests, especially those of colonial nesting waterbirds breaks branches (Weseloh and Ewins 1994). In some cases, those effects can be so severe on islands that all woody vegetation is eliminated, which can leave those islands completely denuded of vegetation (Cuthbert et al. 2002). Lewis (1929) considered the killing of trees by nesting cormorants to be 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, Dorr et al. 2014).

Degradation of habitat can also occur when large concentrations of Canada Geese remove shoreline vegetation resulting in erosion (Atlantic Flyway Council 2011). Severe grazing can result in the loss of turf that stabilizes soil on manmade levees. Heavy rains on the bare soil of levees can result in erosion, which would not have occurred if the levee had been vegetated. 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 may affect water quality around beaches and in wetlands by acting as nonpoint source pollution. For example, nutrient loading has been found to increase in wetlands in proportion to increases in the numbers of roosting geese (Manny et al. 1994, Kitchell et al. 1999). In studying the relationship between bird density and phosphorus and nitrogen levels in Bosque Del Apache National Wildlife Refuge in New Mexico, Kitchell et al. (1999) found an increase in the concentration of both phosphorus and nitrogen correlated with an increase in bird density. 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; therefore, the phosphorus from fecal droppings was considered a form of internal loading. Waterfowl can contribute substantial amounts of phosphorus and nitrogen into lakes through feces, which can cause excessive aquatic macrophyte growth and algae blooms (Scherer et al. 1995) and accelerated eutrophication through nutrient loading (Harris et al. 1981).

Canada Geese and other waterfowl can be attracted to waste water treatment plants because of the water and available vegetation. Sewage treatment plants are often required to test water quality of effluents before release from finishing ponds into the environment. Coliform bacteria causes acidic pH levels in the water and lowers dissolved oxygen, which can kill aquatic organisms (Cagle 1998). In addition, fecal contamination increases nitrogen levels in the pond resulting in algae blooms. Oxygen levels are depleted when the algae dies resulting in the death of aquatic invertebrates and vertebrates.

Birds can carry a wide range of bacterial, viral, fungal, and protozoan diseases that can affect other bird species, as well as mammals. A variety of diseases that birds can carry can affect natural resources (*e.g.*, see Friend and Franson 1999, Forrester and Spalding 2003, Thomas et al. 2007). Potential impacts from diseases found in wild birds may include transmission to a single individual or a local population, transmission to a new habitat, and transmission to other species of wildlife including birds, mammals, reptiles, amphibians, and fish species. Birds may also act as a vector, reservoir, or intermediate host as it relates to diseases and parasites. Diseases like avian botulism, avian cholera, and Newcastle disease can account for the death of hundreds to thousands of bird species across the natural landscape (Friend et al. 2001). For example, an avian botulism outbreak in Lake Erie was responsible for a mass die-off of Common Loons (*Gavia immer*) (Campbell et al. 2001) as well as other species that may have fed on the carcasses or on fly larva associated with the carcasses (Duncan and Jensen 1976). Although diseases spread through populations of birds, it is often difficult to determine the potential impacts they will have on other wildlife species due to the range of variables that are involved in a disease outbreak (Friend et al. 2001).

As the population of Double-crested Cormorants has increased, so has concern for sport fishery populations. Cormorants may have a negative effect on recreational fishing on a localized level. Recreational fishing benefits local and regional economies in many areas of the United States, with some local economies relying heavily on income associated with recreational fisheries. The collapse of sport fisheries can have negative economic impacts on businesses and can result in job losses (Shwiff and DeVault 2009). For example, when the walleye (*Sander vitreus*) and yellow perch (*Perca flavescens*) fishery collapsed on Oneida Lake in New York after the colonization of the lake by cormorants (VanDeValk et al. 2002, Rudstam et al. 2004), research biologists with the National Wildlife Research Center (NWRC) sought to identify the actual monetary damage associated with the declines of those sport fish populations. The total estimated revenue lost in the Oneida Lake region from 1990 to 2005 due to declines in the sport fisheries on the lake ranged from $122 million to $539 million. That lost revenue from the collapse of the fisheries resource resulted in the loss of 3,284 to 12,862 jobs in the Oneida Lake region from 1990 to 2005 (Shwiff and DeVault 2009). In 1998, the WS program in New York was requested to assist with managing damage associated with cormorants on Oneida Lake. Cormorant damage management activities conducted on Oneida Lake from 1998 to 2005 prevented the loss of an estimated $48 million to $171 million in revenue, which allowed between 1,446 and 5,014 jobs to be retained in the Oneida Lake region (Shwiff and DeVault 2009).

The degree to which cormorant predation affects sport fishery populations in a given body of water is dependent on a number of variables, including the number of birds present, the time of year at which predation is occurring, prey species composition, and physical characteristics such as depth or proximity to shore (which affect prey accessibility). In addition to cormorant predation, environmental and human-induced factors affect aquatic ecosystems. Those factors can be classified as biological/biotic (*e.g.*, overexploitation, exotic species), chemical (*e.g.*, water quality, nutrient and contaminant loading), or physical/abiotic (*e.g.*, dredging, dam construction, hydropower operation, siltation). Such activities may lead to changes in species density, diversity, and/or composition due to direct effects on year class strength, recruitment, spawning success, spawning or nursery habitat, and/or competition (USFWS 1995).

1.3 NATIONAL ENVIRONMENTAL POLICY ACT AND WS' DECISION-MAKING

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.), including the actions of WS[7]. The NEPA sets forth the requirement that all federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. In part, the Council of Environmental Quality (CEQ) regulates federal activities affecting the physical and biological environment through regulations in 40 CFR 1500-1508. The NEPA and the CEQ guidelines generally outline five broad types of activities that a federal agency must accomplish as part of projects they conduct. Those five types of activities are public involvement, analysis, documentation, implementation, and monitoring.

Pursuant to the NEPA and the CEQ regulations, WS is preparing this EA[8] to document the analyses associated with proposed federal actions and to inform decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse effects. This EA will serve as a decision-aiding mechanism to ensure that WS infuses the policies and goals of the NEPA and the CEQ into the actions of the WS program in Florida. This EA will also aid WS with clearly communicating the analysis of individual and cumulative impacts of proposed activities to the public. In addition, the EA will facilitate planning, promote interagency coordination, and streamline program management analyses between WS, the USFWS, and the FWC[9].

Individual wildlife damage management projects conducted by the WS program could be categorically excluded from further analysis under the NEPA, in accordance with APHIS implementing regulations for the NEPA (7 CFR 372.5(c), 60 FR 6000-6003). However, the purpose of this EA is to evaluate cumulatively the individual projects that WS could conduct to manage the damage and threats that birds cause. More specifically, the EA will assist WS with determining if alternative approaches to managing bird damage could potentially have significant individual and/or cumulative effects on the quality of the human environment that would warrant the preparation of an Environmental Impact Statement (EIS)[10] in compliance with the NEPA and CEQ regulations.

1.4 DECISIONS THAT THE WS PROGRAM MUST MAKE

Management of migratory birds is the responsibility of the USFWS. As the authority for the overall management of migratory bird populations, the USFWS was involved in the development of the EA and

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[7]The WS program follows the CEQ regulations implementing the NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process.

[8]The CEQ defines an EA as documentation that "*...(1) briefly provides sufficient evidence and analysis for determining whether to prepare an* [Environmental Impact Statement]; *(2) aids an agency's compliance with NEPA when no environmental impact statement is necessary; and (3) facilitates preparation of an Environmental Impact Statement when one is necessary*" (CEQ 2007).

[9]Section 1.6 of this EA discusses the roles, responsibilities, and the authorities of each agency.

[10]The EA process concludes with either a Finding of No Significant Impact or a determination to prepare an EIS. The CEQ states, "*A Federal agency must prepare an EIS if it is proposing a major federal action significantly affecting the quality of the human environment*" (CEQ 2007).

provided information during the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The FWC is responsible for managing wildlife in the State of Florida, including birds. The FWC establishes and enforces regulated hunting seasons in the state, including the establishment of hunting seasons that allow the harvest of some of the bird species addressed in this EA. For some migratory bird species (*e.g.*, waterfowl), the FWC 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 FWC, which would give those agencies an opportunity to incorporate WS' actions 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 could only occur when authorized by a depredation permit issued by the USFWS and/or the FWC; therefore, the take of those bird species to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS and/or the FWC.

Based on the scope of this EA, the decisions are:

- How should WS respond to the need for action to manage damage caused by bird species in the state?
- Would implementation of the alternatives cause effects to the human environment requiring the preparation of an EIS?

1.5 SCOPE OF ANALYSIS

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

Appendix B discusses the methods that WS is considering for use when conducting the alternative approaches to manage bird damage. The alternatives and Appendix B also discuss how WS would employ methods to manage damage and threats associated with birds. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives 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) and/or when permitted by the FWC.

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/control orders. Under authorities in the MBTA, the USFWS is the federal agency responsible for the issuance of depredation permits or the establishment of depredation/control 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 Florida would only conduct damage management activities on Native American lands when requested by a Native American tribe. WS would only conduct activities after WS and the tribe requesting assistance signed a Memorandum of Understanding (MOU), work initiation document, or another similar document. Therefore, the tribe would determine when WS' assistance was required and what activities the tribe would allow. 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 be available for use to alleviate damage on tribal properties when the use of those methods had 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 when agreed upon by the tribe and WS.

Federal, State, County, City, and Private Lands

WS could continue to provide assistance on federal, state, county, municipal, and private land in Florida under two of the alternatives analyzed in detail when the appropriate resource owner or manager requested such assistance from WS.

Period for which this EA is Valid

If the analyses in this EA indicates an 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, if appropriate, supplemented pursuant to the NEPA. Review of the EA would be conducted to ensure that activities implemented under the selected alternative occur within the parameters evaluated in the EA. If the alternative analyzing no involvement in damage management activities by WS were selected, no additional analyses by WS would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of activities conducted by WS in Florida.

Site Specificity

Many of the bird species addressed in this EA occur statewide and throughout the year; therefore, damage or threats of damage associated with those bird species could occur wherever those birds occur. Managing damage caused by birds falls within a category of agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to describe accurately such locations or times in an EA or EIS. Although WS can predict some of the possible locations or types of situations where bird damage might occur, WS cannot predict specific locations or times where such damage would occur in any given year. 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 will be received would be difficult.

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 bird 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. As mentioned previously, WS would only conduct damage management activities when requested by the appropriate resource owner or manager. Therefore, this EA analyzes the potential effects of alternative approaches to managing damage associated with birds that WS could conduct in Florida where WS and the appropriate entities have entered into an agreement through the signing of a MOU, work initiation document, or another comparable document. This EA also addresses the potential effects of conducting damage management approaches in areas where WS and an entity requesting assistance sign additional MOUs, work initiation documents, or another comparable document in the future. Because the need for action is to reduce damage and because the goals and directives of WS are to provide assistance when requested, within the constraints of available funding and workforce, it is conceivable that additional efforts could occur. This EA anticipates those additional efforts and analyzes the impacts of such efforts as part of the alternatives. Thus, the analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Florida.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in Florida. WS' EA development process is issue driven, meaning issues that were identified during the interdisciplinary process and substantive issues identified during the public involvement process, are used to drive the analysis and determine the significance of the environmental impacts of the alternative approaches. Therefore, the level of site specificity must be appropriate to the issues listed. The issues raised during the scoping process of the EA drove the analysis in this EA. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever bird damage occurs and those issues are treated as such in this EA.

The standard WS Decision Model (see WS Directive 2.201; Slate et al. 1992) 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). The WS Decision Model is an analytical thought process used by WS' personnel for evaluating and responding to requests for assistance. Decisions made using the model would be in accordance with WS' directives and Standard Operating Procedures (SOPs) described in this EA as well as relevant laws and regulations. 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 address damage and threats associated with birds.

1.6 AUTHORITY OF FEDERAL AND STATE AGENCIES

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

WS' Legislative Authority

The primary statutory authorities for the WS program are the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. WS' directives define program objectives and guide WS' activities with managing animal damage and threats.

United States Fish and Wildlife Service Authority

The USFWS is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources 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, such as 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 (see 50 CFR 10.13) and those species that are listed as threatened or endangered under the ESA (see 50 CFR 17). The MBTA prohibits the take of migratory birds. However, the USFWS can issue depredation permits for the take of migratory birds when certain criteria are met pursuant to the MBTA. The USFWS can issue depredation permits to take migratory birds to alleviate damage and threats of damage. Under the permitting application process, the USFWS requires applicants to describe prior non-lethal damage management techniques that have been used. In addition, the USFWS can establish depredation/control orders that allow for the take of migratory birds. Under depredation/control orders, lethal removal can occur when those bird species are causing damage without the need for a depredation permit.

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 avicides and repellents available for use to manage bird damage.

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.

Florida Fish and Wildlife Conservation Commission

The FWC was formed on July 1, 1999 through a state constitutional amendment (Article IV, Section 9) that combined several previous state fish and wildlife commissions. The FWC is comprised of seven members that are appointed by the governor. The commission exercises the regulator and executive powers of the state with respect to wild animal life and aquatic life. The authority for management of resident wildlife species is the responsibility of the FWC. The FWC collects and compiles information on wildlife population trends and take, and uses this information to manage wildlife populations. The FWC currently has a MOU with WS that established a cooperative relationship, outlines responsibilities, and sets forth annual objectives and goals of each agency.

Florida Department of Agriculture and Consumer Services (FDACS)

The FDACS enforces state laws pertaining to the use and application of pesticides. The FDACS requires the registration of pesticide products in the state, the licensing and certification of commercial and private applicators and pest control consultants, the proper handling, transportation, storage, and disposal of pesticides, and the licensing of dealers selling restricted use pesticides.

1.7 DOCUMENTS RELATED TO THIS EA

Additional environmental documents relate to activities that WS could conduct to manage damage or threats of damage associated with bird species in the state. The relationship of those documents to this EA occurs below for each of those documents.

Final Environmental Impact Statement: Programmatic Environmental Impact Statement for the Eagle Rule Revision

Developed by the USFWS, this EIS evaluated the issues and alternatives associated with the promulgation of new regulations to authorize the "*take*" of bald eagles and golden eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EIS evaluated the management on an eagle management unit level (similar to the migratory bird flyways) to establish limits on the amount of eagle take that the USFWS could authorize in order to maintain stable or increasing populations. This alternative further establishes a maximum duration for permits of 30 years with evaluations in five-year increments (USFWS 2016). A Record of Decision was issued for the preferred alternative in the EIS. The selected alternative revised the permit regulations for the "*take*" of eagles (see 50 CFR 22.26 as amended) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27 as amended). The USFWS published a Final Rule on December 16, 2016 (81 FR 91551-91553).

Final Environmental Impact Statement: Resident Canada Goose Management in the United States

The USFWS, in cooperation with WS, has issued a Final Environmental Impact Statement (FEIS) addressing the need for and potential environmental impacts associated with managing resident Canada goose populations (USFWS 2005). The FEIS also contains detailed analyses of the issues and methods used to manage Canada goose damage. The USFWS published a Record of Decision and Final Rule on August 10, 2006 (71 FR 45964- 45993). On June 27, 2007, WS issued a Record of Decision and adopted the FEIS (72 FR 35217).

Final Environmental Impact Statement: Light Goose Management

The USFWS has issued a FEIS that analyzes the potential environmental impacts of management alternatives for addressing problems associated with overabundant light goose populations (USFWS 2007). The light geese referred to in the FEIS include Snow Geese (*Anser caerulescens*) and Ross's Geese (*Anser rossii*) that nest in Arctic and sub-Arctic regions of Canada and migrate and winter throughout the United States. A Record of Decision and Final Rule were published by the USFWS and the Final Rule went into effect on December 5, 2008.

Environmental Assessment: Reducing Bird Damage in the State of Florida

WS has previously developed an EA that analyzed the need for action to manage damage associated with several bird species in Florida (USDA 2013). The previous EA identified the issues associated with managing damage those bird species cause in Florida and analyzed alternative approaches to meet the specific need identified in the EA while addressing the issues associated with managing damage. Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to manage bird damage in the state. This new EA will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Because this EA will re-evaluate those activities conducted under the previous EA to address the new need for action and the associated affected environment, the analysis and the outcome of the Decision issued for this EA will supersede the previous EA that addressed the need to manage damage associated with birds.

Southeast United States Waterbird Conservation Plan

The USFWS and their partners developed a regional waterbird conservation plan for the southeastern region of the United States to assist with the recovery of high priority waterbird species (Hunter et al.

2006). The Plan addresses waterbirds from eastern Texas and Oklahoma, through Florida, and northward into eastern North Carolina and Virginia, which includes 10 Bird Conservation Regions (BCRs) and 2 pelagic BCRs (Hunter et al. 2006). The plan addresses several overarching conservation goals including the recovery of high priority species, maintaining healthy populations of waterbirds, restoring and protecting essential habitats, and developing science-based approaches to resolving human interactions with waterbirds (Hunter et al. 2006). Information in the Plan on waterbirds and their habitats provide a regional perspective for local conservation action.

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 2015).

Atlantic Flyway Resident Population Canada Goose Management Plan

The Canada Goose Committee within the Atlantic Flyway Migratory Game Bird Technical Section prepared the resident Canada goose management plan for the Atlantic Flyway, which was adopted by the Atlantic Flyway Council (Atlantic Flyway Council 2011). The management objective of the plan is to "*Manage* [Atlantic Flyway Resident Population] *Canada geese to achieve a socially acceptable balance between the positive values and negative conflicts associated with these birds*." Specific management objectives include reducing the population of Atlantic Flyway resident Canada geese to 700,000 geese (spring estimate) by 2020, permit a wide variety of effective and efficient options for relief of damage and conflicts associated with resident Canada geese, and annually monitor populations, harvest, and damage levels to evaluate effectiveness of management actions (Atlantic Flyway Council 2011).

North American Waterfowl Management Plan

The United States signed a joint venture with Canada, and later Mexico, in an international effort to conserve declining populations of migratory waterfowl and to protect and restore sustainable habitat. The goals set forth by the North American Waterfowl Management Plan in the 2012 revision are to have 1) abundant and resilient waterfowl populations to support hunting and other uses without imperiling habitat, 2) wetlands and related habitats sufficient to sustain waterfowl populations at desired levels while providing ecological services and recreational benefits to society, and 3) growing numbers of waterfowl hunters, conservationists, and other citizens who enjoy and actively support waterfowl and wetlands conservation (USFWS 2012).

Florida State Wildlife Action Plan

The FWC has developed an extensive wildlife action plan that evaluates species of plants and animals within the state (FWC 2012). The wildlife action plan "*…is a comprehensive, statewide plan for conserving the state's wildlife and vital natural resources for future generations*" (FWC 2012). WS consulted the Florida State Wildlife Action Plan (FWC 2012) as part of this analysis and developed the alternative approaches to meeting the need for action to be consistent with the plan.

1.8 PUBLIC INVOLVEMENT

WS initially developed issues related to bird damage management and the alternatives to address those issues in consultation with the USFWS and the FWC. WS defined the issues and identified preliminary alternative approaches to meeting the need for action through the scoping process. As part of this process, and as required by the CEQ and APHIS' NEPA implementing regulations, WS will notice this document to the public for review and comment. WS will notice this EA to the public through legal notices published in local print media, through direct mailings to interested parties, through an electronic notification to stakeholders registered with the APHIS Stakeholder Registry, by posting a notice on the APHIS website, and making the EA available on the regulations.gov website.

WS will make the EA available for a minimum of 30 days for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. WS will fully consider new issues or alternatives identified after publication of notices announcing the availability of the EA to determine whether WS should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

1.9 RATIONALE FOR PREPARING AN EA RATHER THAN AN EIS

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 of 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 will provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. If a determination were made through this EA that the alternatives developed to meet the need for action could result in a significant effect on the quality of the human environment, then an EIS would be prepared.

1.10 ENVIRONMENTAL STATUS QUO DISCUSSION

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 affects that occur or would occur from a non-federal entity conducting the action 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 (*e.g.*, the FWC), invasive species, or unprotected wildlife species.

Most bird species are protected under state and/or federal law and to address damage associated with those species, a permit must be obtained from the appropriate federal and/or state agency. However, in some situations, with the possible exception of restrictions on methods (*e.g.*, firearms restrictions, pesticide regulations), some species can be managed without the need for a permit when they are causing damage (*e.g.*, take under depredation/control orders, unprotected bird species). For example, under the blackbird depredation order (see 50 CFR 21.43), blackbirds can be lethally removed by any entity without the need to obtain a depredation permit when those blackbird species identified in the order are found committing damage or when posing a human safety threat. People can also address resident Canada Geese and Muscovy Ducks under several depredation/control orders (see Section 1.11). People can harvest some bird species, such as waterfowl and Wild Turkeys, during annual hunting seasons. Therefore, other entities can and do conduct activities to alleviate damage.

If a bird species is not afforded protection under the MBTA (see 50 CFR 10.13), then a depredation permit from the USFWS is not required to address damage or threats of damage associated with those species. Free-ranging or feral domestic waterfowl, including Mute Swans, European Starling, House Sparrow, Rock Pigeons, Eurasian Collared-Doves, and Monk Parakeets are not afforded protection under the MBTA and a depredation permit from the USFWS is not required to address damage associated with those species.

When a non-federal entity (*e.g.,* agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action involving a bird species, the action is not subject to compliance with the NEPA due to the lack of federal involvement[11] 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 should be used, WS' involvement in the action would not affect the environmental status quo because the entity could take the action in the absence of WS' involvement. In the absence of WS' involvement, an entity could take an action similar to what would have occurred by WS because take could occur during hunting seasons, under depredation/control orders, through the issuance of depredation permits, or, for some species, take can occur at any time without the need for a depredation permit. WS' involvement would not change the environmental status quo if the requester had conducted the action in the absence of WS' involvement in the action.

In addition, most methods for resolving damage would be available to WS and to other entities; therefore, WS' decision-making ability would be restricted to one of three alternatives. Under those three alternatives, WS could provide technical assistance with managing damage only, take the action using the specific methods as decided upon by the non-federal entity, or take no action. If WS takes no action, the non-federal entity could take the action anyway either without the need for a permit, during the hunting season for some species (*e.g*., waterfowl), under a depredation/control order for some species (*e.g*., blackbirds, Canada Geese), 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.

1.11 COMPLIANCE WITH LAWS AND STATUTES

In addition to the NEPA, several laws or statutes authorize, regulate, or otherwise would affect the activities that the WS program conducts. WS would comply with those laws and statutes and would consult with other agencies as appropriate. WS would comply with all applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Below are brief discussions of those laws and regulations that would relate to damage management activities that WS could conduct in the state.

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

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

The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13. The MBTA also provides the USFWS regulatory authority to protect families of migratory birds. The law prohibits any "*take*" of migratory bird species by any entities, except as permitted by the USFWS. Under permitting guidelines in the Act, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the Act. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21. Feral waterfowl, Wild Turkeys[12], Rock Pigeons, Eurasian Collared-Doves, Monk Parakeets, European Starlings, and House Sparrows are not afforded protection under the MBTA; thus, a depredation permit from the USFWS is not required to take those species. All actions conducted in this EA would comply with the regulations of the MBTA, as amended. The law was further clarified to include only those birds afforded protection from take in the United States by the Migratory Bird Treaty Reform Act of 2004. Under the Reform Act, the USFWS published a list of bird species not protected under the MBTA (70 FR 12710-12716).

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

Depredation/Control Orders for Canada Geese

Under 50 CFR 21.49, resident Canada Geese can be lethally taken at airports and military airfields without the need for a depredation permit by airport authorities or their agents when those geese are causing damage or posing a threat of damage to aircraft. A Canada Goose nest and egg depredation order has also been established that allows the nests and eggs of those geese causing or posing a threat to people, property, agricultural crops, and other interests to be destroyed without the need for a depredation permit once the participant has registered with the USFWS (see 50 CFR 21.50). A similar depredation order was established to manage damage to agricultural resources associated with Canada Geese. Under 50 CFR 21.51, designated people can lethally remove Canada Geese without a permit from the USFWS in those states designated, including Florida, when geese are causing damage to agricultural resources. Resident Canada Geese can be addressed using lethal and non-lethal methods by state agencies, Tribes, and the District of Columbia when those geese pose a direct threat to human health under 50 CFR 21.52. Under the depredation orders for Canada Geese, no individual federal depredation permit is required to take geese once the criteria of those orders have been met.

Control Order for Muscovy Ducks (50 CFR 21.54)

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

[12]The FWC may require a permit to lethally remove wild turkeys because turkeys are managed by the FWC.

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).

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

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to lethally remove blackbirds when those species are found committing damage or when posing a threat to human safety. Those bird species that could be lethally taken under the blackbird depredation order that are addressed in this EA include American Crows, Fish Crows, Red-winged Blackbirds, Common Grackles, Boat-tailed Grackles, and Brown-headed Cowbirds.

Bald and Golden Eagle Protection Act (16 USC 668)

Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of an eagle, any part, egg, or nest 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 50 CFR 22.3, the term "*disturb*", as it relates to take, has been defined as "*to agitate or bother a bald or golden 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 regulations authorize the USFWS to issue permits for the take of bald eagles and golden eagles on a limited basis (see 81 FR 91551-91553, 50 CFR 22.26, 50 CFR 22.27). As necessary, WS would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

Endangered Species Act

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)).

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 Section 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.

Native American Graves Protection and Repatriation Act of 1990

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

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; PL 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.

Federal Insecticide, Fungicide, and Rodenticide Act

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

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

This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the FDA.

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.

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.

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

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

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

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Federal agencies must make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. In addition, federal agencies must ensure agency policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

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

Executive Order 13186 requires each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement a MOU with the USFWS that shall promote the conservation of migratory bird populations. APHIS has developed a MOU with the USFWS as required by this Executive Order and WS would abide by the MOU.

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.

Take of Wildlife on Airport Property in Florida

The FWC, under Rule 68A-9.012, allows wildlife to be addressed on airports without a need for a state permit, with some restrictions. Federally protected species may be addressed as permitted by a federal entity without the need for a state permit. For state listed species that are not federally protected, the Rule allows entities to harass persistently and to remove state listed species using lethal methods. For all other wildlife, entities may lethally remove those individuals posing a threat of aircraft strikes at airports.

Permits to Take Wildlife or Freshwater Fish for Justifiable Purposes

The FWC, under Florida Administrative Code (FAC) Rule 68A-9.002(1), "*...may issue permits authorizing the take or possession of wildlife...for scientific, educational, exhibition, propagation, management or other justifiable purposes*." The take of nuisance wildlife can be authorized by the FWC pursuant to FAC Rule 68A-9.010, which is discussed in the next section.

Taking Nuisance Wildlife

The take of nuisance wildlife can occur under FAC Rule 68A-9.010, which states "[a]*ny person owning property may take nuisance wildlife or they may authorize another person to take nuisance wildlife on their behalf...*". The FWC may "*...authorize...additional methods of take for justifiable purposes by permit issued pursuant to Rule 68A-9.002, F.A.C*". Wildlife are considered a nuisance when causing (or about to cause) property damage, presenting a threat to public safety, or causing an annoyance within, under or upon a building.

CHAPTER 2: ISSUES AND ALTERNATIVES

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 WS identified but will not consider in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter during the discussion of the issues. The discussion of the environmental effects in Chapter 4 incorporates additional descriptions of affected environments.

2.1 AFFECTED ENVIRONMENT

Damage or threats of damage caused by those bird species addressed in this EA can occur statewide in Florida wherever those species of birds occur. However, WS would only provide assistance when the appropriate landowner or manager requested such assistance and only on properties where WS and the appropriate landowner or manager has signed a MOU, work initiation document, or another similar document. Most species of birds addressed in this EA are capable of utilizing a variety of habitats and occur statewide where suitable habitat exists for foraging, loafing, roosting, and nesting. In addition, many of the bird species occur throughout the year in the state. Because several bird species addressed in this EA occur statewide, requests for assistance to manage damage or threats of damage could occur in areas of the state occupied by those bird species. Chapter 4 contains additional information on the affected environment.

WS could continue to provide assistance on federal, state, county, municipal, and private land in Florida under two of the alternatives analyzed in detail when the appropriate resource owner or manager requested such assistance from WS. Upon receiving a request for assistance, the proposed action alternative, or those actions described in the other alternatives, could be conducted on private, federal, state, tribal, and municipal lands in Florida to reduce damages and threats to agricultural resources, natural resources, property, and threats to human safety associated with birds. The analyses in this EA are intended to apply to actions taken under the selected alternative that could occur in any locale and at any time within the analysis area. This EA analyzes the potential impacts of bird damage management and addresses activities in Florida that have been conducted and are currently being conducted under a MOU, work initiation document, or a similar document with WS. This EA also addresses the potential impacts of bird damage management in the state where additional agreements may be signed in the future. The USFWS would only issue a depredation permit for the take of birds when requested; therefore, this EA evaluates information from depredation permits issued previously by the USFWS to alleviate damage.

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

Bird Conservation Regions

BCRs are areas in North America that are characterized by distinct ecological habitats that have similar bird communities and resource management issues. The State of Florida lies almost entirely within the Peninsular Florida region (BCR 31). This region is characterized by tropical habitats of Florida but the northern portion of BCR 31 contains transitional habitats from the pine and bottomland hardwood forests that are dominate of the Southeastern Coastal Plain Region (BCR 27), which includes the northern portion and panhandle portion of the state. The Southeastern Coastal Plain 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 (USFWS 2000).

2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns regarding potential adverse effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. WS developed the issues related to managing damage associated with birds in Florida in consultation with the USFWS and the FWC. This EA will also be made available to the public for review and comment to identify additional issues.

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

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

A common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. Methods available to resolve damage or threats to human safety are categorized into non-lethal and lethal methods. Non-lethal methods available can disperse or otherwise make an area unattractive to target species causing damage, which reduces the presence of those species at the site and potentially the immediate area around the site where non-lethal methods were employed. Lethal methods would also be available to remove a bird or those birds responsible for causing damage or posing threats to human safety. Therefore, if lethal methods were used, the removal of a bird or birds could result in local population reductions in the area where damage or threats were occurring. The number of individuals from a target species that could be removed from a population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, and the efficacy of methods employed.

The analysis to determine the magnitude of impacts on the populations of those species addressed in this EA from the use of lethal methods would be based on a measure of the number of individuals lethally removed in relation to that species abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations would be based on population estimates, allowable harvest levels, and actual harvest data, when available. Qualitative determinations would be based on population trends and harvest trend data, when available. Take would be monitored by comparing the number of birds lethally removed with overall populations or trends. Lethal methods would only be used by WS at the request of a cooperator seeking assistance and only after the take of those bird species had been permitted by the USFWS pursuant to the MBTA and/or the FWC, when required.

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 FWC. Those species addressed in this EA that people can harvest during regulated seasons in the state include Canada Geese, Blue-winged Teal, Mallards, Mottled Ducks, Lesser Scaup, Buffleheads, Wild Turkeys, Mourning Doves, Eurasian Collared-Doves, American Coots, American Crows, and Fish Crows. In addition, people can harvest the waterfowl and game species addressed in Appendix E during annual hunting seasons. A concern is that damage management activities conducted by WS would affect the ability of people to harvest those bird 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.

People can harvest Eurasian Collared-Doves during the regulated hunting season for Mourning Doves given the similarity in appearance between the two species. However, Eurasian Collared-Doves are not afforded protection from take under the MBTA and are considered a non-native species in Florida. 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 with a state hunting license or outside the hunting season to alleviate damage or threats of damage under the depredation order. For many migratory bird species considered harvestable during a hunting season, the number of birds harvested during the season is estimated and reported by the USFWS and/or the FWC.

Therefore, any activities conducted by WS under the alternatives addressed would be occurring along with other natural processes and human-induced events such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

Methods available under each of the alternatives to alleviate damage and reduce threats to human safety would be employed targeting an individual of a bird species or a group of individuals after applying the WS' Decision Model (Slate et al. 1992) to identify possible techniques. The effects on the populations of target bird populations in the state from implementation of the alternatives addressed in detail, including the proposed action, are analyzed in Chapter 4. Information on bird populations and trends are often derived from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population database, published literature, and harvest data. Further information on those sources of information is provided below.

Breeding Bird Survey

Bird populations can be monitored by using trend data derived from data collected during the BBS. Under established guidelines, observers count birds at established survey points along roadways for a set duration along a pre-determined route. Routes are 24.5 miles long and are surveyed once per year with the observer stopping every 0.5 miles along the route to conduct the survey. The numbers of birds observed and heard within 0.25 miles of each of the survey points are recorded during a 3-minute sampling period at each point. Surveys were started in 1966 and are conducted in June, which is generally considered as the period of time when those birds present at a location are likely breeding in the immediate area. The BBS is conducted annually in the United States, across a large geographical area, under standardized survey guidelines. The BBS is a large-scale inventory of North American birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2017). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. 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).

Christmas Bird Count

The CBC is conducted annually in December and early January by numerous volunteers under the guidance of the National Audubon Society. The CBC reflects the number of birds frequenting a location during the winter months. Survey data 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 the data can be used as an indicator of trends in a population over time. Researchers have found that population trends reflected in CBC data tend to correlate well with those from censuses taken by more stringent means (National Audubon Society 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 (Rich et al. 2004, Blancher et al. 2013). Using relative abundances derived from the BBS conducted between 1998 and 2007, the Partners in Flight Science Committee (2013) 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) and updated by the Partners in Flight Science Committee (2013) 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, Blancher et al. 2013).

Annual Harvest Data

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 FWC. Those species addressed in this EA that have established hunting seasons include Canada Geese, Blue-winged Teal, Mallards, Mottled Ducks, Lesser Scaup, Buffleheads, Wild Turkeys, Mourning Doves, Eurasian Collared-Doves, American Coots, American Crows, and Fish Crows. In addition, people can harvest the waterfowl and game species addressed in Appendix E during annual hunting seasons.

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

The potential for effects on non-target species and 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 were as target-selective as possible or would apply such methods in ways to reduce the likelihood of capturing non-target species. Before initiating management activities, WS would select locations that were extensively used by the target species. WS would also use SOPs designed to reduce the effects on populations of non-target species. 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 chemical methods. Chemical methods that would be available to manage damage or threats of damage associated with birds include the avicide DRC-1339, Avitrol, alpha chloralose, mesurol, nicarbazin, and taste repellents. Chemical methods that could be available for use to manage damage and threats associated with birds in Florida are further discussed in Appendix B.

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

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. As part of the scoping process to facilitate interagency cooperation, WS consulted with the USFWS pursuant to Section 7 of the ESA during the development of this EA, which is further discussed in Chapter 4.

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

An additional issue often raised is the potential risks associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. WS' employees would use and recommend only those methods that were legally available, selective for target species, and were effective at resolving the damage associated with the target species. Still, some concerns exist regarding the safety of methods despite their legality, selectivity, and effectiveness. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public and employees of WS. Selection of methods would include 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. The use of chemical methods by WS would be regulated by the EPA through the FIFRA, by the FDACS, by the FDA through an INAD, and by WS' directives. Chemical methods are further discussed in Appendix B of this EA.

Under the alternatives identified, the use of chemical methods would include avicides, alpha chloralose, nicarbazin, and repellents. Avicides are those chemical methods used to remove birds lethally. DRC-1339 is the only avicide currently being considered for use to manage damage in this EA. DRC-1339 is currently registered with the EPA for use by WS to manage damage associated with Rock Pigeons, European Starlings, Red-winged Blackbirds, Brown-headed Cowbirds, Common Grackles, American Crows, Fish Crows, and gulls. However, none of the formulations registered with the EPA were also registered with the FDACS for use in the state during the development of this document. The WS program would only employ those products that are registered with the EPA and the FDACS.

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 method available for use to manage damage associated with some bird species. For those species addressed in this EA, Avitrol is registered with the EPA to manage damage associated with House Sparrows, Red-winged Blackbirds, Common Grackles, Brown-headed Cowbirds, European Starlings, Rock Pigeons, and American 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 the eggs of T&E species.

Nicarbazin is the only reproductive inhibitor currently registered with the EPA. Products containing nicarbazin can be used to inhibit the reproduction of local populations of resident Canada Geese, domestic waterfowl, and pigeons by reducing or eliminating the hatchability of eggs laid. Reproductive inhibitors containing the active ingredient nicarbazin could also be available under the alternatives.

Alpha chloralose is a sedative that is also being considered as a method that could be employed under the alternatives to manage damage associated with waterfowl. Alpha chloralose could be used to sedate waterfowl temporarily and lessen stress on the animal from handling and transportation from the capture site. Drugs delivered to immobilize waterfowl would occur on site with close monitoring to ensure proper care of the animal. Alpha chloralose is reversible with a full recovery of sedated animals occurring.

Safety of Non-Chemical Methods Employed

Most methods available to alleviate damage and threats associated with birds are considered non-chemical methods. Non-chemical methods employed to reduce damage and threats to safety caused by birds, if misused, could potentially be hazardous to human safety. Non-chemical methods may include cultural methods, limited habitat modification, animal behavior modification, and other mechanical methods. Changes in cultural methods could include confining livestock inside a structure, altering feeding schedules, changes in crop rotations, or conducting structural repairs. Limited habitat modification would be practices that alter specific characteristics of a localized area, such as pruning trees to discourage birds from roosting or planting vegetation that was 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, eyespot balloons, or nest destruction. Other mechanical methods could include live-traps, mist nests, cannon nets, net guns, shooting, or recommending a local population of harvestable birds be reduced through hunting.

Effects of Not Employing Methods to Reduce Threats to Human Safety

An issue that WS identified was 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 (see Section 1.2). The low risk of disease transmission from birds does not lessen the concerns of cooperators requesting assistance to reduce threats from zoonotic diseases. Increased public awareness of zoonotic events has only heightened the concern of direct or indirect exposure to zoonoses. Not adequately addressing the threats associated with potential zoonoses could lead to an increase in incidences of injury, illness, or loss of human life.

Additional concern is raised with inadequately addressing threats to human safety associated with aircraft striking birds at airports in the state. Birds have the potential to cause severe damage to aircraft and can threaten the safety of flight crews and passengers. If the use of certain methods to address the threat of aircraft striking birds was limited or were excluded from use, the unavailability of those methods could lead to higher risks to passenger safety. This issue will be fully evaluated in Chapter 4 in relationship to the alternatives.

Issue 4 - Effects on the Aesthetic Values of Birds

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target birds to the public, resource owners, or neighboring residents in the area where damage management activities occur. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987). 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. In modern societies, many households have indoor or outdoor pets. However, some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing and/or feeding 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, which may take the form of direct consumptive use (*e.g.*, using parts of or the entire animal) or non-consumptive use (*e.g.*, viewing 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 translocated to another area to alleviate damage or threats to protected resources. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations. 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.

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."*

Suffering has previously been described by the American Veterinary Medical Association (AVMA) as a *"…highly unpleasant emotional response usually associated with pain and distress"* (AVMA 1987). However, suffering *"…can occur without pain…,"* and *"…pain can occur without suffering…"* because suffering carries with it the implication of occurring over time, 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 may 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. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991).

The AVMA has previously stated, "*...euthanasia is the act of inducing humane death in an animal*" and "*... the technique should minimize any stress and anxiety experienced by the animal prior to unconsciousness*" (Beaver et al. 2001). Some people would prefer AVMA accepted methods of euthanasia to be used when killing all animals, including wild animals. The AVMA has previously stated 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, because *"…neither medical nor veterinary curricula explicitly address suffering or its relief"* (California Department of Fish and Game 1991). Research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991).

The decision-making process can involve 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.

Additional concerns have been expressed over the potential separation of goose families through management actions. Generally, adult geese form pair bonds that are maintained until one of the pair dies. Goose family units generally migrate together during the fall migration period and spend much of the fall and winter together (Raveling 1968, Raveling 1969). The separation of family units could occur during damage management activities targeting geese. This could occur through translocation of geese, dispersal, or through removal and euthanasia.

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

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

WS, the FWC, and the USFWS also identified additional issues during the scoping process of this EA. WS considered the following issues; however, those issues will not receive detailed analyses for the reasons provided.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife in the state. WS operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. Methods available are employed to target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population or group is frequently temporary because immigration from adjacent areas or natural reproduction replaces those animals that an entity removes. WS operates on a small percentage of the land area of Florida 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 will not adversely affect biodiversity in the state.

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 will receive the greatest application. As part of an integrated approach, evaluation of methods would continually occur to allow for those methods that were most effective at resolving damage or threats to be employed under similar circumstances where birds are causing damage or pose a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove birds lethally. As described in Appendix B, the lethal removal of birds with firearms by WS to alleviate damage or threats could occur using a shotgun or rifle, including an air rifle. 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 USFWS Migratory Bird Permit Program has implemented the requirement to use non-toxic shot as defined under 50 CFR 20.21(j) as part of the standard conditions of depredation permits issued pursuant to the MBTA for the lethal take of birds under 50 CFR 21.41. In 2011, the depredation order for blackbirds (see 50 CFR 21.43(b)) was amended to include the requirement for use of non-toxic shot, as defined under 50 CFR 20.21(j), in most cases. However, this prohibition does not apply if an air rifle, an air pistol, or a .22 caliber rimfire firearm was used for removing depredating birds under the depredation order. 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.

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

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around 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 naturally serves to 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 hunting in general, lead contamination from such sources would be minimal to nonexistent.

Because the take of birds could occur by other entities during regulated hunting seasons, through the issuance of depredation permits, under depredation/control orders, or without the need to obtain a depredation permit, WS' assistance with removing birds would not be additive to the environmental status quo. WS' assistance would not be additive to the environmental status quo because 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 activities due to efforts by WS to ensure projectiles do not pass through, but are contained within the bird carcass, which would limit the amount of lead potentially deposited into soil. 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 would further reduce the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. In addition, WS' involvement would ensure efforts were made to retrieve bird carcasses lethally removed using firearms to prevent the ingestion of lead in carcasses by scavengers. WS' involvement would also ensure carcasses were disposed of properly to limit the availability of lead. Based on current information, the risks associated with lead bullets that would be deposited into the environment from WS' activities due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or contamination. As stated previously, when using shotguns, only non-toxic shot would be used by WS pursuant to 50 CFR 20.21(j). Additionally, WS may utilize non-toxic ammunition in rifles and air rifles as the technology improves and ammunition become more effective and available.

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 could 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, overall, 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*a*, Chipman et al. 2008). A similar conflict could develop when habitat alteration was used to disperse a bird roost. This concern would be heightened in large metropolitan areas where the likelihood of birds dispersed from a roost finding a new roost location and not coming into conflict would be very low. WS has developed alternatives to minimize the potential of dispersing bird roosts in urban/suburban areas by evaluating a management option to depopulate a bird roost.

In urban areas, WS would often work with the community or municipal leaders to address bird damage involving large bird roosts that would likely be affecting several people. Therefore, WS often consults not only with the property owner where roosts were located but also with community leaders to allow for community-based decision-making on the best management approach. In addition, funding would often be provided by the municipality where the roost was located, which would allow activities to occur within city limits where bird roosts occurred. This would allow roosts that relocated to other areas 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.

Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 3.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment, including the Clean Air Act. The actions discussed in this EA do not involve major ground disturbance, construction, or habitat alteration. Chapter 3 discusses the SOPs to reduce risks to the environment that WS would incorporate into activities when implementing applicable alternative approaches to managing damage. Activities that WS could implement pursuant to those applicable alternative approaches discussed in Section 3.1 would not alter aquatic systems or cause changes in the flow, quantity, or storage of water resources. Personnel of WS would use, store, and dispose of all chemical methods in accordance with applicable laws and regulations pursuant to WS Directive 2.210. The use, storage, and disposal of chemical methods by WS' personnel would also follow WS' directives, including WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, WS Directive 2.455, and WS Directive 2.465.

Personnel of WS would follow EPA-approved label directions for all pesticide use (see WS Directive 2.401). The intent of the registration process for chemical pesticides is to assure minimal adverse effects occur to the environment when people use the chemicals in accordance with label directions. The WS program would properly dispose of any excess solid or hazardous waste in accordance with applicable federal, tribal, state, and local regulations.

Consequently, the WS program in Florida does not expect the alternative approaches discussed in Section 3.1 to significantly impact soils, geology, minerals, water quality and quantity, floodplains, other aquatic resources, air quality, prime and unique farmlands, timber, and range. Therefore, the EA will not analyze those elements further.

Influence of Global Climate Change

The State of the Climate in 2012 report indicates that every year has been warmer than the long-term average since 1976 (Blunden and Arndt 2013). Impacts of this change will vary throughout the United States, but some areas could experience air and water temperature increases, alterations in precipitation, and increased severe weather events. Temperature and precipitation often influence the distribution and abundance of a plant or animal species. According to the EPA (2016), as temperatures continue to increase, the ranges of many species will likely expand into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g*., less snowfall, range expansions of other species).

The impact of climate change on wildlife and their habitats is of increasing concern to land managers, biologists, and members of the public. For example, climate change may alter the frequency and severity of habitat-altering events, such as wildfires, weather extremes, such as drought, presence of invasive species, and wildlife diseases. WS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Over time, a combination of factors is likely to lead to changes in the scope and nature of human-wildlife conflicts in the state. Because these types of changes are an ongoing process, this EA has developed a dynamic system, including SOPs, and built in measures that allow agencies to monitor for and adjust to impacts of ongoing changes in the affected environment (see Section 3.3 and Section 3.4).

If WS selected an alternative approach to meeting the need for action that allows the program to provide assistance (see Section 3.1), WS would monitor activities, in context of the issues analyzed in detail, to determine if the need for action and the associated impacts remain with the parameters established and analyzed in this EA. Pursuant to SOPs discussed in Section 3.3 and Section 3.4, WS would continue to coordinate activities to reduce and/or prevent bird damage in the state with the FWC and/or the USFWS. Coordinating activities would ensure the FWC and/or the USFWS have the opportunity to incorporate any activities the WS program conducts into population objectives established for wildlife populations in the state. If WS determines there to be a new need for action, changed conditions, new issues, or new alternatives having different environmental impacts, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Through monitoring, the WS program in Florida can evaluate and adjust activities as changes occur over time.

Monitoring by WS would also include reviewing the list of species the USFWS and the National Marine Fisheries Service consider as threatened or endangered within the state pursuant to the ESA. As appropriate, WS would consult with the USFWS and/or the National Marine Fisheries Service pursuant to Section 7 of the ESA to ensure the activities conducted by WS would not jeopardize the continued existence of threatened or endangered species or result in adverse modification to areas designated as critical habitat for a species within the state. Through the review of species listed as threatened or endangered and the consultation process with the USFWS and/or the National Marine Fisheries Service, WS can evaluate and adjust activities conducted pursuant to any alternative approach selected to meet the need for action. Accordingly, WS could supplement this analysis or conduct a separate evaluation pursuant to the NEPA based on the review and consultation process. In this way, any actions conducted by WS would be responsive to ongoing climate changes and the associated cumulative impacts of actions conducted in Florida in accordance with the NEPA.

Greenhouse Gas Emissions by the WS Program

Under the alternative approaches intended to meet the need for action discussed in Section 3.1, the WS program in Florida could potentially produce criteria pollutants (*i.e*., pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, travel at field locations (vehicles or ATV), and from other work-related travel (*e.g*., attending meetings). During evaluations of the national program to manage feral swine (*Sus scrofa*), the WS program reviewed greenhouse gas emissions for the entire national WS program (see pages 266 and 267 in USDA 2015*a*). The analysis estimated effects of vehicle, aircraft, office, and ATV use by WS for federal fiscal year (FY) 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by feral swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended by CEQ for actions requiring detailed review of impacts on greenhouse gas emissions. The activities that WS could conduct under the alternative approaches discussed in Section 3.1 would have negligible cumulative effects on atmospheric conditions, including the global climate.

Impacts on Cultural, Archaeological, and Historic Resources, and Tribal Cultural Properties

The methods that would be available for use under the alternatives would not cause major ground disturbance, would not cause any physical destruction or damage to property, would not cause any alterations of property, wildlife habitat, or landscapes, and would not involve the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that could be used by WS under the relevant alternatives 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 were planned under an alternative selected because 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 animals 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 alleviate a damage problem, which means such use, would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by the Section 106 of the NHPA would be conducted as necessary in those types of situations.

In addition, the WS program in Florida would only conduct activities on tribal lands at the request of the tribe and only after signing appropriate authorizing documents. Therefore, the tribe would determine what activities they would allow and when WS' assistance was required. Because tribal officials would be responsible for requesting assistance and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would likely occur.

CHAPTER 3: ALTERNATIVES

Section 3.1 and Section 3.2 discuss those alternative approaches that WS identified during the initial scoping process for this EA. WS developed the alternative approaches based on the need for action. The need for action identified by WS is associated with requests for assistance that WS receives to manage damage and threats of damage caused by several bird species in Florida. WS also developed the alternative approaches to address those issues identified in Section 2.2.

Section 3.1 discusses those alternative approaches WS will consider in detail within Chapter 4 of this EA. Chapter 4 analyzes the environmental consequences of each alternative as an alternative relates to the identified issues. Section 3.2 discusses additional alternative approaches that WS identified but this EA will not analyze those alternative approaches in detail within Chapter 4 for the reasons provided in the description of each alternative. Section 3.3 and Section 3.4 discuss SOPs that WS would incorporate into the relevant alternative approaches identified in Section 3.1.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed to meet the need for action and 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 (Slate et al. 1992; see WS Directive 2.201), to reduce damage and threats caused by birds in Florida. A major goal of the program would be to resolve and prevent bird damage and to reduce threats to human safety[13]. To meet this goal, WS, in consultation with the USFWS, the FWC, and the FDACS would continue to respond to requests for assistance with, at a minimum, technical assistance or, when funding was available, operational damage management.

Therefore, 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. Funding for activities conducted by WS could occur through federal appropriations; however, in most cases, those entities requesting assistance would provide the funding for activities conducted by WS.

A key component of assistance provided by WS would be providing information to the requester about wildlife and wildlife damage. 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. When responding to a request for assistance, WS would provide those entities with information regarding the use of appropriate methods. Property owners or managers requesting assistance would be provided with information regarding the use of effective and practical techniques and methods. In addition to the routine dissemination of recommendations and information to individuals or organizations experiencing damage, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that other wildlife professionals and the public are periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies. Providing information about bird damage and methods would be a primary component of technical assistance and direct operational assistance available from WS under this alternative.

[13] All management actions conducted or recommended by WS would comply with appropriate federal, state, and local laws in accordance with WS Directive 2.210.

The WS program in Florida 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 extent of the damage, and previous methods that the cooperator has employed to alleviate the problem. WS would then provide information on appropriate methods that the cooperator may consider to alleviate 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 2012 and FY 2016, WS has conducted 683 technical assistance projects in Florida associated with birds addressed in this EA. Technical assistance provided by WS would occur as described in Alternative 2 of this EA.

Direct operational damage management assistance would include damage management activities that WS' personnel would conduct directly or supervise. WS' employees may initiate operational damage management assistance when technical assistance alone could not effectively alleviate the damage or the threat of damage and when WS and the entity requesting assistance have signed a MOU, work initiation document, or another comparable document. The initial investigation would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to alleviate the problem.

Under this alternative, the WS program 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 a local decision-maker(s) to reduce damage or threats. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources are available. Those entities requesting assistance could choose to use the services of private businesses, use volunteer services of private organizations, implement WS' recommendations on their own (*i.e.*, technical assistance), request direct assistance from WS (*i.e.*, direct operational assistance), or take no action. Generally, a decision-maker seeking assistance would be part of a community, municipality, business, governmental agency, and/or a private property owner.

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 was made. By involving decision-makers in the process, WS could present damage management recommendations to the appropriate decision-maker(s) to allow 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 the decision-maker(s) to present information on damage management activities 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 presentations by WS on activities to manage damage. This process allows WS to recommend and implement activities based on local input.

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 can be more complex because business 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 operational assistance could be provided by WS only if requested by the local community decision-maker, funding was provided, and if the requested assistance was compatible with WS' recommendations.

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

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.

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 alleviate using available methods because birds are conditioned to feed, roost, loaf, and are familiar with a particular location. Subsequently, making that area unattractive using available methods can be difficult to achieve once damage has been ongoing. 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.

In general, the most effective approach to resolving damage would be to integrate the use of several methods simultaneously or sequentially. This adaptive approach to managing damage associated with birds would integrate the use of the most practical and effective methods as determined by a site-specific evaluation for each request after applying the WS Decision Model. The philosophy behind an adaptive approach would be to integrate the best combination of methods in a cost-effective[14] 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), and local population reduction, or any combination of these, depending on the circumstances of the specific damage problem.

Once contacted for direct operational assistance, WS would conduct site visits to assess the damage or threat of damage, would identify the species responsible, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to alleviate or prevent damage. WS' personnel would assess the damage or threat of damage and then evaluate the

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

appropriateness and availability (legal and administrative) of strategies and methods based on several considerations, including legal, biological, humaneness, economic, and social considerations. Following this evaluation, WS' employees would incorporate methods deemed practical for the situation into a damage management strategy. After WS' employees implemented this strategy, employees would continue to monitor and evaluate the strategy to assess effectiveness. If the strategy were effective, the need for further management would end. In terms of the WS Decision Model, most efforts to resolve wildlife damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

The general thought process and procedures of the WS Decision Model would include the following steps.

1. **Receive Request for Assistance:** WS would only provide assistance after receiving a request for such assistance. WS would not respond to public bid notices.
2. **Assess Problem:** First, WS would make a determination as to whether the assistance request was within the authority of WS. If an assistance request were within the authority of WS, WS' employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that WS' employees could gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. **Evaluate Management Methods:** Once a problem assessment was completed, a WS' employee would conduct an evaluation of available management methods. The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on legal, safety, biological, humaneness, environmental, social, and cultural factors.
4. **Formulate Management Strategy:** A WS' employee would formulate a management strategy using those methods that the employee determines to be practical for use. The WS employee would also consider factors essential to formulating each management strategy, such as available expertise, legal constraints on available methods, costs, and effectiveness.
5. **Provide Assistance:** After formulating a management strategy, a WS employee could provide technical assistance and/or direct operational assistance to the requester (see WS Directive 2.101).
6. **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, it is necessary to monitor the results of the management strategy. Monitoring would be important for determining whether further assistance was required or whether the management strategy resolved the request for assistance. Through monitoring, a WS' employee would continually evaluate the management strategy to determine whether additional techniques or modification of the strategy was necessary.
7. **End of Project:** When providing technical assistance, a project would normally end after a WS' employee provided recommendations or advice to the requester. A direct operational assistance project would normally end when WS' personnel stop or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from WS' personnel and may have no well-defined termination point.

Methods available to alleviate or prevent damage under this alternative could be considered lethal methods or non-lethal methods. Preference would be given to non-lethal methods when practical and effective under this alternative (see WS Directive 2.101). Non-lethal methods that would be available for use by WS would include, but would not be limited to, habitat/behavior modification, inactive nest destruction, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, alpha chloralose, reproductive inhibitors, and chemical repellents (see Appendix B for a complete list and description of potential methods). Lethal methods that would be available to WS would include live-capture followed by euthanasia, the avicide DRC-1339, the recommendation of take during hunting seasons, egg destruction, and firearms. Euthanasia of live-captured birds would occur in accordance with WS Directive 2.505. WS would employ cervical dislocation, carbon dioxide, or firearms to euthanize target birds once those birds were live-captured using other methods. Carbon dioxide, cervical dislocation, and the use of firearms are considered acceptable forms of euthanasia for free-ranging birds with conditions[15] (AVMA 2013).

As discussed in Chapter 1, the lethal removal of many bird species to alleviate damage would be prohibited unless authorized by the USFWS pursuant to the MBTA. The take of birds can only legally occur through the issuance of a depredation permit by the USFWS and only at levels specified in the permit, unless those bird species are afforded no protection under the MBTA or a depredation/control order has been established by the USFWS, in which case, no permit for take would be required. In addition, authorization from the FWC may be required to lethally control protected birds causing damage in the state. For some bird species (*e.g.*, waterfowl, turkeys, crows, doves), lethal take can occur during a hunting season that the FWC implements and regulates. In most cases, the use of non-lethal dispersal methods and the destruction of inactive nests (*i.e.*, nests that to not contain eggs and/or nestlings) would not require a permit from the USFWS and/or the FWC.

The use of many lethal and non-lethal methods would be short-term attempts at reducing damage occurring at the time those methods were employed. Long-term solutions to managing bird damage would include limited habitat manipulations and changes in cultural practices that are addressed in Chapter 4. Appendix B contains a discussion of the methods that would be available for use in an integrated approach under this alternative. The WS program also researches and actively develops methods to address bird damage through the NWRC. The NWRC functions as the research unit of WS by providing scientific information and by developing methods to address damage caused by animals. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate methods and techniques. For example, research biologists from the NWRC were involved with developing and evaluating the repellent mesurol for crows. Research biologists with the NWRC have authored hundreds of scientific publications and reports based on research conducted involving wildlife and methods.

The effectiveness of any damage management program could be defined in terms of losses or risks potentially reduced or prevented, how accurately practitioners diagnose 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. An adaptive integrated approach calls for the use of several management methods simultaneously or sequentially (Courchamp et al. 2003). The purpose behind integrated management is to implement methods in the most effective manner while minimizing the potentially harmful effects on people, target and non-target species, and the environment[16]. 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.

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[15]The AVMA (2013) defines acceptable with conditions as "A *method considered to reliably meet the requirements of euthanasia when specified conditions are met."*

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

The goal would be to reduce damage, risks, and conflicts with birds as requested and not to necessarily reduce/eliminate populations. Localized population reduction could be short-term because new individuals may immigrate to an area, be released at the site, or new individuals could 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 return to pre-management population levels eventually does not mean individual management actions were unsuccessful, but that periodic management may be necessary. The return of wildlife to pre-management levels also demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

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

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

Under this alternative, WS would provide those cooperators requesting assistance with technical assistance only. Technical assistance would provide those cooperators experiencing damage or threats of damage with information, demonstrations, and recommendations on available and appropriate methods available. The implementation of methods and techniques to alleviate 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 were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Similar to the proposed action alternative, a key component of assistance provided by WS would be providing information to the requester about wildlife and wildlife damage. Educational efforts conducted under the proposed action alternative would be similar to those conducted under this alternative.

Technical assistance would include collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator had used to alleviate the problem. WS would then provide information on appropriate methods that the cooperator may consider to alleviate 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.

Generally, several management strategies would be described to the requester for short and long-term solutions to managing damage based on the level of risk, need, and the practicality of their application. Only those methods legally available for use by the appropriate individual would be recommended or loaned by WS. Similar to Alternative 1, those methods described in Appendix B would be available to those people experiencing damage or threats associated with birds in the state, except for alpha chloralose, DRC-1339, and mesurol, which are currently only available for use by WS.

Those entities seeking assistance with reducing damage could seek direct operational assistance from other governmental agencies, private entities, or conduct activities on their own. In situations where non-lethal methods were ineffective or impractical, WS could 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/or the FWC, when a permit was required. WS could evaluate damage occurring or the threat of damage and complete a Migratory Bird Damage Report, which would include information on the extent of the damages or risks, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate damage or the threat of damage. Following review by the USFWS of a complete application for a depredation permit from a property owner or manager and the Migratory Bird Damage Report, the USFWS could issue a depredation permit to authorize the lethal take of a specified number of birds.

This alternative would place the immediate burden of using methods to alleviate damage on the resource owner, other governmental agencies, and/or private businesses. Those entities could take action using those methods legally available to alleviate 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 would preclude any activities by WS to reduce threats to human health and safety, and alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management in the state. All requests for assistance received by WS to alleviate damage caused by birds would be referred to the USFWS, to the FWC, and/or to 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. Therefore, under this alternative, entities seeking assistance with addressing damage caused by birds could contact WS but WS would immediately refer the requester to other entities. The requester could then contact other entities for information and assistance, could take actions to alleviate damage without contacting any entity, or could take no further action.

Many of the methods listed in Appendix B would be available for use by other agencies and private entities to manage damage and threats associated with birds. All methods described in Appendix B would be available for use by those persons experiencing damage or threats, except for the use of DRC-1339 for blackbirds, pigeons, and gulls, the use of alpha chloralose for waterfowl, and mesurol for crows.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives identified in Section 3.1, several alternatives were also identified during the scoping process for the EA. The following issues were identified and considered but will not be analyzed in detail for the reasons provided:

Non-lethal Methods Implemented by WS before Lethal Methods

This alternative would require that WS apply non-lethal methods or techniques described in Appendix B to all requests for assistance to reduce damage and threats to safety from birds in the state. If the use of non-lethal methods failed to resolve the damage situation or reduce threats to human safety in 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 people experiencing bird damage.

Those people 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 the diligence of the requester 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) would be similar to a non-lethal before lethal alternative because the use of non-lethal methods would be considered before lethal methods by WS (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not provide additional information to the analyses in this 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 Florida. 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 when permitted by the USFWS and/or the FWC, when required. The non-lethal methods that could be employed or recommended by WS under this alternative would be identical to those methods identified in any of the alternatives. Non-lethal methods would be employed by WS in an integrated approach under this alternative.

Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary exclusionary methods are netting and overhead 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, agricultural resources, 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 methods identified in any of the alternatives. WS would not apply for a depredation permit from the USFWS and/or the FWC under this alternative because no take of birds would occur.

In situations where non-lethal methods were impractical or ineffective to alleviate damages, WS could refer requests for information regarding lethal methods to the FWC, the USFWS, local municipalities, 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. The USFWS needs professional recommendations on individual damage situations before issuing a depredation permit for lethal methods, and the USFWS does not have the mandate or resources to conduct activities related to wildlife damage management. State agencies with responsibilities for migratory birds would likely have to provide this information if depredation permits were 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 the proposed action/no action alternative.

Property owners or managers could conduct management using any non-lethal or lethal method that was legal, once a permit had 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 the lack of WS’ assistance with the full range of methods 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 USFWS may authorize more lethal take than was necessary to alleviate bird damages and conflicts because agencies, businesses, and organizations may have less technical knowledge and experience managing wildlife damage than WS.

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 could effectively resolve damage caused by birds, those methods would be used or recommended under the proposed action. Because non-lethal methods would be available for use under the alternatives analyzed in detail, this alternative would not add to the analyses.

This alternative was not analyzed in detail because the take of birds and the destruction of active nests that contain eggs and/or nestlings could continue at the levels analyzed in the proposed action alternative. The USFWS and/or the FWC could permit the take, when required, despite WS' lack of involvement in the action. In addition, limiting the availability of methods under this alternative to only non-lethal methods could be inappropriate when attempting to address threats to human safety expeditiously, primarily at airports.

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. 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 some bird damage. For example, the use of non-lethal methods has been effective in dispersing urban crow roosts and vulture roosts (Avery et al. 2002*b*, Seamans 2004, Avery et al. 2008*a*, Chipman et al. 2008). In those situations where damage could be alleviated using non-lethal methods, those methods would be employed or recommended as determined by the WS Decision Model. Therefore, this alternative was not considered in detail.

WS would implement Alternative 1 but would establish a Loss Threshold before Allowing Lethal Methods

A concern that WS sometimes receives during public comments is damage caused by animals should be a cost of doing business and/or that there should be a threshold of damage before allowing the use of lethal methods to manage damage. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by birds could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking birds could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of aircraft strikes prior to an actual strike occurring would be appropriate. For those reasons, WS did not carry this alternative forward for further analysis in Chapter 4.

WS would require Cooperators Completely Fund Activities (no taxpayer money)

This alternative would be similar to Alternative 1 except WS would require the entity requesting assistance to pay for any activities conducted by WS. Therefore, no activities conducted by WS would occur through federal appropriations or state funding (*i.e.*, no taxpayer money). Funding for WS' activities could occur from federal appropriations, through state funding, and/or through money received from the entity requesting assistance. In those cases where WS receives federal and/or state funding to conduct activities, federal, state, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall. Therefore, WS did not carry this alternative forward for further analysis in Chapter 4.

Trap and Translocate Birds Only by WS

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, net guns, mist nets, or hand-capture. All birds live-captured through direct operational assistance by WS would be translocated. Prior to live-capture, release sites would be identified and approved by the USFWS, the FWC and/or the property owner where the translocated birds would be released.

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 FWC. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the FWC, WS could translocate birds under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). However, birds could be translocated by other entities to alleviate damage under Alternative 3. Because WS does not have the authority to translocate birds in the state unless permitted by the USFWS and/or the FWC, this alternative was not considered in detail.

The translocation of birds causing damage or posing a threat of damage to other areas following live-capture generally would not be effective or cost-effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. In addition, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (*e.g.*, urban crow roosts); therefore, translocation would be unrealistic in those circumstances. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, the potential for disease transmission, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988, Craven et al. 1998).

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 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 factors, and other factors.

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

Population modeling indicates that reproductive control is more effective 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 reproductive 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 proven effective in reducing localized bird populations, the use of the inhibitor could be evaluated as a method available under the alternatives. This EA would be reviewed and supplemented to the degree necessary to evaluate the use of the reproductive inhibitor. Currently, the only reproductive inhibitor registered with the EPA is nicarbazin, which is registered for use to manage local populations of Canada Geese, domestic Mallards, Muscovy Ducks, other feral waterfowl, and Rock Pigeons. However, the only reproductive inhibitor currently available in Florida is a formulation of nicarbazin under the trade name of OvoControl® P, which people can use to manage urban pigeon populations. Reproductive inhibitors for the other bird species addressed in this EA do not currently exist.

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. Compensation would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) most likely would be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) not be practical for reducing threats to human health and safety. For the above listed reasons, this alternative was not considered in detail.

WS would refer requests for assistance to Private Nuisance Wildlife Control Agents

People experiencing damage or threats of damage associated with birds could contact private wildlife control agents and/or other private entities to reduce damage when they deem appropriate. In addition, WS could refer persons requesting assistance to private wildlife control agents and/or other private entities if WS implemented Alternative 1 or Alternative 2. WS Directive 3.101 provides guidance on establishing cooperative projects and interfacing with private businesses. WS only responds after receiving a request for assistance. If WS implemented Alternative 1 or Alternative 2, WS would inform requesters that other service providers, including private entities, might be available to provide assistance. Therefore, WS did not carry this alternative forward for further analysis.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

WS' directives and SOPs improve the safety, selectivity, and efficacy of those methods available to alleviate or prevent damage. WS' directives and SOPs would be incorporated into activities conducted by WS when addressing bird damage and threats in the state.

Some key SOPs pertinent to the alternatives include the following:

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

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

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

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

- 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 FWC to determine the potential risks to T&E species in accordance with the ESA and state laws.

- All personnel who use chemicals would be 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 assistance.

- Management actions would be directed toward specific birds posing a threat of damage or causing damage.

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

- The lethal removal of birds would only occur when authorized by the USFWS and/or the FWC, when applicable, and only at levels authorized.

3.4 ADDITIONAL STANDARD OPERATING PROCEDURES SPECIFIC TO THE ISSUES

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

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

- Lethal take of birds by WS would be reported and monitored by WS, by the USFWS, and by the FWC to evaluate population trends and the magnitude of cumulative 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 damage management strategies.

- WS would monitor 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 pursuant to WS Directive 2.101.

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

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 placement, and capture devices that were strategically placed at locations likely to capture a target bird species 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 was possible and safe to do so.

- Carcasses of birds retrieved after damage management activities had 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 FWC to evaluate activities to resolve bird damage and threats to ensure the protection of T&E species.

- WS' personnel would be present during the use of live-capture methods or live-traps would be checked frequently to ensure non-target species were released immediately or would be prevented from being captured.

- 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 were not possible, then activities would be conducted during periods when human activity was low (*e.g.*, early morning).

- The use of firearms would occur during times when public activity and access to the control areas was restricted, when possible. Personnel involved in the use of firearms would be fully trained in the proper and safe application of this method.

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

- All chemical methods used by WS or recommended by WS would be registered with the FDA, the EPA, and/or the FDACS, when applicable.

- 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 with the property owner and/or manager by entering into a work initiation document, 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' personnel would be present during the use of most live-capture methods (*e.g.*, mist nets, cannon nets, rocket nets) to ensure birds captured were addressed in a timely manner to minimize the stress of being restrained.

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

- The NWRC would continue to conduct research to improve the selectivity and humaneness of wildlife damage management devices used by personnel in the field.

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

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as those alternatives relate to the issues identified.

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 USFWS, the FWC, and the FDACS.

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 were employed. WS would maintain ongoing contact with the USFWS and the FWC to ensure activities occurred within management objectives for those species. WS would submit annual activity reports to the USFWS. Therefore, the USFWS would have the opportunity to monitor the total take of birds from all sources and could factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the USFWS and the FWC would assure local, state, and regional knowledge of bird population trends were considered.

As discussed previously, methods available to address bird damage or threats of damage in the state that would be available for use or recommendation by WS under Alternative 1 (technical and operational assistance) and Alternative 2 (technical assistance only) would be either lethal methods or non-lethal methods. Under Alternative 2, WS could recommend lethal and non-lethal methods as part of an integrated approach to resolving requests for assistance but would provide no direct operational assistance. Alternative 1 addresses requests for assistance received by WS through technical and operational assistance where an integrated approach to methods could be employed and/or recommended. Non-lethal methods would include, but would not be limited to habitat/behavior modification, lure crops, visual deterrents, lasers, live traps, translocation, alpha chloralose, inactive nest destruction, exclusionary devices, frightening devices, nets, 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, the avicide DRC-1339, shooting, egg destruction, and the recommendation of legal hunting practices, where appropriate. Target birds would be euthanized using cervical dislocation, carbon dioxide, or firearms once birds were live-captured using other methods. Cervical dislocation, carbon dioxide, and firearms are considered conditionally acceptable forms of euthanasia for birds (AVMA 2013). 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 (see WS Directive 2.101). However, non-lethal methods would not necessarily be employed to alleviate every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance had already used non-lethal methods, WS would not likely recommend or continue to employ those particular methods because their use had already been proven ineffective in adequately resolving the damage or threat. Non-lethal methods would be used to exclude, harass, and disperse target wildlife from areas where damage or threats were occurring. When effective, non-lethal methods would disperse 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 proven effective in dispersing birds. For example, Avery et al. (2002*b*) 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*a*), 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.

The use of non-lethal methods could cause those species to move to other areas with minimal impact on those species' populations. Non-lethal methods would generally be regarded as having minimal effects on overall populations of target bird species because those birds would be 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 such a wide geographical scope that long-term adverse effects would occur to a species' population.

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*a*, Chipman et al. 2008). For any management methods employed, the proper timing would be essential in effectively dispersing those birds causing damage. Employing methods soon after damage begins or soon after threats were identified would increase the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of bird damage. The use of non-lethal methods would not have adverse effects on populations of birds in the state under any of the alternatives.

Lethal methods would be employed or recommended to alleviate 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 because 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 number of birds removed from a species' 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 because a reduction in the number of birds at a location leads to a reduction in damage, which is similar to the intent of using non-lethal methods because non-lethal methods disperse birds so they are no longer at a location to cause damage (*e.g.*, see Avery et al. 2008*a*, Chipman et al. 2008). The use of lethal methods has been successful in reducing bird damage (Boyd and Hall 1987, Gorenzel et al. 2000). Boyd and Hall (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. 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; thereby, leading to a reduction in damage at the location where those birds were dispersed. The intent of using lethal methods would be similar to the objective trying to be achieved when using non-lethal methods, which would be to reduce the number of birds in the area where damage was occurring; thereby, leading 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 would most often be used to supplement and reinforce the noise associated with non-lethal methods (*e.g.*, pyrotechnics). The capture of birds using live-traps and subsequently euthanizing those birds would be employed to reduce the number of birds using a particular area where damage was occurring. Similarly, the recommendation that birds be harvested during the regulated hunting season for those species in the state would be intended to manage those populations in an area where damage was occurring.

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 move into the area) or by birds the following year (increase in reproduction that could result from less competition for limited resources). This would assume birds only return to an area where damage was occurring if WS used lethal methods; however, the use of non-lethal methods can also be temporary, which could result in birds returning to an area where damage was occurring once those methods were no longer used. The common factor when employing any method would be that birds would return if suitable conditions continue to exist at the location where damage was occurring and bird densities were sufficient to occupy all available habitats. Therefore, any reduction or prevention of damage from the use of methods addressed in Appendix B would be temporary if habitat conditions continued to exist that attracted birds to an area where damage was occurring.

Furthermore, any method that disperses or removes birds from areas would only be temporary if preferred characteristics continued to exist the following year when birds returned. Dispersing birds using non-lethal methods addressed in Appendix B often requires repeated application to discourage birds from returning to locations, which can increase costs, moves birds to other areas where they could cause damage, and could be temporary if conditions where damage was occurring remained unchanged. Dispersing and the relocating of birds could move a problem from one area to another, which would require addressing damage caused by those birds at another location. WS' recommendation of or use of techniques to modify existing habitat or making areas unattractive to birds is discussed in Appendix B. WS' objective would be to respond to requests for assistance with the most effective methods and to provide for the long-term solution to the problem using WS' Decision Model.

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

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*a*, Chipman et al. 2008). For example, Chipman et al. (2008) found that crows returned to roosts previously dispersed using non-lethal methods within two to eight 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 that evaluated the use of only non-lethal methods. 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. For example, 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). 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.

Avery et al. (2008*a*) found similar results 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*a*). 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 because the intent of those methods would be to reduce the number of birds present at a site where damage was occurring at the time those methods were employed.

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

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 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 that 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 FWC 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.

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)

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 associated with birds in Florida. WS would work with those people 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 could be difficult to alleviate using available methods because birds would be conditioned to feed, roost, loaf, and would be familiar with a particular location. Subsequently, making that area unattractive using available methods could be difficult to achieve once damage was 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.

WS could employ and/or recommend those methods described in Appendix B in an adaptive approach that would integrate methods to reduce damage and threats associated with birds in the state. Under the proposed action alternative, WS' employees would give priority to non-lethal methods when addressing requests for assistance (see WS Directive 2.101) and WS could employ only non-lethal methods when determined to be appropriate for each request for assistance to alleviate damage or reduce threats of damage using the WS Decision Model. However, WS could also use or recommend the use of lethal methods under this alternative. When employing lethal methods, a depredation permit may be required from the USFWS and/or the FWC.

As previously stated, the lethal take of birds can occur without a permit if those species are non-native, under depredation/control orders, through the issuance of depredation permits by the USFWS and/or the FWC, or people can harvest some bird species during hunting seasons. The USFWS can issue permits for those species of birds protected under the MBTA while the FWC may also issue permits to take bird species, including non-migratory resident bird species, such as Wild Turkey.

The USFWS could issue depredation permits to WS and to those entities experiencing bird damage when requested and when deemed appropriate by the USFWS for those species that require a permit. When applying for a depredation permit, the requesting entity would submit with the application the number of birds requested to be taken to alleviate the damage. Therefore, under this alternative, the USFWS could 1) deny an application for a depredation permit when requested to alleviate bird damage; 2) could issue a depredation permit at the take levels requested; or 3) could issue permits at levels below those take levels requested. In addition to a depredation permit from the USFWS, the FWC may also require a permit to take migratory and non-migratory bird species. When the USFWS issues a depredation permit for a migratory bird species protected by the MBTA, the FWC could issue permits to take the same number of birds authorized by the USFWS or the FWC could issue a permit authorizing the lethal removal of less than the number permitted by the USFWS. However, the take authorized by the FWC cannot exceed the take level authorized by the USFWS.

The property owner or manager may choose to apply for their own depredation permit from the USFWS to lethally take birds, as required by the implementing regulations of the MBTA for depredation control (see 50 CFR 21.41). The USFWS requires non-lethal methods be used and shown ineffective or impractical before the USFWS will issue a depredation permit for lethal take. 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 review by the USFWS 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 could commence the authorized activities and would be required to submit a written report of their activities upon expiration of their permit. Permits may be renewed annually as needed to alleviate 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 would be the immobilizing drug alpha chloralose, the avicide DRC-1339, and the repellent mesurol, which are methods that can only be used by WS.

Under this alternative, WS would submit an application to the USFWS for a one-year depredation permit in anticipation of receiving requests for assistance to manage bird damage. The application submitted by WS would estimate the maximum number of birds of each species that could be lethally removed as part of an integrated approach. When submitting an application for a depredation permit each year, WS would use adaptive management principles to adjust the requested number of birds that could be lethally removed. Adjustments on the requested lethal take levels would be made based on anticipated needs using activities conducted previously as a guide. WS would not submit a Migratory Bird Damage Report as part of the application process. The USFWS would conduct an independent review of the application, and if acceptable, would issue a permit as allowed under the depredation permit regulations. WS could request an amendment to a permit to increase the number of birds that could be taken to address unpredicted and emerging damage or threats.

Therefore, the USFWS and/or the FWC could 1) deny WS' application for a depredation permit; 2) issue a depredation permit for the take of birds at a level below the number requested by WS; or 3) issue a depredation permit for the number of birds requested by WS. In addition, WS could be listed as subpermittees under depredation permits issued to other entities.

If WS implements Alternative 1, WS could destroy nests and the associated eggs of certain target bird species as part of an integrated approach to managing damage. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success, which may cause them to relocate and nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected when destroying eggs in nests and nest destruction, this activity generally has no long-term effect on breeding adult birds when conducted in limited situations. WS would not use nest and egg removal as a population management method. WS would use this method to inhibit nesting in an area experiencing damage due to or associated with the nesting activity in a localized area. If WS' personnel encounter eggs and/or nestlings in an active nest, WS could destroy the eggs by egg addling, egg oiling, shaking the egg, or by breaking the eggs open. If WS' personnel encountered nestlings in an active nest, WS' personnel would euthanize those nestlings in accordance with WS Directive 2.505. For the purposes of the analysis for those target bird species, WS will consider nestlings euthanized as part of the cumulative take of a target bird species. As with the lethal take of birds, the USFWS and/or the FWC must authorize the take of active nests. Therefore, the number of active nests that WS destroys would occur at the discretion of the USFWS and/or the FWC.

WS could also address requests for assistance using live-capture methods and the subsequent translocation of target bird species. Any of the target birds could be live-captured using live-traps, cannon nets, rocket nets, mist nests, bow nets, or other methods and translocated; however, translocation would most often be used for raptor species, waterfowl species, and bird species that were harvestable (*e.g.*, Wild Turkeys). Translocation of birds could only occur under the authority of the USFWS and/or the FWC, when required. Therefore, the translocation of birds by WS would only occur as directed by those agencies. Translocation sites would be identified and have to be approved by the USFWS, the FWC, and/or the property owner where the translocated birds would be placed prior to live-capture. When authorized by the USFWS and/or the FWC, WS could translocate birds under this alternative and recommend translocation under Alternative 2. When birds were released into appropriate habitat and when translocation occurred during the migration periods, WS does not anticipate translocation to affect target bird populations adversely or to affect individual birds adversely.

As part of translocating birds and for other purposes (*e.g*., movement studies), WS could band target birds for identification purposes using appropriately sized leg bands. Banding would occur pursuant to a banding permit issued by the USGS. Fair et al. (2010) stated "[w]*hen appropriate* [leg] *band sizes are used, the occurrence and rate of adverse effects on the subjects is ordinarily very low*". Therefore, WS does not expect the use of appropriately sized leg bands to adversely affect populations or individual birds.

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; however, the primary concern would be from the use of lethal methods to address damage. The lethal take of birds would be monitored by comparing numbers of animals killed with overall populations, trends in populations, and other available information to assure the magnitude of take is maintained below the level that would cause significant adverse effects to the viability of native species' populations. The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below.

CANADA GOOSE BIOLOGY AND POPULATION IMPACTS ANALYSIS

Canada Geese are endemic to North America, where they occur in each state of the United States (except Hawaii), each Province of Canada, and many States of Mexico. In the past, most authorities recognized 11 subspecies of Canada Geese, which differed primarily in body size and color (Bellrose 1980). Today, there are generally two recognized distinct species of geese. Those two distinct species are the smaller Cackling Goose and the larger Canada Goose (Mowbray et al. 2002, Willcox and Giuliano 2012). There are generally four recognized subspecies of Cackling Geese, which are generally found breeding and migrating within western and northwestern North America. There are seven recognized subspecies of the Canada Goose found in North America (Willcox and Giuliano 2012). In Florida, only the Canada Goose can be found.

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

Within the flyways, there are two behaviorally distinct types of Canada Goose populations that may be present depending on the time of year. The two distinct types of geese that could be present are generally referred to as "*resident*" and "*migratory*" geese. Canada Geese are considered resident geese when one of the following criteria are met: 1) nests and/or resides on a year round basis within the contiguous United States; 2) nests within the lower 48 states in the months of March, April, May, or June; or 3) resides within the lower 48 states and the District of Columbia in the months of April, May, June, July, and August (see 50 CFR 21.3; Rusch et al. 1995, Ankney 1996, USFWS 2005). Migrant geese nest across the arctic, subartic, and boreal regions of Canada and Alaska and are present in the conterminous United States during the winter.

In the Atlantic Flyway, resident Canada Geese consist of several subspecies that were introduced and established during the early 1900s after extirpation of native birds (Delacour 1954, Dill and Lee 1970, Pottie and Heusmann 1979, Benson et al. 1982). Today, most Atlantic Flyway resident Canada Geese are non-migratory or travel only short distances between wintering and breeding areas (Atlantic Flyway Council 2011). Historically, Florida did not support a breeding population of Canada Geese (Atlantic Flyway Council 2011). During the 1960s and 1970s, the FWC conducted a series of releases of Canada Geese into numerous counties across the panhandle of the state and some counties further south. The release of those geese has slowly allowed some local populations of Canada Geese to become resident, which are present in those areas throughout the year. As the breeding population increased, the resident population of geese began to expand. By 1991, Canada Geese had been confirmed breeding in Clay, Dade, Duval, Gadsden, Jefferson, Lake, Leon, Manatee, Marion, Pasco, Santa Rosa, Seminole, Sumter, Suwannee, and Volusia Counties, with probable breeding populations occurring in Madison County and possible breeding populations occurring in Alachua County (Kale et al. 1992).

As populations of resident geese increased and expanded in the Atlantic Flyway, the number of complaints regarding damage increased (USFWS 2005). Due to an increasing resident Canada Goose population and an increase in damage complaints received across all the flyways, the USFWS developed an EIS that analyzed issues and alternatives associated with managing resident goose populations (USFWS 2005). Under the selected alternative in the resident Canada Goose FEIS developed by the USFWS, several mechanisms were established to allow the states to further manage resident goose populations and goose damage (USFWS 2005). An additional mechanism in place to address increasing resident goose populations was increased opportunities to address resident geese during regulated hunting seasons.

In 2006, the USFWS published a final rule in the Federal Register (see 71 FR 45964) establishing regulations (see 50 CFR 20 and 50 CFR 21) to expand management opportunities to address damage from resident Canada Geese. Those management opportunities included the Agricultural Depredation Order (see 50 CFR 21.51), the Control Order for Resident Geese at Airports and Military Airfields (see 50 CFR 21.49), and the Nest and Egg Depredation Order (see 50 CFR 21.50). To date, the FWC has implemented the Nest and Egg Depredation Order and the Agricultural Depredation Order (Atlantic Flyway Council 2011).

The first management plans for resident Canada Geese in the Atlantic Flyway were developed in 1989, to help manage harvest and manage human/goose conflicts. The current management plan addressing resident Canada Geese in the Atlantic Flyway outlines the main goals of state and federal agencies "*...to achieve a socially acceptable balance between the positive values and negative conflicts associated with* [resident Canada Geese]" (Atlantic Flyway Council 2011). The main subject areas covered in the current plan as they relate to population management focusing on population objectives, harvest management, and population control. Population objectives as outlined in the management plan were to reduce the resident Canada Goose population in the Atlantic flyway to 700,000 geese by 2020. During the development of the current resident Canada Goose management plan, the population of resident Canada Geese in the Atlantic Flyway was estimated at 1.4 million geese (Atlantic Flyway Council 2011). The spring 2017 estimate for the Atlantic Flyway resident Canada Goose population was estimated at 933,300 (788,300–1,078,300) geese which was similar to the 2016 estimate of 950,000 (792,900–1,107,000; P = 0.879) geese (USFWS 2017*a*) and remains above the population objective recommended by the Atlantic Flyway Council in their resident Canada Goose management plan (Atlantic Flyway Council 2011).

To relieve damage and conflicts, the plan called for the maximum opportunities for the use and appreciation of resident Canada Geese that are consistent with population goals. The plan also called for the management of resident Canada Goose populations to be compatible with management criteria established for migrant geese and to annually monitor populations, harvest, and conflict levels to evaluate the effectiveness of the management plan (Atlantic Flyway Council 2011).

The current resident Canada Goose population in Florida is unknown. However, the number of adult resident Canada Geese in Florida during 2010 was estimated at 5,000 geese, which represented an increase from the 1,000 geese estimated in 2004 (Atlantic Flyway Council 2011). From 1966 through 2015, the number of geese observed in areas of the state surveyed during the BBS has increased annually, with the annual increase estimated at 17.78% (Sauer et al. 2017). From 2005 through 2015, the number of geese observed in areas surveyed during the BBS has shown an increasing trend estimated at 8.25% annually (Sauer et al. 2017). During most of the year, the Canada Geese present in the state are resident, not migratory. Those resident geese reside in Florida throughout the year; however, distinguishing a resident Canada Goose and a migratory Canada Goose can be difficult.

In the Atlantic Flyway, migratory Canada Geese consist primarily of three distinct populations. Those populations include the North Atlantic Population (NAP), Atlantic Population (AP), and the Southern James Bay Population (SJBP) (USFWS 2017*a*). Historically, only migratory Canada Geese were found in Florida. A regularly occurring migratory population of up to 47,000 geese could be found wintering in the Wakulla County area of northern Florida (FWC 2003). However, since the 1960s, the majority of those birds have been stopping and wintering in states further to the north, which reduced the overwinter population in that area to less than 2,000 birds (FWC 2003, Willcox and Giuliano 2012). Today, the number of migratory goose wintering annually in the northern portion of the state has stabilized at approximately 1,000 geese (Willcox and Giuliano 2012).

Like other waterfowl, Canada Geese can be harvested during annual hunting seasons across the Atlantic Flyway. Frameworks for the annual hunting seasons are established by the USFWS and implemented by the wildlife management agency in each state. In Florida, hunting frameworks for geese are implemented by the FWC. Prior to 1997, geese could not be harvested in the state (Atlantic Flyway Council 2011). In 1997, the FWC allowed geese to be harvested but only on Lake Seminole in northern Florida, with goose hunting prohibited elsewhere in the state. In 2008, resident Canada Goose populations had increased sufficiently to allow a statewide hunting season for geese. Today, geese can be harvested statewide in Florida during an early September season and during the regular waterfowl season (FWC 2017). Preliminary data shows that no geese were harvested in the state during the 2012 season, 1,690 geese were harvested during the 2013 season, 5,740 geese were harvested during the 2014 season, 840 geese were harvested during the 2015 season, and no geese were harvested during the 2016 season (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

Most requests for assistance received by WS to address damage caused by Canada Geese occurs during those months when geese present in the state would be considered resident. Most geese present in the state are not migratory. As stated previously, only a small migratory population may be present in the state during the migration periods and is generally isolated to an area in northern Florida. Therefore, the geese addressed by WS to alleviate damage will be analyzed here as if all geese addressed were resident geese. Distinguishing resident and migratory Canada Geese is not possible through visual identification. However, based on the type of damage occurring and the locations where requests for assistance occur, those geese addressed by WS would likely be resident geese (*i.e.*, present in the state all year). Most requests for assistance received by WS are associated with airports and urban areas where geese are present throughout the year.

From FY 2012 through FY 2016, WS employed pyrotechnics, human presence, and the noise associated with the discharge of a firearm to disperse 546 geese to alleviate damage and threats of damage (see Table 4.1). In addition, WS employed lethal methods to remove 143 geese between FY 2012 and FY 2016, with the highest level of annual take occurring in FY 2015 when 55 geese were removed by WS. Geese have also been addressed by other entities to alleviate damage. From 2012 through 2016, 285 geese have been removed by other entities, averaging 57 per year with the highest annual take by other entities occurring in 2016 when 94 geese were removed (see Table 4.1).

Based on the number of requests received to manage damage associated with Canada Geese and the number of Canada Geese addressed previously, WS could take up to 200 geese annually in the state to alleviate damage. In addition, up to 50 nests/eggs could be destroyed by WS annually to alleviate damage or threats of damage. The take of geese, including their nests and eggs, is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits or pursuant to depredation orders.

Table 4.1 – Number of Canada Geese addressed in Florida by all entities, 2012 - 2016

Year	Hunter Harvest[1,2]	WS' Activities[3]		Take by Other Entities[4]
		Dispersed	Take	
2012	0	126	42	11
2013	1,690	123	14	36
2014	5,740	88	8	57
2015	840	164	55	87
2016	0	45	24	94
TOTAL	**8,270**	**546**	**143**	**285**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. (2014), Raftovich et al. (2015), Raftovich et al. (2016), and Raftovich et al. (2017)

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

If the statewide goose population has remained relatively stable in Florida, WS' annual take of up to 200 geese would represent 4.0% of the estimated statewide goose population in 2010, which was estimated at 5,000 geese. Since 2012, the highest number of geese harvested annually in the state has been estimated at 5,740 geese. Based on the highest previous harvest levels of geese from 2012 through 2016, take of up to 200 geese annually by WS would have represented 3.5% of the highest estimated harvest of geese in the state and take of 294 geese by all entities in the state would have represented 5.1% of the highest estimated harvest of geese in the state. As discussed previously, trend data from the BBS indicates that resident Canada Goose populations in the state continue to increase, despite WS' previous take and take during the hunting season.

Under the proposed action, the nests and/or eggs of resident Canada Geese could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, WS could destroy up to 50 nests annually, including eggs in the nest. WS' take of nests and/or eggs would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests would not exceed 50 annually and would not exceed the level permitted under depredation permits.

Impacts due to nest and egg destruction would have little adverse effect on the resident goose population in Florida. Additionally, geese are a long-lived species and have the ability to identify areas with regular human disturbance and low reproductive success, which causes them to relocate and nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected, this activity would not have long-term effects on breeding adult geese. Nest and egg removal would not be used by WS as a population management method. This method would be used by WS to discourage nesting in an area and would be employed only at the localized level. Treatment of 95% of all Canada Goose eggs each year would result in only a 25% reduction in the population over 10 years (Allan et al. 1995). The resident Canada Goose management FEIS developed by the USFWS concluded that a nest and egg depredation order would have minimal impacts on goose populations with only localized reductions in the number of geese occurring (USFWS 2005).

The reproductive inhibitor known as nicarbazin has been registered with the EPA for use to manage Canada Goose and domestic waterfowl populations on a local scale by reducing the likelihood that eggs laid will hatch. Nicarbazin, as a reproductive inhibitor for geese and domestic waterfowl, has been registered with the EPA as a pesticide pursuant to the FIFRA under the trade name OvoControl® G (Innolytics, LLC, Rancho Sante Fe, CA). Label requirements of OvoControl® G restrict the application of the product to urban areas, which limits the extent of the products use for reducing localized waterfowl populations. Based on current information, WS' use or recommendation of nicarbazin formulated under the trade name OvoControl® G would not adversely affect resident goose populations in Florida because WS' activities would not be additive to those activities that could occur in the absence of WS' use of the product. Given that the effects of nicarbazin would only be temporary if birds were not fed an appropriate dose of nicarbazin daily, the reduction in the population could be fully reversed if treated bait was no longer supplied and other conditions (*e.g.*, food, disease) were favorable for population growth.

FERAL WATERFOWL BIOLOGY AND POPULATION IMPACT ANALYSIS

Feral 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, Egyptian Geese, Embden Geese, and Pilgrim Geese. Feral ducks may include a combination of Mallards, Muscovy Duck, and Mallard-Muscovy hybrids. All domestic ducks, except for Muscovy Ducks, were derived from the Mallard (Drilling et al. 2002).

Many waterfowl of domestic or semi-wild genetic backgrounds have been released by humans into rural and urban environments; including numerous species of ducks, geese, and swans. Selective breeding has resulted in the development of numerous domestic varieties of the Mallard that no longer exhibit the external characteristics or coloration of their wild Mallard ancestors. An example of a feral duck is the "*urban*" Mallard duck. The coloration of the feathers of urban ducks can be highly variable and often does not resemble that of the wild Mallard. Urban Mallard ducks in the state often display a variety of physical characteristics. For example, males may be missing the white neck ring or the neck ring will be an inch wide instead of the narrow 1/4 inch wide ring found on wild Mallards. Males may have purple heads instead of green heads and heavily mottled breast feathers while females may have be blonde coloration instead of mottled brown. The bills of females may be small and black instead of orange mottled with black and either sex may have white coloration on the wings, tail, or body feathers. In addition, urban ducks may weigh more than wild ducks (2.5 to 3.5 pounds).

Domestic waterfowl have been purchased and released by property owners for their aesthetic value and as a food source, but may not always remain at the release sites; thereby, becoming feral. Feral waterfowl is defined as a domestic species of waterfowl that cannot be linked to a specific ownership. Examples of areas where domestic waterfowl have been released are business parks, universities, wildlife management areas, parks, military bases, residential communities, and housing developments. Many times, those birds are released with no regard or understanding of the consequences that releasing domestic waterfowl can have on the environment or the local community. Under Florida Statutes (Title XXVIII, Chapter 379, Part 1, Section 379.231) it is unlawful to release within the state any species of the animal kingdom that is not native to Florida without authorization from the FWC.

Federal law does not protect domestic varieties of waterfowl (see 50 CFR 21), nor are domestic waterfowl specifically protected by state law in Florida. Domestic and feral waterfowl in the state may be of mixed heritage and may show feather coloration of wild waterfowl. Some domestic and feral ducks are incapable of sustained flight, while some are incapable of flight at all due to hybridization. Domestic waterfowl may at times crossbreed with migratory waterfowl species creating a hybrid cross breed (*e.g.*, Mallard X domestic duck, Canada Goose X domestic goose). Those types of hybrid waterfowl species would be taken in accordance with definitions and regulations provided in 50 CFR 10 and 50 CFR 21.

Domestic ducks, geese, and swans are non-indigenous species considered by many wildlife biologists and ornithologists to be an undesirable component of North American wild and native ecosystems. Any reduction in the number of these domestic waterfowl species could be considered as providing some benefit to other native bird species because they compete with native wildlife for resources. Domestic and feral waterfowl are usually found near water, such as ponds, lakes, retaining pools, and waterways. Domestic and feral waterfowl generally reside in the same area year around with little to no migration occurring. Those birds are often found in areas where resident Canada Geese inhabit. Currently, there are no population estimates for domestic and feral waterfowl in Florida. Domestic and feral waterfowl are not protected by federal and state laws and are not considered for population goal requirements, including the MBTA, except for certain portions of the Muscovy Duck population.

The Muscovy Ducks located in the state are from non-migratory populations that originated from domestic stock. The USFWS has recently changed the regulations governing Muscovy Ducks. Because Muscovy Ducks now occur naturally in southern Texas, this species has been added to the list of migratory birds provided protections under the MBTA. However, it has been introduced and is not native in other parts of the United States, including the State of Florida. The USFWS now prohibits sale, transfer, or propagation of Muscovy Ducks for hunting and any other purpose other than food production, and allows their removal in locations where the species does not occur naturally in United States, including Florida. The USFWS has revised 50 CFR 21.14 (permit exceptions for captive-bred migratory waterfowl other than Mallards) and 50 CFR 21.25 (waterfowl sale and disposal permits), and has added 50 CFR 21.54, an order to allow control of Muscovy Ducks, their nests, and eggs.

From FY 2012 through FY 2016, WS used non-lethal methods to address 21 feral waterfowl to alleviate damage and threats of damage (see Table 4.2). In addition, WS employed lethal methods to address 216 feral waterfowl from FY 2012 through FY 2016, which is an average removal of 43 feral waterfowl per year. In FY 2012, WS lethally removed 181 feral waterfowl to alleviate damage, which represented the highest annual take level from FY 2012 through FY 2016. The number of feral waterfowl addressed by other entities in the state is currently unknown. The reporting of feral waterfowl take is not currently required.

Based on previous efforts to alleviate the threat of damage associated with feral waterfowl and the number of feral waterfowl addressed previously to alleviate those threats, WS anticipates the need to lethally remove up to 300 feral waterfowl annually in the state to alleviate damage or the threat of damage. In addition, up to 150 feral waterfowl nests could be destroyed annually when requested.

Table 4.2 – Number of feral waterfowl addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	10	181
2013	5	12
2014	2	23
2015	3	0
2016	1	0
TOTAL	**21**	**216**

Because feral waterfowl often compete with native wildlife species for resources, any reduction of the feral waterfowl population in the state, even to the extent of complete eradication from the natural environment, could be viewed as providing some benefits to the natural environment. The number of feral waterfowl inhabiting the state is currently unknown. However, based on the limited take proposed and the likely benefits to the natural environment that could occur, take of up to 300 feral waterfowl and up to 150 nests would not adversely affect the population.

BLUE-WINGED TEAL BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Blue-winged Teal is a small dabbling duck with slight sexual dimorphism that can be found throughout North America with breeding grounds in the northern United States and southern Canada, primarily in mixed-grass prairies (Rohwer et al. 2002). These ducks are long distance migrants, some crossing the Gulf of Mexico from South America to North America, and are one of the earliest North American ducks to migrate south in the fall, and one of the last to migrate north in the spring. Blue-winged Teal can be found throughout the year in east Texas and coastal Louisiana (Rohwer et al. 2002). Blue-winged Teal populations are highly correlated to the condition of prairie wetlands on their breeding grounds, with current populations well above North American Waterfowl Management Plan goals and ranking as the second most abundant duck in North America (Rohwer et al. 2002).

The number of Blue-winged Teal observed during the breeding season from 1966 through 2015 in areas surveyed during the BBS have shown declining trends estimated at -0.04% annually, but have shown increases of 1.52% from 2005 through 2015 (Sauer et al. 2017). The current breeding population of Blue-winged Teal is approximately 7.9 million (USFWS 2017*a*).

Between 1996 and 2015, the number of Blue-winged Teal observed during the CBC in areas surveyed in Florida has shown a cyclical trend (National Audubon Society 2010). Between 2006 and 2015, 8,536 Blue-winged Teal have been observed on average per year in areas surveyed in Florida (National Audubon Society 2010). The highest count occurred in 2007 when 10,925 Blue-winged Teal were counted during the CBC, while the lowest count occurred in 2014 when 5,089 Blue-winged Teal were counted (National Audubon Society 2010). In 2015, observers counted 8,179 Blue-winged Teal in areas surveyed during the CBC (National Audubon Society 2010).

Like other waterfowl, Blue-winged Teal can be harvested in the state during a regulated hunting season. Between 2012 and 2016 hunting seasons, 259,094 Blue-winged Teal have been harvested in the state (see Table 4.3, which is an average of 51,819 Blue-winged Teal harvested per year in the state. The highest harvest level occurred in 2012 when 71,029 Blue-winged Teal were harvested (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

Requests for assistance received by WS associated with Blue-winged Teal would primarily be associated with aircraft strike risks at airports and military bases. Aircraft strikes with waterfowl can cause substantial damage to aircraft and can cause the catastrophic failure of aircraft systems, especially when multiple birds are ingested into engines. WS has addressed previous requests for assistance associated with Blue-winged Teal with non-lethal methods. From FY 2012 through FY 2016, WS dispersed 5,867 Blue-winged Teal to alleviate damage. In addition, from FY 2012 through FY 2016, WS employed lethal methods to lethally remove 87 Blue-winged Teal, with the highest take levels occurring in FY 2014 when WS lethally removed 51 Blue-winged Teal (see Table 4.3). Other entities have also removed Blue-winged Teal to address damage and threats of damage. From 2012 through 2016, five Blue-winged Teal were lethally removed by other entities to reduce damage risks. Take by WS and all other entities would occur under a depredation permit issued by the USFWS for the take of Blue-winged Teal, which would ensure the cumulative take of Blue-winged Teal from all known sources was considered when establishing population objectives.

Table 4.3 – Number of Blue-winged Teal addressed in Florida by all entities, 2012 - 2016

Year	Hunter Harvest[1,2]	WS' Activities[3]		Take by Other Entities[4]
		Dispersed	Take	
2012	71,029	787	0	0
2013	50,422	1,264	1	4
2014	39,083	1,523	51	0
2015	55,690	1,524	21	1
2016	42,870	769	14	0
TOTAL	**259,094**	**5,867**	**87**	**5**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, and Raftovich et al. 2017.

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

Based on previous efforts to address damage risks associated with Blue-winged Teal and in anticipation of additional efforts to alleviate risks, WS could lethally remove up to 200 Blue-winged Teal per year under the proposed action alternative. If WS had lethally removed 200 Blue-winged Teal each year from FY 2012 through FY 2016, WS' annual take would have represented 0.3% to 0.5% of the number of Blue-winged Teal harvested from 2012 through 2016. If WS lethally removes 200 Blue-winged Teal per year, total take would represent 2.3% of the average number of Blue-winged Teal observed in areas surveyed during the CBC from 2006 through 2015. The lowest number of Blue-winged Teal observed in areas surveyed during the CBC from 2006 through 2015 was 5,089 teal. The lethal removal of 200 Blue-winged Teal would represent 3.9% of lowest number of Blue-winged Teal observed during the CBC from 2006 through 2015. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect Blue-winged Teal populations.

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 evaluate the magnitude of take that could occur by WS when compared to the number of Blue-winged Teal observed in the state during the CBC. The number of teal observed in areas surveyed during the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the state.

MALLARD BIOLOGY AND POPULATION IMPACTS ANALYSIS

Found across most of North America, the Mallard is the most abundant and one of the most recognizable waterfowl species (Drilling et al. 2002). In Florida, Mallards can be found statewide throughout the year (Drilling et al. 2002). Mallards are often associated with wetlands, streams, ponds, and lakes; however, Mallards are flexible and adaptable and can be found in a variety of habitats (Drilling et al. 2002). An omnivorous and opportunistic duck, Mallards will consume a wide variety of invertebrates, vegetation, seeds, and human provided food (Drilling et al. 2002). With the exception of the mating season, Mallards are highly social, congregating in flocks that can number in the thousands during the winter and spring and fall migration (Drilling et al. 2002).

The number of Mallards observed in the state during the BBS has increased an estimated 14.47% annually since 1966 with an increase of 17.27% annually estimated from 2005 through 2015 (Sauer et al. 2017). Across all BBS routes surveyed in the United States, the number of Mallards observed annually has increased at an estimated rate of 1.56% annually between 1966 and 2015 (Sauer et al. 2017). The number of Mallards observed in the state during the CBC had shown a declining trend between 1966 and the late-1990s; however, since the late-1990s, the number of Mallards observed has increased to levels not observed since the early-1960s (National Audubon Society 2010). The statewide population of Mallards is unknown.

Like other waterfowl species, Mallards can be harvested during a regulated season in the state. From 2012 through 2016, an estimated 5,270 Mallards were harvested in the state. In addition, it was estimated that 1,017 domestic Mallards were harvested in the state during the same period (see Table 4.4). In 2016, 550 Mallards were harvested in the state (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

In addition to the harvest of Mallards during the hunting season, 21 Mallards have been lethally taken by WS from FY 2012 through FY 2016. Other entities have lethally removed 495 Mallards and 5,202 Mallard eggs to alleviate damage or threats of damage in the state from 2012 through 2016. From 2012 through 2016, the combined take of WS and the take of Mallards under depredation permits by other entities represented 8.2% of the total number of Mallards harvested in Florida during the regulated hunting season from 2012 through 2016.

Table 4.4 - Number of Mallards addressed in Florida by all entities, 2012 - 2016

	Hunter Harvest[1,2]		WS' Activities[3]		
Year	**Mallard**	**Domestic Mallard**	**Dispersed**	**Take**	**Take by Other Entities[4]**
2012	1,360	210	20	1	0
2013	1,160	130	13	2	2
2014	460	127	18	2	0
2015	520	210	182	12	13
2016	550	220	79	4	480
TOTAL	**5,270**	**1,017**	**312**	**21**	**495**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. (2014), Raftovich et al. (2015), Raftovich et al. (2016), and Raftovich et al. (2017)

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

Based on the number of requests received for assistance previously and in anticipation of additional efforts to manage damage, an annual take of up to 200 Mallards by WS 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 will increase. Since 2012, the average number of Mallards harvested in the state has been 1,257 Mallards. Based on the average take of Mallards from 2012 through 2016, take of up to 200 Mallards by WS would have represented 15.9% of the estimated average harvest 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 Florida. All take by WS would occur under a depredation permit issued by the USFWS for the take of those Mallards, which would ensure the cumulative take of Mallards from all known sources was considered when establishing population objectives for Mallards.

MOTTLED DUCK BIOLOGY AND POPULATION IMPACT ANALYSIS

The Mottled Duck is a relative of the American Black Duck and the Mallard that can be found from peninsular Florida westward along the coastal marshes of the Gulf of Mexico (Bielefeld et al. 2010).

Mottled Ducks can be found throughout the year in peninsular Florida (Bielefeld et al. 2010). Mottled Ducks are associated with freshwater wetlands, including marshes, natural and human-made ponds, ditches, and impoundments in rural and suburban areas in Florida (Bielefeld et al. 2010). Although less gregarious than other waterfowl species, large concentrations of Mottled Ducks can be found in Florida during their wing molt (Bielefeld et al. 2010).

The number of Mottled Ducks observed during the breeding season in Florida has shown a declining trend estimated at -0.03% annually since 1966 with the number of Mottled Ducks observed from 2005 through 2015 in areas surveyed during the BBS showing declining trends estimated at -3.3% annually (Sauer et al. 2017). Mottled Ducks are also showing decreases across the United States estimated at -3.13% since 1966, with a -1.93% annual decrease occurring from 2005 through 2015 (Sauer et al. 2017). The current breeding population of Mottled Ducks in Florida is currently unknown.

Between 1996 and 2011, the number of Mottled Ducks observed in areas of Florida surveyed during the CBC has shown a general increasing trend (National Audubon Society 2010). Between 2006 and 2015, 4,651 Mottled Ducks have been observed on average per year in areas surveyed in Florida during the CBC (National Audubon Society 2010). Between 2006 and 2015, the highest count occurred during 2010 when 5,710 Mottled Ducks were counted during the CBC, while the lowest count occurred in 2014 when 3,887 Mottled Ducks were counted (National Audubon Society 2010). In 2015, observers counted 4,193 Mottled Ducks in areas of the state surveyed during the CBC (National Audubon Society 2010).

Like other waterfowl, Mottled Ducks can be harvested in the state during a regulated hunting season. As shown in Table 4.5, 39,210 Mottled Ducks have been harvested in the state during the hunting season from 2012 through 2016. The average number of Mottled Ducks harvested per year in the state is 7,842 Mottled Ducks. The highest harvest level occurred in 2013 when 9,050 Mottled Ducks were harvested (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

Requests for assistance received by WS associated with Mottled Ducks would primarily be associated with aircraft strike risks at airports and military bases. Aircraft strikes with waterfowl can cause substantial damage to aircraft and can cause the catastrophic failure of aircraft systems, especially when multiple birds are ingested into engines. WS has addressed previous requests for assistance associated with Mottled Ducks primarily with non-lethal methods. From FY 2012 through FY 2016, WS dispersed 1,044 Mottled Ducks to alleviate damage. In addition, from FY 2012 through FY 2016, WS employed lethal methods to lethally remove 87 Mottled Ducks, with the highest take levels occurring in FY 2013 and FY 2015 when WS lethally removed 25 Mottled Ducks each year (see table 4.5). Other entities have also removed Mottled Ducks to address damage and threats of damage. From 2012 through 2016, 51 Mottled Ducks were lethally removed by other entities to reduce damage risks. Take by WS and all other entities would occur under a depredation permit issued by the USFWS for the take of Mottled ducks, which would ensure the cumulative take of Mottled Ducks from all known sources was considered when establishing population objectives.

Based on previous efforts to address damage risks associated with Mottled Ducks and in anticipation of additional efforts to alleviate risks, WS could lethally remove up to 100 Mottled Ducks per year under the proposed action alternative. If WS had lethally removed 100 Mottled Ducks each year from FY 2012 through FY 2016, WS' annual take would have represented 1.1% to 1.6% of the number of Mottled Ducks harvested from 2012 through 2016. If WS lethally removes 100 Mottled Ducks per year, total take would represent 2.2% of the average number of Mottled Ducks observed in areas surveyed during the CBC from 2006 through 2015. The lowest number of Mottled Ducks observed in areas surveyed during the CBC from 2006 through 2015 was 3,887 ducks. The lethal removal of 100 Mottled Ducks would represent 2.6% of lowest number of Mottled Ducks observed during the CBC from 2006 through 2015. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect Mottled Duck populations.

Table 4.5 - Number of Mottled Ducks addressed in Florida by all entities, 2012 - 2016

Year	Hunter Harvest[1,2]	WS' Activities[3]		Take by Other Entities[4]
		Dispersed	Take	
2012	7,940	93	18	0
2013	9,050	308	25	26
2014	6,380	193	11	5
2015	8,480	276	25	20
2016	7,360	174	8	0
TOTAL	**39,210**	**1,044**	**87**	**51**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. (2014), Raftovich et al. (2015), Raftovich et al. (2016), Raftovich et al. (2017)

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

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 evaluate the magnitude of take that could occur by WS when compared to the number of Mottled Ducks observed in the state during the CBC. The number of ducks observed in areas surveyed during the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the state.

LESSER SCAUP BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Lesser Scaup is a medium sized black and white diving duck and is one of the most abundant and widespread North American ducks (Anteau et al. 2014). It breeds primarily in Canada, and is one of the last waterfowl to leave an area at freeze-up, at which point the Lesser Scaup tends to form large flocks on rivers, lakes, and large wetlands (Anteau et al. 2014). It is found in Florida during the winter and is a late spring migrant, often still seen in migration into mid-May (Anteau et al. 2014).

The number of Lesser Scaup observed during the breeding season from 1966 through 2015 in areas surveyed during the BBS have shown increasing trends estimated at 0.75% annually, and have shown increases of 3.75% from 2005 through 2015 (Sauer et al. 2017). The current breeding population of scaup (breeding ground surveys include both Lesser Scaup and Greater Scaup) in the United States is approximately 4.4 million (USFWS 2017*a*).

From 1966 through 2015, the number of Lesser Scaup observed during the CBC in areas surveyed in Florida has shown a cyclical trend (National Audubon Society 2010). Between 2006 and 2015, 241,245 Lesser Scaup have been observed on average per year in areas surveyed in Florida (National Audubon Society 2010). The highest count occurred in 2012 when 1,082,255 Lesser Scaup were counted during the CBC, while the lowest count occurred in 2009 when 52,106 Lesser Scaup were counted (National Audubon Society 2010). In 2015, observers counted 73,234 Lesser Scaup in areas surveyed during the CBC (National Audubon Society 2010).

Like other waterfowl, Lesser Scaup can be harvested in the state during a regulated hunting season. As shown in Table 4.6, an estimated 2,420 Lesser Scaup were harvested in the state during the 2016 hunting season. From 2012 through 2016, 56,786 Lesser Scaup have been harvested in the state, which is an average of 11,357 Lesser Scaup harvested per year in the state. The highest harvest level occurred in 2012 when 18,906 Lesser Scaup were harvested (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

Requests for assistance received by WS associated with Lesser Scaup would primarily be associated with aircraft strike risks at airports and military bases. Aircraft strikes with waterfowl can cause substantial damage to aircraft and can cause the catastrophic failure of aircraft systems, especially when multiple birds are ingested into engines. WS has addressed previous requests for assistance associated with Lesser Scaup with non-lethal methods. From FY 2012 through FY 2016, WS dispersed 29,687 Lesser Scaup to alleviate damage. In addition, from FY 2012 through FY 2016, WS employed lethal methods to lethally remove 73 Lesser Scaup, with the highest take levels occurring in FY 2016 when WS lethally removed 61 Lesser Scaup (see Table 4.6). Other entities have also removed Lesser Scaup to address damage and threats of damage. From 2012 through 2016, 15 Lesser Scaup were lethally removed by other entities to reduce damage risks. Take by WS and all other entities would occur under a depredation permit issued by the USFWS for the take of Lesser Scaup, which would ensure the cumulative take of Lesser Scaup from all known sources was considered when establishing population objectives.

Table 4.6 – Number of Lesser Scaup addressed in Florida by all entities, 2012 - 2016

Year	Hunter Harvest[1,2]	WS' Activities[3]		Take by Other Entities[4]
		Dispersed	Take	
2012	18,906	0	0	0
2013	8,145	1,089	0	7
2014	18,208	152	5	0
2015	9,107	4,361	7	6
2016	2,420	24,085	61	2
TOTAL	**56,786**	**29,687**	**73**	**15**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. (2014), Raftovich et al. (2015), Raftovich et al. (2016), Raftovich et al. (2017)

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

Based on previous efforts to address damage risks associated with Lesser Scaup and in anticipation of additional efforts to alleviate risks, WS could lethally remove up to 200 Lesser Scaup per year under the proposed action alternative. If WS had lethally removed 200 Lesser Scaup each year from FY 2012 through FY 2016, WS' annual take would have represented 1.1% to 8.3% of the number of Lesser Scaup harvested from 2012 through 2016. If WS lethally removes 200 Lesser Scaup per year, total take would represent 0.08% of the average number of Lesser Scaup observed in areas surveyed during the CBC from 2006 through 2015. The lowest number of Lesser Scaup observed in areas surveyed during the CBC from 2006 through 2015 was 52,106 scaup. The lethal removal of 200 Lesser Scaup would represent 0.4% of lowest number of Lesser Scaup observed during the CBC from 2006 through 2015. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect Lesser Scaup populations.

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 evaluate the magnitude of take that could occur by WS when compared to the number of Lesser Scaup observed in the state during the CBC. The number of scaup observed in areas surveyed during the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the state.

BUFFLEHEAD BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Bufflehead is a small diving duck that breeds in the boreal forests and aspen parkland of North America (Gauthier 2014). Although breeding grounds lie solely in Canada and Alaska, Buffleheads winter throughout the southern United States and northern Central America, and along the coasts as far north as Alaska and Nova Scotia (Gautier 2014). Buffleheads breed in habitat with ponds and small lakes where they can dive for insect larvae and amphipods, and nest in the small cavities created by the Northern flicker (Gauthier 2014). Buffleheads can be found in northern Florida during the winter (Gauthier 2014).

The number of Bufflehead observed during the breeding season from 1966 through 2015 in areas surveyed during the BBS have shown increasing trends estimated at 0.04% annually, and increases of 6.95% from 2005 through 2015 (Sauer et al. 2017). Between 1996 and 2016, the number of Bufflehead observed during the CBC in areas surveyed in Florida has shown a cyclical, but increasing trend (National Audubon Society 2010). From 2007 through 2016, 3,387 Bufflehead have been observed on average per year in areas of Florida surveyed during the CBC (National Audubon Society 2010). The highest count occurred in 2015 when 6,658 Bufflehead were counted during the CBC, while the lowest count occurred in 2009 when 2,123 Bufflehead were counted (National Audubon Society 2010).

Like other waterfowl, Bufflehead can be harvested in the state during a regulated hunting season. As shown in Table 4.7, an estimated 1,760 Bufflehead were harvested in the state during the 2016 hunting season. From the 2012 through 2016 hunting seasons, 9,651 Bufflehead have been harvested in the state, which is an average of 1,930 Bufflehead harvested per year in the state. The highest harvest level occurred in 2013 when 2,456 Bufflehead were harvested (Raftovich et al. 2014, Raftovich et al. 2015, Raftovich et al. 2016, Raftovich et al. 2017).

Requests for assistance received by WS associated with Bufflehead would primarily be associated with aircraft strike risks at airports and military bases. Aircraft strikes with waterfowl can cause substantial damage to aircraft and can cause the catastrophic failure of aircraft systems, especially when multiple birds are ingested into engines. WS has addressed previous requests for assistance associated with Bufflehead with non-lethal methods. From FY 2012 through FY 2016, WS dispersed 611 Bufflehead to alleviate damage. In addition, from FY 2012 through FY 2016, WS employed lethal methods to lethally remove 66 Bufflehead, with the highest take levels occurring in FY 2016 when WS lethally removed 64 Bufflehead (see Table 4.7). Other entities have also removed Bufflehead to address damage and threats of damage. From 2012 through 2016, 23 Bufflehead were lethally removed by other entities to reduce damage risks. Take by WS and all other entities would occur under a depredation permit issued by the USFWS for the take of Bufflehead, which would ensure the cumulative take of Bufflehead from all known sources was considered when establishing population objectives.

Based on previous efforts to address damage risks associated with Bufflehead and in anticipation of additional efforts to alleviate risks, WS could lethally remove up to 100 Bufflehead per year under the proposed action alternative. If WS had lethally removed 100 Bufflehead each year from FY 2012 through FY 2016, WS' annual take would have represented 4.1% to 8.0% of the number of Bufflehead harvested from 2012 through 2016. If WS lethally removes 100 Bufflehead per year, total take would represent 3.0% of the average number of Bufflehead observed in areas surveyed during the CBC from 2006 through 2016. The lowest number of Bufflehead observed in areas surveyed during the CBC from 2007 through 2016 was 2,123 Bufflehead. The lethal removal of 100 Bufflehead would represent 4.7% of lowest number of Bufflehead observed during the CBC from 2007 through 2016. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect Bufflehead populations.

Table 4.7 – Number of Bufflehead addressed in Florida by all entities, 2012 - 2016

Year	Hunter Harvest[1,2]	WS' Activities[3]		Take by Other Entities[4]
		Dispersed	Take	
2012	1,253	0	0	0
2013	2,456	40	0	10
2014	2,088	0	0	0
2015	2,094	6	2	5
2016	1,760	565	64	8
TOTAL	**9,651**	**611**	**66**	**23**

[1]Reported by hunting season, which generally occur in the fall and overlap into the following calendar year

[2]Adapted from Raftovich et al. (2014), Raftovich et al. (2015), Raftovich et al. (2016), Raftovich et al. (2017)

[3]Data reported by federal fiscal year

[4]Data reported by calendar year

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 evaluate the magnitude of take that could occur by WS when compared to the number of Bufflehead observed in the state during the CBC. The number of Bufflehead observed in areas surveyed during the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the state.

WILD TURKEY BIOLOGY AND POPULATION IMPACTS ANALYSIS

A non-migratory bird, wild turkeys can be found from southern Canada south across the United States (McRoberts et al. 2014). Wild Turkeys found in Florida consist of the Eastern Wild Turkey subspecies and the Osceola subspecies. The Eastern Wild Turkey subspecies is endemic to the eastern half of the United States, including the northern panhandle portion of the state (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). The Osceola subspecies is found only in Peninsular Florida and is similar in appearance to the Eastern subspecies but tends to be smaller with subtle color differences. The two subspecies do interbreed where they interact in the northern portion of the state. The FWC considers those turkeys found within or south of Dixie, Gilchrist, Alachua, Union, Bradford, Clay, and Duval Counties to be the Osceola subspecies (FWC 2018*a*).

The number of turkeys observed in areas surveyed in Florida during the BBS has shown an increasing trend in the state estimated at 7.82% between 1966 through 2015 with a 8.42% annual increase observed from 2005 through 2015 (Sauer et al. 2017). The numbers of turkeys observed in the state during the CBC have been cyclical but have shown an overall increasing trend since 1966 (National Audubon Society 2010). The current statewide population of turkeys is not available.

Like many eastern states, the Wild Turkey population in Florida saw a decline in past years, but after a successful restoration project, ending in 1970, the Wild Turkey population in the state has made a successful rebound. Presently, turkeys occur in all 67 counties in the state and populations are sufficient to allow for annual hunting seasons (FWC 2017). Currently, turkeys can be harvested in the state during a spring and a fall hunting season (FWC 2017). The number of turkeys harvested annually in the state during the spring season from 2012 through 2016 can be found in Figure 4.1.

Since 2012, the highest number of turkeys harvested during the spring hunting seasons occurred in 2015 when 21,248 turkeys were taken. The lowest harvest occurred in 2014 when 20,374 turkeys were harvested by hunters. On average, 20,769 turkeys have been harvested in the state during the spring hunting season. The number of turkeys harvested during the fall hunting season is currently not available.

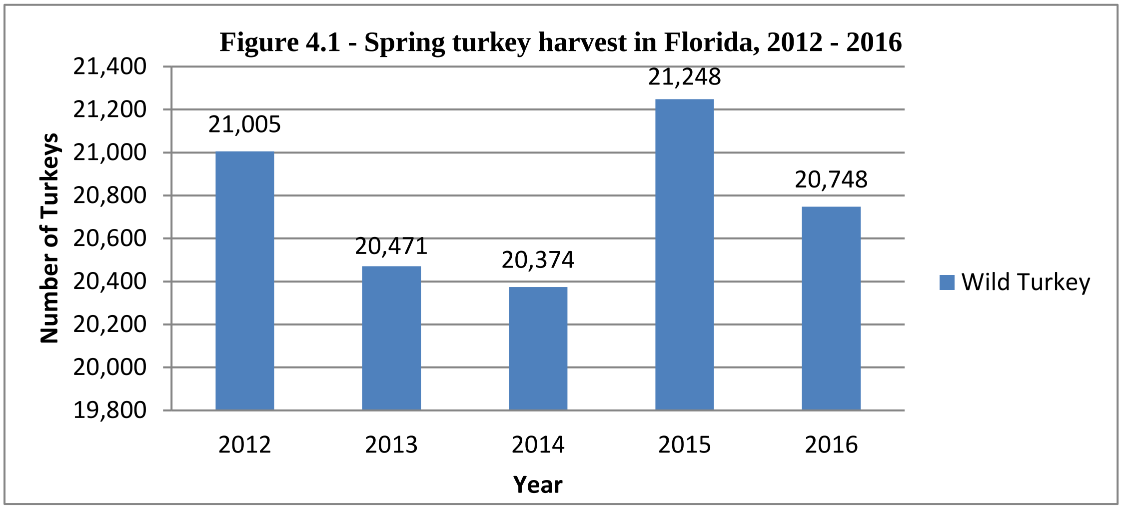
Requests for assistance received by the WS program in Florida to manage damage or threats of damage associated with Wild Turkeys occur primarily at airports where turkeys can pose strike risks to aircraft. Turkeys are also known to cause damage to windows, siding, and vehicles when turkeys, primarily 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 2012 through FY 2016, WS has dispersed 2,000 turkeys, and employed lethal methods to take 68 turkeys to manage damage or threats of damage occurring within the state, when requested (see Table 4.8). Turkeys were primarily lethally taken 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.

Table 4.8 – Number of Wild Turkeys addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	382	20
2013	323	17
2014	683	13
2015	257	6
2016	355	12
TOTAL	**2,000**	**68**

Based on previous efforts to address damage and in anticipation of additional efforts, WS could lethally take up to 100 Wild Turkeys annually under the proposed action alternative. If WS had lethally removed 100 turkeys in FY 2014 the take would have represented 0.5% of the number of turkeys harvested in the state during the spring hunting season in 2014, which was the lowest harvest level in the state from the 2012 season through the 2016 season. The take of Wild Turkeys in the state by WS would only occur at levels permitted by the FWC, which regulates the take of Wild Turkeys in the state.

According to Florida Administrative Code 68A-12.009 (c), airport personnel may take Wild Turkeys on airport property if their presence poses a potential threat to aircraft safety and human lives. Carcasses of Wild Turkeys killed under Florida Administrative Code 68A-12.009 (c) must be buried, incinerated on-site, or donated to a charitable, non-profit institution or agency. The total number of turkeys lethally removed to alleviate damage in the state is currently unknown.



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 lethal removal 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. This would be based on the areas where requests for assistance were likely to occur and based on the low magnitude of take that would likely occur when compared to the annual harvest of turkeys. The permitting of WS' take by the FWC would ensure WS' activities were conducted within any population management objectives for turkeys in the state.

ROCK PIGEON BIOLOGY AND POPULATION IMPACTS ANALYSIS

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

Pigeons are closely associated with people where human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994). Thus, pigeons are commonly found around city buildings, bridges, parks, farmyards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994). Additionally, although pigeons are primarily grain and seed eaters, they will readily feed on garbage, livestock manure, spilled grains, insects, and any other available bits of food (Williams and Corrigan 1994). In Florida, pigeons can be found statewide throughout the year and are considered a common resident of the state (Lowther and Johnston 2014).

The number of pigeons observed along routes surveyed during the BBS in the state have shown an increasing trend since 1966, which has been estimated at 0.44% annually. From 2005 through 2015, the number of pigeons observed along routes surveyed has shown a decreasing trend estimated at -3.44% annually (Sauer et al. 2017). Based on data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 150,000 pigeons. The number of pigeons observed in areas surveyed during the CBC has shown a general increasing trend in the state since 1966; however, a declining trend has been observed since 2005 (National Audubon Society 2010).

Pigeons are afforded no protection under the MBTA because the species is not native to the United States and the take of pigeons to alleviate damage or to reduce threats can occur without the need for a depredation permit from the USFWS. Therefore, take by other entities in Florida is unknown. Because pigeons are a non-native species that often competes with native wildlife species for food and habitat, any take could be viewed as providing some benefit to the native environment in Florida. Between FY 2012 and FY 2016, WS employed non-lethal harassment methods to disperse 1,707 Rock Pigeons to alleviate damage or threats of damage (see Table 4.9). In addition, WS employed methods to lethally remove 1,438 pigeons from FY 2012 through FY 2016 to alleviate damage. Requests for assistance received by WS often arise from airports where the gregarious flocking behavior of pigeons can pose risks to aircraft at or near airports. Pigeons also cause damaging situations when the buildup of their droppings at nesting and roosting sites poses a health risk to the public, for example at a power plant or other industrial facility.

Table 4.9 – Number of Rock Pigeons addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	433	635
2013	656	365
2014	502	216
2015	80	166
2016	36	56
TOTAL	**1,707**	**1,438**

Based on previous requests for assistance and in anticipation of the number of requests received by WS to increase, WS could annually remove up to 3,000 pigeons in the state to alleviate damage. Based on a breeding population estimated at 150,000 pigeons (Partners in Flight Science Committee 2013), the lethal removal of up to 3,000 pigeons by WS would represent 2.0% of the estimated statewide breeding population. Activities would be conducted pursuant to Executive Order 13112 to reduce invasion of exotic species and the associated damages.

EURASIAN COLLARED-DOVE BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Eurasian Collared-Dove was first introduced to North America when several were released in the Bahamas in the mid-1970s and have quickly expanded their range with established populations in the southeastern United States and localized populations elsewhere (Romagosa 2012). Because collared-doves are considered an introduced, non-native species in the United States, they are afforded no protection under the MBTA (70 FR 12710-12716). Collared-doves can be found statewide in Florida throughout the year (Romagosa 2012).

Since 1966, BBS data indicates Eurasian Collared-Dove populations have increased annually at an estimated rate of 23.64% in Florida; however, from 2005 through 2015 the number of doves observed in areas surveyed has shown a decline estimated at -4.83% annually (Sauer et al. 2017). CBC data indicates collared-doves were first observed in Florida during that survey in 1987 when 106 doves were documented on two routes (National Audubon Society 2010). In 2015, CBC data shows collared-doves were observed on 68 routes with 4,293 doves observed (National Audubon Society 2010). The current population in the state is unknown.

Because Eurasian Collared-Doves are afforded no protection from take under the MBTA, take can occur by any entity in Florida without a depredation permit issued by the USFWS. Therefore, the take of collared-doves by entities other than WS for damage management purposes is unknown but is likely of low magnitude because doves are not associated with causing extensive damage to resources, except doves can pose threats to aircraft at airports. From FY 2012 through FY 2016, WS has lethally removed 27 Eurasian Collared-Doves in the state to alleviate damage (see Table 4.10). Eurasian Collared-Doves are similar in appearance to Mourning Doves and are often harvested during the regulated hunting season for Mourning Doves. Mourning Doves can be harvested under frameworks established by the USFWS and implemented by the FWC. However, because Eurasian Collared-Doves are considered a non-native species, no frameworks for the harvest of collared-doves exists. Therefore, the annual take of Eurasian Collared-Doves during the annual hunting season for Mourning Doves is not currently available.

Table 4.10 – Number of Eurasian Collared-Doves addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	0	3
2013	90	2
2014	0	0
2015	25	8
2016	0	14
TOTAL	**115**	**27**

Based on the increasing population trends of Eurasian Collared-Doves observed on BBS routes and the CBC along with the likelihood that collared-doves are likely to form mixed species flocks with Mourning Doves, the take of collared-doves to alleviate damage by WS would also likely occur. Based on the previous activities conducted by WS to alleviate damage associated with collared-doves and Mourning Doves, up to 100 Eurasian Collared-Doves could be lethally taken by WS annually in the state to alleviate damage or threats of damage.

Because Eurasian Collared-Doves are a non-native species in Florida, take can occur without a depredation permit from the USFWS. However, the take of collared-doves could be viewed as providing some benefit to native wildlife species because non-native species often compete with native species for resources, such as food and nesting habitat. WS' lethal removal of Eurasian Collared-Doves to reduce damage and threats would comply with Executive Order 13112.

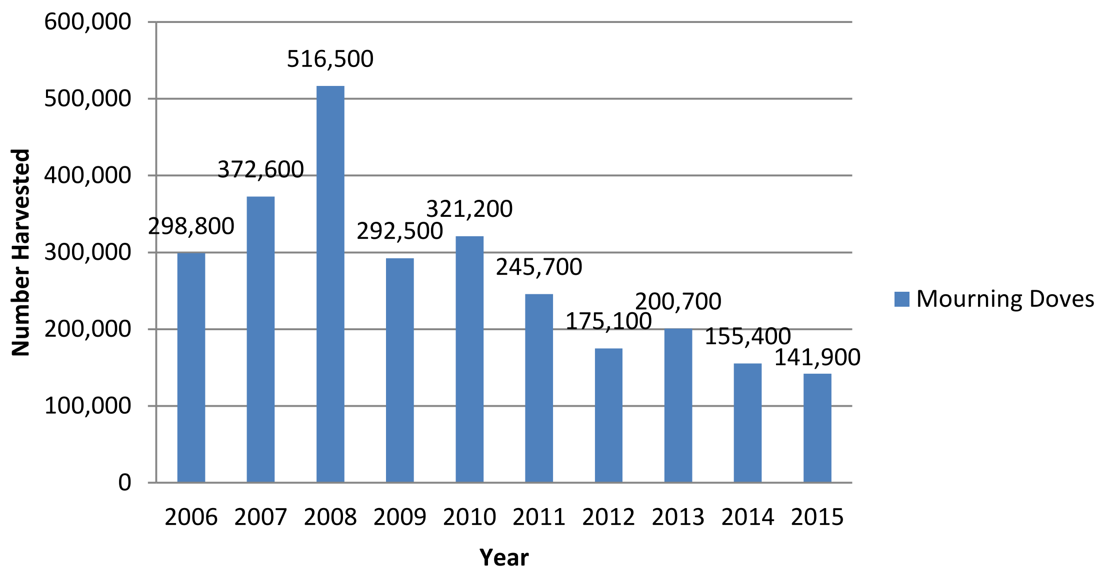
MOURNING DOVE BIOLOGY AND POPULATION IMPACTS ANALYSIS

Mourning Doves are considered migratory game birds with substantial populations throughout much of North America. They occur in all 48 contiguous states of the United States and the southern portions of Canada with the northern populations being more migratory than the southern populations. They are a drab grayish brown with a slender, white edged, pointed tail. Mourning Doves can be found throughout the year over most of the United States, including Florida (Otis et al. 2008).

According to trend data provided by Sauer et al. (2017), the number of Mourning Doves observed on routes surveyed has shown an increasing trend in the state estimated at 1.95% annually from 1966 through 2015. From 2005 through 2015, the number of doves observed in areas surveyed during the BBS in the state has increased annually estimated at 0.95% (Sauer et al. 2017). From 2006 through 2015, the estimated trend of dove abundance, based on BBS data, has increased 1.0% annually in Florida (Seamans 2016). Based on BBS data, the Partners in Flight Science Committee (2013) estimated the statewide breeding population at 2.3 million Mourning Doves.

The number of Mourning Doves observed during the CBC has shown a stable trend in the state since 1966 (National Audubon Society 2010). From 2006 through 2015, 26,861 doves have been observed per year on average in areas surveyed during the CBC, with the lowest count occurring in 2015 when 21,366 doves were observed. Many states have regulated annual hunting seasons for doves each year with generous bag limits. Across the United States, the preliminary Mourning Dove harvest in 2015 was estimated at 13.2 million doves with 141,900 doves harvested in Florida (Raftovich et al. 2016). Figure 4.2 shows the number of doves harvested in Florida during the annual hunting season from 2006 through 2015 (Dolton et al. 2008, Sanders and Parker 2010, Seamans et al. 2012, Seamans and Sanders 2014, Seamans 2016). On average, people have harvested 272,040 Mourning Doves per year from 2006 through 2015.

Figure 4.2 - Harvest of Mourning Doves in Florida, 2006 - 2015



From FY 2012 through FY 2016, WS has addressed 80,602 doves to alleviate damage and threats (see Table 4.11). Of those doves addressed by WS from FY 2012 through FY 2016, 5,712 were addressed using lethally methods while 74,890 doves were addressed using non-lethal methods. The take of doves by other entities has not occurred in the state previously. 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 3,000 Mourning Doves could be lethally taken by WS annually in the state to address damage or threats.

An annual take by WS of up to 3,000 Mourning Doves would represent 0.1% of the estimated statewide breeding population of 2.3 million doves, and 1.1% of average annual hunter harvest in Florida from 2006 through 2015. Under the proposed action, the nests and/or eggs of Mourning Doves could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, up to 50 nests could be destroyed annually by WS, including eggs in the nests. WS' take of active nests would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of active nests would not exceed 50 annually and would not exceed the level permitted under depredation permits. Impacts due to nest and egg destruction would have little adverse effect on the Mourning Dove population in Florida. Local populations of Mourning Doves in the state are likely augmented by migrating birds during the migration periods and during the winter months.

Table 4.11 – Number of Mourning Doves addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	16,898	1,010
2013	17,754	502
2014	13,657	1,015
2015	15,628	1,687
2016	10,953	1,498
TOTAL	**74,890**	**5,712**

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 authorized by the USFWS and only at levels authorized by the USFWS, which ensures WS' take and take by all entities, including hunter harvest, would be considered to achieve the desired population management levels of doves in Florida.

COMMON NIGHTHAWK BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Common Nighthawk can be found breeding throughout most of North America, except for the far northern arctic region and parts of the southwestern United States and winters in South America (Brigham et al. 2011). Nighthawks are most active at dawn and dusk as they forage on flying insects and are commonly recognized by their calls as they forage (Brigham et al. 2011). Common Nighthawks nest on the open ground, gravel beaches, rocky outcrops, and burn-over woodlands, including frequently nesting on flat gravel rooftops of buildings (Brigham et al. 2011). In Florida, the nighthawk is considered a common summer resident throughout the state that can be found foraging over old fields, pastures, cultivated fields, prairies, open pine forest, and beaches (FWC 2003). Common Nighthawks are considered less common in the Lower Florida Keys (FWC 2003). Eggs of nighthawks are generally laid in April and May in Florida, with some reports of eggs occurring into late July (FWC 2003). Spring migration dates generally occur in late March and early April with the fall migration occurring as early as July but is most common from August through September. Some flocks of nighthawks during the fall migration can be quite large (FWC 2003).

Populations of nighthawks are generally showing declining trends across their breeding range, likely due to loss of breeding habitat, declining insect populations from the use of pesticides, and/or predation (Brigham et al. 2011), including Florida (FWC 2003). In areas surveyed during the BBS, the number of nighthawks observed has shown an annual declining trend estimated at -5.45% since 1966, with a -5.16% annual trend occurring from 2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the breeding population of nighthawks in Florida at 600,000 individuals using BBS data. Common Nighthawks are infrequently observed in Florida during the CBC (National Audubon Society 2010), because nighthawks are known to winter in South America.

Most requests for assistance received by WS concerning nighthawks are associated with airports and the aircraft strike risks associated with nighthawks foraging over runways and taxiways. The open habitat environment of most airports provides ideal foraging areas for nighthawks. In addition, large flocks of nighthawks that can occur during the migration periods can also increase strike risks at airports. As shown in Table 4.12, most nighthawks posing a threat of damage were addressed by WS using non-lethal dispersal methods. However, WS has employed lethal methods to address nighthawks that were posing direct threats to aviation safety.

Table 4.12 – Number of Common Nighthawks addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	95	25
2013	151	26
2014	27	10
2015	331	32
2016	1,828	49
TOTAL	**2,432**	**142**

Based on the number of nighthawks addressed previously during damage management activities, WS could lethally remove up to 250 nighthawks annually to alleviate damage risks. WS would continue to address most requests for assistance with non-lethal dispersal methods. With a breeding population estimated at 600,000 nighthawks, the take of 250 nighthawks by WS would represent 0.04% of the statewide breeding population. The take of Common Nighthawks by WS to alleviate damage risks would only occur when authorized by the USFWS and only at levels authorized. During the migration periods, an influx of nighthawks likely occurs as they move along their migration paths. Most requests for assistance are associated with nighthawks during the migration periods when large flocks can occur. Although current surveys for the Common Nighthawk indicate a declining trend, the International Union for Conservation of Nature lists the Common Nighthawk population in a category of "*least concern*" (BirdLife International 2016*a*).

AMERICAN COOT BIOLOGY AND POPULATION IMPACTS ANALYSIS

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

In Florida, coots are a very common migrant and winter resident across the state with smaller numbers being observed in the state during the summer breeding season (FWC 2003). Breeding populations of American Coots in Florida indicated the number of coots observed in areas surveyed have shown an annual decreasing trend estimated at -6.91% since 1966 (Sauer et al. 2017). As mentioned previously, the numbers of breeding coots in the state is relatively low and Florida is probably on the extreme southern edge of the breeding range (FWC 2003). Across all BBS routes surveyed in the United States, the number of coots observed has shown a stable trend since 1966, with a 6.67% annual increasing trend occurring from 2005 through 2015 (Sauer et al. 2017). The average number of American Coots observed in areas surveyed during the CBC from 2006 through 2015 was 146,807 coots. The lowest number of coots observed during the CBC from 2006 through 2015 occurred in 2006 when 60,217 coots were recorded. The highest number of coots recorded in the state during the CBC between 2006 through 2015 occurred in 2010 when 238,110 coots were observed (National Audubon Society 2010). Since 1966, the number of coots observed in areas surveyed has shown a cyclical pattern (National Audubon Society 2010).

American Coots are often identified as a possible conveyance for disease transmission between aquaculture ponds and facilities. Coots primarily feed on aquatic vascular plants and algae but their diet may consist of grains, aquatic invertebrates, and vertebrates, including fish (Brisbin and Mowbray 2002). Coots can also negatively affect fish farming operations when they directly consume fish feed. Coot competition for pelletized feed increases fish farming costs and decreases growth potential of commercial fish. The USFWS has authorized the take of coots in the state to alleviate damage and threats. From FY

2012 through FY 2016, 12,589 American Coots were dispersed by WS and 274 American Coots have been lethally taken by WS to alleviate damage pursuant to depredation permits (see Table 4.13). Between 2012 and 2016, 23 American Coots were lethally removed by other entities in the state. Coots also maintain sufficient population densities to allow for annual hunting seasons. During the 2016 hunting season, an estimated 4,200 coots were harvested in the state (Raftovich et al. 2017).

Table 4.13 – Number of American Coots addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	422	25	0
2013	9,889	143	8
2014	1,135	84	2
2015	1,090	18	13
2016	53	4	0
TOTAL	**12,589**	**274**	**23**

†Reported by federal fiscal year

‡Reported by calendar year

Based on the number of requests received to alleviate the threat of damage associated with American Coots and the number of American Coots addressed previously to alleviate those threats, WS could lethally remove up to 200 American Coots annually in the state to alleviate damage. If WS had lethally removed 200 Coots during FY 2016, WS' take would have represented 4.8% of the number of Coots harvested in the state during the 2016 hunting season. Using the average number of American Coots observed in areas of the State surveyed from 2006 through 2015, WS' take of 200 coots would represent 0.1% of the average. Using the lowest number of American Coots in areas of the state surveyed from 2006 through 2016 during the CBC, WS' take of 200 coots would represent 0.3% of the 60,217 coots observed. The take of American Coots by other entities is not expected to increase above the number of coots taken between 2012 through 2016. Based on the limited take that could occur by WS and other entities when compared to the number observed during the CBC and the permitting of the take by the USFWS, WS' take would have no adverse effects on American Coot populations in the state.

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

BLACK-NECKED STILT BIOLOGY AND POPULATION IMPACT ANALYSIS

Black-necked Stilts are a long-legged shorebird characterized by bright orange legs and shiny black wings and back with a white breast and under parts. Stilts are most commonly found in the shallow waters of salt ponds, lagoons, sewage ponds, and inland wetlands with breeding occurring primarily in freshwater wetlands with emergent vegetation (Robinson et al. 1999). Breeding populations can be found in the interior United States in appropriate habitat from Oregon, Idaho, Colorado, New Mexico, and Kansas and along the Atlantic and Gulf coasts southward through most of Central America and South America, including the West Indies (FWC 2003). Black-necked Stilts can be found throughout the year in Florida, with breeding populations occurring primarily in peninsular Florida. Spring migration dates for stilts in Florida occurs between February 12 and June 9 with the fall migration occurring between August and November (FWC 2003).

The FWC (2003) classified the Black-necked Stilt as a regular breeder in the upper St. Johns River marshes, Cape Canaveral area, Tampa Bay area, Charlotte Harbor area, the phosphate mines in Polk and Hillsborough Counties, the Water Conservation Areas of western Palm Beach County, areas along the southern coast, and the Florida Keys. The stilt is considered a rare and irregular breeder in Duval County (FWC 2003). BBS data indicates the number of stilts observed in areas surveyed in Florida have increased annually since 1966 at an estimated trend of 1.37%, with a 0.87% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). However, the number of stilts breeding in Florida is currently unknown. Stilts observed in areas surveyed during the CBC have also shown a general increasing trend since 1966 (National Audubon Society 2010). However, the number of stilts present in the state during the migration periods is also currently unknown.

WS has received requests for assistance associated with Black-necked Stilts in Florida, primarily associated with aircraft strike threats at airports. Stilts can often be found in large flocks during migration periods, which can pose a risk of aircraft strikes when occurring on or near airports. As shown in Table 4.14, WS has addressed 1,186 stilts using non-lethal harassment methods from FY 2012 through FY 2016, with 41 stilts being addressed using lethal methods. Nearly 97% of the stilts addressed by WS from FY 2012 through FY 2016 were addressed using non-lethal methods.

Table 4.14 – Number of Black-necked Stilts addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	185	23
2013	370	13
2014	338	3
2015	15	0
2016	278	2
TOTAL	**1,186**	**41**

Based on previous efforts to address stilts at airports in the state, WS could lethally remove up to 100 stilts annually to address strike risks. WS would continue to address stilts using primarily non-lethal methods; however, WS could use lethal methods to address stilts that are posing direct threats of aircraft strikes or when stilts have become habituated to non-lethal methods. Population data for stilts present in the state is not currently available. However, take of up to 100 Stilts annually by WS would not result in adverse effects to the statewide population. Most take would likely occur during the migration periods when large groups of stilts may be present at or near airports. Survey data currently available indicates that the number of stilts present in areas surveyed continues to increase annually. Take by WS would only occur when authorized by the USFWS through the issuance of a depredation permit and total annual take would only occur within permitted levels determined by the USFWS.

KILLDEER BIOLOGY AND POPULATION IMPACTS ANALYSIS

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, Jackson and Jackson 2000). Although Killdeer are technically in the family of 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, roadside ditches, mudflats, airports, pastures, and gravel roads and levees but are seldom seen in large flocks.

Distinguishing characteristics include a dark, double banded breast, with the top band completely encircling the upper body/breast. Another band is located at the head, resembling a mask absent of the facial portion. The band is continuous, thinning while going across the face along the forehead region and above the bill, and thickening at the supercilium; extending around the eye and onward around the back of the head. Plumage is relatively absent of complexity with the exception of a vividly colored, reddish-orange rump that is visible during flight and behavioral displays. The rest the body consists of a grayish-brown coloration along the dorsal side, crown, and nape, while the ventral region is white. Sex characteristics are difficult to determine because Killdeer are essentially monomorphic. The clutch of up to four eggs is laid in a ground scrape in open habitats (Leck 1984). Based on broad-scale surveys, the United States Shorebird Conservation Plan estimated the population of Killdeer in the United States to be approximately 2 million birds in 2001 (Brown et al. 2001).

In Florida, the number of Killdeer observed during the BBS has shown declining trends since 1966 estimated at -2.76% annually with a -4.78% annual decline estimated from 2005 through 2015 (Sauer et al. 2017). Currently, no breeding population data is available for Killdeer in Florida. The average number of Killdeer observed in areas surveyed during the CBC from 2006 through 2015 was 11,093 Killdeer. The lowest number of Killdeer observed during the CBC from 2006 through 2015 occurred in 2012 when 8,627 Killdeer were recorded. The highest number of Killdeer recorded in the state during the CBC from 2006 through 2015 occurred in 2010 when 14,861 Killdeer were observed (National Audubon Society 2010). Since 1966, the number of Killdeer observed in areas surveyed has shown a relatively stable trend (National Audubon Society 2010).

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. From FY 2012 through FY 2016, WS has lethally taken 645 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 2014 when 176 Killdeer were lethally taken (see Table 4.15). In addition, WS has employed non-lethal methods at airports in the state to harass 25,899 Killdeer from FY 2012 through FY 2016. Of those Killdeer addressed by WS from FY 2012 through FY 2016, nearly 98% were addressed using non-lethal dispersal methods and all lethal take by WS in the state occurred pursuant to depredation permits issued by the USFWS.

Table 4.15 – Number of Killdeer addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	3,771	146
2013	3,062	86
2014	4,336	176
2015	7,661	126
2016	7,069	111
TOTAL	**25,899**	**645**

To address an increasing number of requests for assistance, up to 400 Killdeer could be lethally taken by WS annually under the proposed action. WS' take of 400 Killdeer would represent 3.6% of the average number of Killdeer observed in areas surveyed during the CBC in the state from 2006 through 2015. Using the lowest number of CBC observations of 8,627 Killdeer, WS' take of 400 Killdeer would represent 4.6% of the lowest number observed. Based on broad-scale surveys, the United States Shorebird Conservation Plan estimated the population of Killdeer in the United States to be approximately 2 million birds in 2001 (Brown et al. 2001). WS' take of up to 400 Killdeer would only represent 0.02% of the estimated United States population. The permitting of the take of Killdeer by the

USFWS pursuant to the MBTA ensures take is considered as part of trending and population data available for Killdeer and will not adversely affect the population. WS will continue to assist airport personnel in identifying habitat and other attractants to Killdeer on airport property. Killdeer will continue to be addressed using primarily non-lethal harassment and dispersal methods.

DUNLIN BIOLOGY AND POPULATION IMPACT ANALYSIS

Dunlins are ground nesting birds that breed in wet coastal tundra areas of northern Alaska and Canada. Dunlins are wading birds that feed on insects, worms, and crustaceans. During winter, large congregations migrate to mudflats and marshes along the east and west coasts of North America and winter as far south as Central America. Dunlin can be found wintering in Florida and during their migration periods, primarily along the coastal areas of the state. Buchanan (2011) indicated that Dunlins, like other shorebirds, were gregarious and form large flocks to escape predation from raptors, including Merlins and Peregrine Falcons. This flocking behavior can be of concern when large groups of Dunlins occur at or near airports.

The number of Dunlins observed in Florida in areas surveyed during the CBC has shown a general declining trend since 1966 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 20,005 Dunlins annually in the state. The fewest number of Dunlins observed during the CBC conducted in the state occurred in 2015 when 10,793 individuals were observed (National Audubon Society 2010). The highest number of Dunlins observed during the CBC occurred in 2008 when 33,214 individuals were counted (National Audubon Society 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 Dunlins 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 Dunlins that could be present in the state. The number of Dunlins observed by surveyors during the CBC would be considered minimum estimates because not all areas of the state are surveyed during the CBC.

From FY 2012 through FY 2016, 29,998 Dunlins were addressed by WS using non-lethal methods and 40 Dunlins have been lethally taken by WS to alleviate damage pursuant to depredation permits (see Table 4.16). WS anticipates continuing to address Dunlins that pose aircraft strike risks with primarily non-lethal dispersal methods. However, Dunlins that pose direct threats to aircraft or habituate to non-lethal methods could be lethally removed by WS. Based on previous efforts to address risks associated with Dunlins, WS anticipates that up to 150 Dunlins could be lethally removed by WS annually.

Table 4.16– Number of Dunlins addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	1,687	2
2013	1,341	0
2014	1,810	0
2015	13,740	33
2016	11,420	5
TOTAL	**29,998**	**40**

Take of up to 150 Dunlins by WS would represent 0.8% of the average number of Dunlins observed annually during the CBC conducted from 2005 through 2015. If 150 Dunlins were lethally removed by WS during 2015 that corresponded with the lowest number of Dunlins observed in areas surveyed during the CBC, WS' take would have represented 1.4% of the number of Dunlins observed.

Like other protected bird species, take of Dunlins is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits. Therefore, the number of Dunlins taken annually by WS and other entities in the state would occur at the discretion of the USFWS based on allowable harvest levels and current population information. Thus, the take of Dunlins by WS would only occur at levels authorized by the USFWS, which would ensure WS' take, and take by all entities, would be considered to achieve desired population management levels. In addition, the take of Dunlins by WS would only occur in conjunction with migratory seasons and would therefore be on a limited scale that would have no adverse effect on the overall population.

LEAST SANDPIPER BIOLOGY AND POPULATION IMPACT ANALYSIS

Least Sandpipers are another species that breeds in the arctic and subarctic tundra of North America and only occurs in Florida over the winter and during the migration periods. Like other shorebirds, Least Sandpipers can occur in large groups during the migration periods, occurring in flocks that occasionally number in the thousands (Nebel and Cooper 2008). When large flocks occur at or near airports, those birds can pose aircraft strike risks. Requests for assistance received by WS associated with Least Sandpipers occur from airports where those birds pose a strike risk.

The number of Least Sandpipers overwintering in the state and present during the migration periods is unknown. The number of Least Sandpipers observed in areas of the state surveyed during the CBC has shown a cyclical pattern since 1966 but a general increasing trend because the late 1980s (National Audubon Society 2010). Between 2006 and 2015, an average of 8,730 Least Sandpipers have been observed annually in areas of the state surveyed during the CBC. The highest count total for the CBC conducted from 2006 through 2015 occurred in 2008 when 14,060 Least Sandpipers were observed. The lowest count occurred in 2015 when 5,280 Least Sandpipers were observed (National Audubon Society 2010). As stated previously, CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the state and is not intended to represent population estimates of wintering bird populations. 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 Least Sandpipers 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 FY 2012 through FY 2016, WS has addressed Least Sandpipers with primarily non-lethal dispersal methods. WS has dispersed 3,668 Least Sandpipers from FY 2012 through FY 2016 and employed methods to lethally remove 16 sandpipers (see Table 4.17). In addition to take by WS, other entities within the state employed lethal methods to remove 8 Least Sandpipers to alleviate damage. Lethal removal of sandpipers by WS' and all other entities in the state occurred pursuant to depredation permits issued by the USFWS. WS anticipates continuing to address Least Sandpipers that pose aircraft strike risks with primarily non-lethal dispersal methods.

Based on previous efforts to address risks associated with Least Sandpipers, WS anticipates that up to 50 sandpipers could be lethally removed by WS annually. Take of up to 50 sandpipers by WS would represent 0.6% of the average number of Least Sandpipers observed annually during the CBC conducted from 2006 through 2015. If 50 Sandpipers were lethally removed by WS during 2015 that corresponded with the lowest number of sandpipers observed in areas of the state surveyed from 2005 through 2015 during the CBC, WS' take would have represented 1.0% of the number of sandpipers observed. Take by other entities could also occur to alleviate damage associated with Least Sandpipers. The highest take of Least Sandpipers by other entities to alleviate damage threats occurred in 2016 when five sandpipers were removed. If the highest level of take by other entities were combined with the estimated annual take by WS, the cumulative take would represent 1.0% of the lowest number of Least Sandpipers observed during the CBC and 0.6% of the average number of Least Sandpipers observed during the CBC conducted from 2006 through 2015.

Table 4.17 – Number of Least Sandpipers addressed in Florida by all entities, 2012 – 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	10	0	0
2013	122	5	2
2014	40	3	0
2015	689	1	1
2016	2,807	7	5
TOTAL	**3,668**	**16**	**8**

†Reported by federal fiscal year

‡Reported by calendar year

The take of sandpipers is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits. Therefore, the number of sandpipers taken annually by WS and other entities in the state would occur at the discretion of the USFWS based on allowable harvest levels and current population information. Thus, the take of Least Sandpipers by WS would only occur at levels authorized by the USFWS, which would ensure WS' take, and take by all entities, would be considered to achieve desired population management levels. In addition, the take of sandpipers by WS would only occur in conjunction with migratory seasons and would therefore be on a limited scale that would have no adverse effect on the overall population.

LAUGHING GULL BIOLOGY AND POPULATION IMPACTS ANALYSIS

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 2015). Localized breeding colonies can also be found along the Gulf of California and the Pacific Coast of Mexico (Burger 2015). Characterized by a black hood, Laughing Gulls are often associated with human activities near coastal areas where food sources are readily available (Burger 2015). Burger (2015) 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) 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). Laughing Gulls are the only species of gulls that nests in the state and can be found year-round (FWC 2003). Nesting colonies occur on coastal islands and man-made structures primarily around Tampa Bay but nesting occurs elsewhere in the state. Laughing Gulls are becoming more abundant in the interior part of the state as populations have expanded (FWC 2003).

In Florida, the number of Laughing Gulls observed during the breeding season has decreased annually since 1966 at -1.96% and -1.73% from 2005 through 2015 (Sauer et al. 2017). CBC data from 2006 through 2015 indicates that an average of 89,158 Laughing Gulls have been observed overwintering in the state annually (National Audubon Society 2010). The highest number recorded during the CBC conducted from 2006 through 2015 occurred in 2015 when 126,430 Laughing Gulls were counted in areas surveyed. The lowest number of Laughing Gulls observed during the CBC conducted from 2006 through 2015 occurred in 2012 when 65,228 Laughing Gulls were observed (National Audubon Society 2010).

Laughing Gulls observed in areas surveyed within the state have shown an overall increasing trend since 1966; however, the number of Gulls observed since the early 1990s has shown a declining trend but have not reached the lows observed during the late 1960s and early 1970s (National Audubon Society 2010). The breeding population in that portion of Florida considered part of the Southeastern Coastal Plain (BCR 27) has been estimated at approximately 1,000 breeding pairs with the breeding population in Peninsular Florida (BCR 31) estimated at 24,000 breeding pairs (Hunter et al. 2006), which 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. Therefore, the statewide breeding population could be estimated at 50,000 breeding Laughing Gulls and 25,000 non-breeding Laughing Gulls. However, the exact population of Laughing Gulls in Florida is currently unknown and likely fluctuates throughout the year as Laughing Gulls begin arriving during the migration periods and overwinter within the state.

Of the five tiers of action levels for waterbirds in the southeastern United States, Laughing Gulls were assigned to the "*planning and responsibility*" tier, which includes birds that require some level of planning to maintain sustainable populations in the region (Hunter et al. 2006). The "*planning and responsibility*" tier is the second lowest tier in terms of action priority ahead of only the last tier, which includes those waterbirds that are considered above management levels and could require population management (Hunter et al. 2006). The breeding population of Laughing Gulls in the southeastern United States has been placed in the "*planning and responsibility*" category of the waterbird conservation plan for the southeastern United States due to the large portion of the breeding population that occurs in the region (Hunter et al. 2006). Hunter et al. (2006) acknowledges that Laughing Gull populations in the southeastern United States have increased "*dramatically*", which could be having adverse effects on other nesting high priority bird species at a local level. The waterbird plan for the southeastern United States recommended the population of Laughing Gulls be reduced from the estimated 170,000 breeding pairs to 100,000 breeding pairs to reduce predation on higher priority beach nesting species such as plovers, oystercatchers, and terns (Hunter et al. 2006). The waterbird plan also recommended reducing the number of Laughing Gulls in the southeastern coastal plain from the current estimate of 46,116 breeding pairs to 25,000 breeding pairs (Hunter et al. 2006).

From FY 2012 through FY 2016, the WS program in Florida 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 2012 and FY 2016 to alleviate damage or threats of damage when requested are shown in Table 4.18. WS has employed non-lethal methods to disperse 574,433 Laughing Gulls in the state since FY 2012 to alleviate damage or threats of damage. In addition, WS lethally removed 7,814 Laughing Gulls from FY 2012 through FY 2016 to alleviate damage or threats of damage. Other entities have employed lethal methods to remove 1,610 Laughing Gulls to alleviate damage.

Table 4.18 – Number of Laughing Gulls addressed in Florida by all entities, 2012 – 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	131,300	2,161	0
2013	143,484	1,329	541
2014	138,712	1,209	172
2015	100,452	2,008	846
2016	60,485	1,107	51
TOTAL	**574,433**	**7,814**	**1,610**

†Reported by federal fiscal year

‡Reported by calendar year

Based on the number of Laughing Gulls addressed previously by WS in response to requests for assistance, WS anticipates that up to 3,000 Laughing Gulls could be lethally taken annually in the state by WS to address requests for assistance under the proposed action alternative. The take of Laughing Gulls by WS would only occur after the issuance of a depredation permit by the USFWS. If 3,000 Laughing Gulls were lethally removed by WS during FY 2012, which corresponded with the lowest number of Laughing Gulls observed in areas surveyed during the CBC, WS' take would have represented 4.6% of the number of Laughing Gulls observed. Take of up to 3,000 Laughing Gulls by WS would represent 3.4% of the average number of Laughing Gulls observed annually during the CBC conducted from 2005 through 2015. If the statewide breeding population, including non-breeding Gulls, were 75,000 Laughing Gulls, take of 3,000 Gulls by WS would represent 4.0% of the estimated population.

Take of up to 3,000 Laughing Gulls by WS annually in the state would represent 1.3% of the 230,000 adult Laughing Gulls estimated by Belant and Dolbeer (1993) to overwinter along the Gulf Coast states. Hunter et al. (2006) estimated the breeding population at 170,000 breeding pairs of Laughing Gulls or 340,000 adults in the southeastern United States. Take of up to 3,000 Laughing Gulls by WS annually would represent 0.9% of the estimated breeding population, if the population remains at least stable. The number of Laughing Gulls breeding in the southeastern coastal plain has been estimated at 46,116 breeding pairs. Take of up to 3,000 Laughing Gulls by WS annually would represent 3.3% of the estimated breeding population, if the population remains at least stable. If the population objective of 25,000 breeding pairs in the southeastern coastal plain were achieved, take of up to 3,000 Laughing Gulls would represent 6.0% of the breeding population if the population remained at least stable. Based on the permitting of the take by the USFWS pursuant to the MBTA, WS' take of up to 3,000 Laughing Gulls annually would occur within allowable take levels to reach desired population objectives for Laughing Gulls. Take of Laughing Gulls would only occur as determined and analyzed by the USFWS to ensure the desired population objectives for Laughing Gulls are achieved.

RING-BILLED GULL BIOLOGY AND POPULATION IMPACTS ANALYSIS

Pollet et al. (2012) describes the Ring-billed Gull as a medium sized gull with a white head and the characteristic black ring on their bills. Ring-billed Gulls are inland nesting gulls that are colonial ground nesters on sparsely vegetated islands in large lakes with occasional colonies on mainland peninsulas and near-shore oceanic islands (Pollet et al. 2012). Ring-billed Gulls are commonly found in large numbers at garbage dumps, parking lots, and southern coastal beaches during the winter. Ring-billed Gulls are considered opportunistic feeders that feed primarily on fish, insects, earthworms, rodents, and grains (Pollet et al. 2012).

The breeding population of Ring-billed Gulls is divided into the western population and the eastern population. The eastern breeding population of the United States includes New York, Vermont, Ohio, Illinois, Michigan, Wisconsin, and Minnesota (Blokpoel and Tessier 1986). Ring-billed Gulls nest in high densities and, in the Great Lakes region, nesting colonies may be located on islands, parklands, slag yards, rooftops, breakwalls, and landfills (Blokpoel and Tessier 1986, Pollet et al. 2012). 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. The number of Ring-billed Gulls nesting on Lake Erie increased by 161% from 1976 through 2009 (Morris et al. 2011). No breeding populations of Ring-billed Gulls are known to occur in Florida. Ring-billed Gulls may be present in Florida during the breeding season; however, those Ring-billed Gulls present in the state during the breeding season are considered non-breeding gulls. The number of gulls present in the state likely increases during the migration periods and during the winter.

Across all BBS routes in the United States, the number of Ring-billed Gulls observed has shown an increasing trend estimated at 0.99% since 1966 (Sauer et al. 2017). Between 2005 and 2015, the number of gulls observed across all routes surveyed in the United States has shown an increasing trend estimated at 6.02% annually (Sauer et al. 2017). In the eastern United States, the number of Ring-billed Gulls observed during the BBS has increased 3.34% annually since 1966, with an 5.75% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). In the Southeastern Coastal Plain (BCR 27), the number of Ring-billed Gulls observed during the BBS has shown a declining trend estimated at -1.45% annually since 1966. In Florida, the number of number Ring-billed Gulls observed in areas surveyed during the BBS has shown an increasing trend since 1966 estimated at 2.17% annually, with a 5.03% annual increase occurring from 2005 through 2015 (Sauer et al. 2017).

The numbers of Ring-billed Gulls observed in Florida during the CBC shows a general increasing trend from the mid-1970s through the mid-1990s; however, from the mid-1990s, the number observed has shown declining trends (National Audubon Society 2010). Between 2006 and 2015, observers have counted 63,764 Ring-billed Gulls per year on average during the CBC. The highest count occurred in 2008 when 88,517 Ring-billed Gulls were counted during the CBC, while the lowest count occurred in 2012 when 32,814 gulls were observed (National Audubon Society 2010).

Requests for direct operational assistance received by WS in the Florida associated with Ring-billed Gulls occurs primarily at airports where those gulls pose aircraft strike hazards; however, WS could also receive requests for assistance associated with gulls feeding on aquaculture stock and gulls causing damage at waste facilities. Large concentrations of gulls on aquaculture ponds can consume enough fish to pose economic concerns to aquaculture producers. Gulls at waste facilities can carry trash and debris away from facilities and leave the refuse in residential neighborhoods.

As shown in the Table 4.19, the WS program in Florida has addressed 18,822 gulls using non-lethal dispersal methods to alleviate damage. In addition, WS has employed lethal methods to remove 471 Ring-billed Gulls in the state since FY 2012. From 2012 through 2016, 142 Ring-billed Gulls have been lethally taken in the state under depredation permits issued by the USFWS to other entities. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, up to 500 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.

Table 4.19 – Number of Ring-billed Gulls addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	231	26	6
2013	520	6	61
2014	7,136	62	42
2015	5,628	177	33
2016	5,307	200	0
TOTAL	**18,822**	**471**	**142**

†Reported by federal fiscal year

‡Reported by calendar year

WS' lethal take of gulls would occur under permits issued to WS or under permits issued to cooperators where WS was acting as an agent on the permit. Based on previous requests for assistance and in anticipation of additional efforts, up to 500 Ring-billed Gulls could be taken annually by WS in the state to address damage and threats of damage when a request for assistance was received. An estimate of the number of Ring-billed Gulls present in the state during the migration periods is currently unavailable. No breeding populations of Ring-billed Gulls are known to occur within the state. The only information currently available to evaluate the magnitude of WS' proposed take of up to 500 Ring-billed Gulls annually in the state is the number of Ring-billed Gulls observed in the state during the CBC. Over the last 10-years, an average of 63,764 Ring-billed Gulls has been observed annually in the state during the CBC (National Audubon Society 2010). If 500 Ring-billed Gulls were taken by WS, WS' take would represent 0.8% of the average number of Ring-billed Gulls observed in the state during the CBC from 2006 through 2015. Over the same 10-year period, the number of gulls observed during the CBC in the state has ranged from a low of 32,814 gulls observed in 2012 to a high of 88,517 gulls observed in 2008 (National Audubon Society 2010). Therefore, if WS had taken 500 Ring-billed Gulls annually from 2006 through 2015 in the state, the annual take by WS would range from a low of 0.6% to a high of 1.5% of the number of gulls observed in the state during the CBC.

From 2012 through 2016, non-WS take totaled 142 Ring-billed Gulls under depredation permits issued by the USFWS to alleviate damage and threats of damage in the state, which is an average of 28 gulls taken annually. If WS had taken 500 gulls annually from FY 2012 through FY 2016, the average annual take by all entities would have increased to 528 gulls taken per year in the state. Therefore, the cumulative take of gulls in the state, if WS had taken 500 gulls per year, would have represented 0.8% of the average number of gulls observed in the state during the CBC from 2006 through 2015.

HERRING GULL BIOLOGY AND POPULATION IMPACTS ANALYSIS

Herring Gulls are large white-headed gulls with a wide distribution in North America, Europe, and Central Asia (Nisbet et al. 2017). Herring Gulls are the most widely distributed gull species in the Northern Hemisphere. Herring Gulls breed in colonies near bodies of water, such as oceans, lakes, or rivers (Nisbet et al. 2017). Herring Gulls nest across the northern and eastern parts of Canada, with breeding populations in Alaska, the Great Lakes, and along the Atlantic coast in the United States. Herring Gulls will nest on natural or man-made sites, such as rooftops and break walls. Herring Gulls are increasingly nesting on man-made structures, particularly on rooftops or in areas with complete perimeter fencing, such as electrical substations.

Herring Gulls are a common seasonal resident throughout the winter in Florida (Nisbet et al. 2017) as large numbers of Herring Gulls move into the southeastern United States during winter, primarily along the Atlantic Coast (Hunter et al. 2006). CBC data gathered in Florida from 1966 through 2015 indicates the number of Herring Gulls observed during the survey has shown a general declining trend in the state (National Audubon Society 2010). Herring Gulls are also known to occur in Florida during the breeding season but those Herring Gulls present in the state are considered non-breeding gulls. The number of Herring Gulls observed in areas surveyed during the BBS in the state have shown an annual decreasing trend estimated at -2.74% since 1966; however, from 2005 through 2015, the number of Herring Gulls observed in Florida has shown an increasing trend estimated at 6.43% annually (Sauer et al. 2017). Across all BBS routes surveyed in the United States, Herring Gulls are showing a declining trend estimated at -3.65% annually since 1966, with a -1.38% annual decline occurring from 2005 through 2015 (Sauer et al. 2017). 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).

The number of Herring Gulls addressed by WS to alleviate damage from FY 2012 through FY 2016 is shown in Table 4.20. Between FY 2012 and FY 2016, WS has addressed 125,279 Herring Gulls using non-lethal methods, with the highest number of Herring Gulls addressed occurring in 2013 when 51,974 gulls were dispersed by WS using non-lethal methods. WS has also employed lethal methods to address damage and damage threats. In FY 2012, WS lethally removed 804 Herring Gulls, which represented the highest take levels by WS from FY 2012 through FY 2016. The USFWS has also authorized the take of 1,000 Herring Gulls annually in the state to alleviate damage.

Based on previous requests for assistance and the gregarious behavior of gulls, WS could lethally take up to 700 Herring Gulls annually to alleviate damage or threats of damage when requested by a cooperating entity. The number of Herring Gulls overwintering in the state each year is unknown. Herring Gulls are most commonly observed near the coastal areas of the state and near large bodies of water. The only known breeding colonies of Herring Gulls in the southeastern United States occur in North Carolina, which is considered the southern edge of the breeding range for Herring Gulls (Hunter et al. 2006). Herring Gulls are considered predatory, feeding on eggs and nestlings of other water bird species, including terns and plovers (Hunter et al. 2006). In some areas, Hunter et al. (2006) recommend reducing local populations of Herring Gulls to reduce predation on other higher priority ground nesting bird species. For example, the waterbird management plan for the southeastern United States recommended reducing the number of Herring Gulls nesting in North Carolina from approximately 1,000 breeding pairs down to 750 breeding pairs due to concern associated with Herring Gulls predating the eggs and nestlings of more sensitive beach-nesting birds (Hunter et al. 2006).

Between 2006 and 2015, 4,412 Herring Gulls on average have been observed annually in the state during the CBC (National Audubon Society 2010). Observers counted 6,977 Herring Gulls in areas surveyed during the CBC in 2014, which represented the highest number of gulls observed from 2006 through 2015. The lowest observed count of Herring Gulls in areas surveyed during the CBC occurred in 2013 when 3,073 Herring Gulls were counted (National Audubon Society 2010). WS' take of up to 700 Herring Gulls annually would represent 15.9% of the average number of Herring Gulls observed in the state during the CBC and 22.8% of the lowest count number from 2006 through 2015. In 2016, the USFWS authorized the lethal take of up to 1,000 Herring Gulls in the state to alleviate damage. If lethal removal activities reached 1,000 Herring Gulls, the cumulative take would represent 22.7% of the average number of gulls observed in the state during the CBC conducted from 2006 through 2015.

Table 4.20 – Number of Herring Gulls addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	29,338	804	0
2013	51,974	537	7
2014	33,171	169	0
2015	8,698	200	12
2016	2,098	80	3
TOTAL	**125,279**	**1,790**	**22**

†Reported by federal fiscal year

‡Reported by calendar year

WS' take and the cumulative take of Herring Gulls likely represents a smaller percentage of the actual number of Herring Gulls present in the state because data from the CBC would be considered a minimum population estimate given the survey parameters of the CBC and the survey only covering a small portion of the state. As stated previously, CBC data is best interpreted as an indication of long-term trends in the number of birds observed wintering in the state and is not intended to represent population estimates of wintering bird populations.

The North American Waterbird Conservation Plan ranked the Herring Gull as a species of "*low concern*" in North America (Kushlan et al. 2002), and the Southeastern United States Waterbird Conservation Plan placed the Herring Gull in the large scale population control/suppression action level (Hunter et al. 2006). The take of Herring Gulls by WS in Florida would only occur after a depredation permit had been issued by the USFWS and take would occur only at levels permitted. Therefore, the USFWS would determine the appropriate cumulative take level for Herring Gulls and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

BLACK TERN BIOLOGY AND POPULATION IMPACTS ANALYSIS

Black Terns breed across the northern United States and southern Canada and winter in South America (Heath et al. 2009). Black Terns nest in emergent vegetation in fresh-water wetlands across their breeding range (Heath et al. 2009). During the migration periods, terns travel inland through the United States to their wintering grounds along the coasts of Central and South America (Heath et al. 2009). Terns often forage in flocks and may form large groups during the migration periods, likely in response to concentrated food sources (Heath et al. 2009). Terns begin leaving breeding ground during the fall migration movement by late July with most terns leaving by mid- to late August (Heath et al. 2009). Black Terns are present in Florida during the migration periods (Heath et al. 2009) and can appear in large foraging flocks where they can pose aircraft strike risks when present near airports.

Because of the seasonal occurrence of terns during the migration periods, population and trend data for terns that occur in Florida is not available. Across all United States routes surveyed during the BBS, the number of terns observed has declined -2.25% annually since 1966, but has increased 4.79% annually from 2005 through 2015 (Sauer et al. 2017). Most requests for assistance received by WS related to Black Terns are associated with airports. Because terns are only present during migration periods, they usually occur in sporadic unpredictable flocks. Hurricanes can also lead to an increase in tern activity in relation to inland habitats. During a hurricane, terns can be pushed inland to escape the inclement weather.

From FY 2012 through FY 2016, 2,692 Black Terns have been dispersed by WS and 200 have been lethally taken by WS to alleviate aircraft strike risks (see Table 4.21). WS addressed 2,692 terns during FY 2012 to alleviate aircraft strike risks, which was the highest number of terns addressed from FY 2012 through FY 2016. As indicated in Table 4.21 the number of terns addressed annually by WS fluctuates, with years where no requests for assistance associated with Black Terns occur.

Table 4.21 – Number of Black Terns addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	2,692	200
2013	0	0
2014	0	0
2015	0	0
2016	0	0
TOTAL	**2,692**	**200**

Based on the number of requests received to alleviate the threat of damage associated with Black Terns and the number of Black Terns addressed previously to alleviate those threats, WS anticipates taking up to 200 Black Terns annually in the state to alleviate the threat of damage. The take of Black Terns is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits. Therefore, the number of Black Terns taken annually by WS in the state would be at the discretion of the USFWS based on allowable harvest levels and current population information. Thus, the take of Black Terns by WS would only occur at levels authorized by the USFWS, which ensures WS' take, and take by all entities, would be considered to achieve desired population management levels. In addition, the take of Black Terns by WS would only occur in conjunction with migratory seasons or hurricane events and would therefore be on a limited scale that would have no adverse effect on the overall population.

WOOD STORK BIOLOGY AND POPULATION IMPACT ANALYSIS

With its distinctive dark featherless head contrasting with the white feathers of the body and large size, the Wood Stork is one of the largest wading birds in the United States (Coulter et al. 1999, FWC 2003). The Wood Stork is the only species of stork that is commonly found in the United States (Coulter et al. 1999, FWC 2003). Storks can be found foraging for fish, small reptiles, amphibians, mammals and other aquatic organisms in shallow freshwater and coastal wetlands, including tidal creeks, tidal flats, marshes, cypress wetlands, ponds, ditches, and flooded fields (USFWS 1996, Coulter et al. 1999, FWC 2003).

Traditionally, the Wood Stork nested almost exclusively in southern Florida around the areas of Corkscrew Swamp, Big Cypress, and Cape Sable (FWC 2003). However, due to the loss of wetland habitat and degradation of wetland quality, the breeding population declined by more than 90% in southern Florida between the late 1940s and the late 1960s (Coulter et al. 1999, FWC 2003), which prompted the USFWS to list the Wood Stork as an endangered species in 1984 (USFWS 1996). The breeding population of Wood Storks was estimated at 20,000 nesting pairs in the 1930s but declined to approximately 10,000 pairs by 1960 and further declined to approximately 5,000 pairs in the late 1970s (USFWS 1996). Surveys conducted between 1983 and 1995 indicated a population ranging from 4,073 pairs to 7,853 pairs while a survey conducted in 2006 indicated 11,279 pairs (USFWS 2007*b*).

Due to the loss of foraging habitat in southern Florida, Wood Storks expanded their breeding range with nesting colonies now occurring in northern Florida, Georgia, and South Carolina (USFWS 1996, Coulter et al. 1999, FWC 2003). Storks also nest locally along the coastal areas in Mexico, Central America, South America, and the Caribbean (Coulter et al. 1999). Breeding storks in Georgia and South Carolina generally migrate into southern Georgia and Florida during the winter (Coulter et al. 1999). Wood Storks are more numerous in northern Florida during the summer than in winter, which indicates storks in northern Florida generally move southward during the fall migration period (FWC 2003). In addition, Wood Storks disperse widely outside of their normal breeding range after the breeding season prior to the fall migration period (Coulter et al. 1999, FWC 2003). The spring migration generally occurs during March and April (Coulter et al. 1999, FWC 2003).

Nesting can occur throughout the year in Florida (FWC 2003). From 1966 through 2015, trend data from the BBS indicates the number of Wood Storks observed in the state in areas surveyed has decreased at an annual rate of -0.08%, with a -0.78% annual decrease occurring from 2005 through 2015 (Sauer et al. 2017). Wood Stork numbers have increased in the Southeastern Coastal Plain at a rate of 5.99% annually since 2005 (Sauer et al. 2017). In the Peninsular Florida region, the number of storks observed in areas surveyed during the BBS has increased at an estimated rate of 0.03% from 1966 through 2015, but has decreased at estimated rates of -0.65% annually since 2005 (Sauer et al. 2017). The breeding population in Florida has been estimated at 15,600 storks with an overall population objective of approximately 44,000 storks (Hunter et al. 2006). Delisting of the Wood Stork from the ESA could be accomplished if surveys indicated 10,000 nesting pairs of storks occurred over a 5-year period with an annual regional productivity greater than 1.5 chicks per nest per year based on a 5-year average and at least 500 successful nesting pairs in southern Florida (USFWS 1996). Consideration for reclassification from endangered to threatened status could occur if 6,000 nesting pairs were documented and if the average annual regional productivity over a 3-year period was greater than 1.5 chicks per nest per year (USFWS 1996). The USFWS is currently considering reclassifying the status of Wood Storks from endangered to threatened (see 77 FR 75947-75966 and 78 FR 278-278).

The number of Wood Storks observed in Florida in areas surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 4,755 Wood Storks annually in the state. The fewest number of Wood Storks observed during the CBC conducted in the state from 2006 through 2015 occurred in 2014 when 4,186 Wood Storks were observed (National Audubon Society 2010). The highest number of Wood Storks observed during the CBC occurred in 2009 when 6,019 Wood Storks were counted (National Audubon Society 2010).

Requests for assistance associated with Wood Stork would occur primarily at airports within the state where storks were posing a direct strike risk with aircraft. Since 1990, 15 aircraft strikes involving Wood Storks have been reported in Florida (FAA 2017). Requests for assistance could also occur at aquaculture facilities within the state associated with storks feeding on aquatic organisms. Requests for assistance received by WS associated with Wood Storks would only be addressed using non-lethal harassment methods intended to disperse storks from areas where damages or threats of damage were occurring.

The ESA prohibits the "*take*" of T&E species unless specifically authorized. Under the ESA, the definition of "*take*" includes actions that can "*...harass, harm,* [or] *pursue...*" a T&E species. Therefore, activities conducted by WS to disperse Wood Storks to alleviate damage or threats of damage would only occur by WS when authorized by the USFWS. WS would abide by all conditions associated with the authorization issued by the USFWS. No activities would be conducted by WS unless specifically authorized by the USFWS. No lethal take of Wood Storks would occur. In general, conditions of authorizations are likely to include provisions that storks only be harassed while roosting or foraging but would not include activities at active nest sites that contain eggs or young. Another condition of authorizations would likely be a requirement that efforts be conducted to modify or eliminate, to the maximum extent possible, the factors or conditions that attract storks to those sites where damages or threats of damage occur. WS would abide by all measures and stipulations provided by the USFWS in permits issued for the harassment of storks and would re-initiate consultation pursuant to the ESA when and if necessary.

DOUBLE-CRESTED CORMORANT BIOLOGY AND POPULATION IMPACTS ANALYSIS

Double-crested Cormorants are large fish-eating colonial waterbirds widely distributed across North America (Dorr et al. 2014). There are generally five recognized subspecies of Double-crested Cormorants in North America (Dorr et al. 2014). In Florida, two subspecies of Double-crested Cormorants occur with *P. a. floridanus* present throughout the year and *P. a. auritus*, which is widely distributed across eastern and central North America, present in the state during the migration periods and the winter period (Guillaumet et al. 2011, Dorr et al. 2014). The fall migration period for Double-crested Cormorants generally occurs from August through early November with the peak occurring from late August through mid-October (Dorr et al. 2014). The spring migration period generally occurs from late March through the end of May with the peak occurring from mid-April through early March (Dorr et al. 2014). When both *P. a. floridanus* and *P. a. auritus* are present in the state, distinguishing between the two subspecies can be difficult with body size being the primary way to differentiate subspecies outside the breeding season (Dorr et al. 2014).

Since the late 1970s, the Double-crested Cormorant population has increased in many regions of North America, including those subspecies that may be present in Florida (Wires et al 2001). Wires et al. (2001) and Jackson and Jackson (1995) 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. Between the late 1970s and early 1990s, the Double-crested Cormorant population expanded to an estimated 372,000 nesting pairs (Tyson et al. 1999, Wires et al. 2001). Tyson et al. (1999) estimated the Double-crested Cormorant population (breeding and non-breeding birds) in the United States to be greater than 1 million cormorants. 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 in the early to mid-1990s by 6.5% overall, 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). Based on 2012 data, the Wetlands International (2017) estimated the continental population of Double-crested Cormorants to be between 1,078,280 and 1,160,590 cormorants. In Northeast and Central North America, the Wetlands International (2017) estimated the population of Double-crested Cormorants to be between 947,000 and 1,020,000 cormorants. The USFWS recently estimated the double-crested cormorant population in the central and eastern United States and Canada to be 731,880 to 752,516 Double-crested Cormorants with approximately 8,000 breeding pairs of cormorants occurring in Florida (see Table 4-1 and Table A-1 in USFWS (2017*b*)). The population of *P. a. floridanus* was estimated at 18,560 to 19,360 Double-crested Cormorants (breeding and non-breeding) (see Table 4-1 in USFWS (2017*b*)).

According to the Atlantic and Mississippi Flyways Double-crested Cormorant Management Plan, the breeding population of Double-crested Cormorants in Florida are "*essentially sedentary*" (Atlantic Flyway Council and Mississippi Flyway Council 2010). Historically, Double-crested Cormorants nested in the southern two-thirds of Florida with occasional colonies occurring in the northern one-third of the state (Atlantic Flyway Council and Mississippi Flyway Council 2010). The Atlantic Flyway Council and Mississippi Flyway Council (2010) stated, "*Current breeding distribution is similar with birds concentrated in central Florida along both coasts with additional colonies inland on marshes, lakes, and phosphate mine settling ponds*". Although the breeding population has fluctuated since the 1970s, the number of Double-crested Cormorants nesting in the state has shown an overall increase (Atlantic Flyway Council and Mississippi Flyway Council 2010). Double-crested Cormorants are common winter residents throughout Florida, except the interior portion of the Panhandle, and the number of cormorants present in the state during the winter appears to be increasing (Atlantic Flyway Council and Mississippi Flyway Council 2010).

Dorr et al. (2014) stated, "*Numbers* [of Double-crested Cormorants] *nesting in Florida are poorly known because the breeding season is long, colonies are inaccessible, and the cormorants are surrounded by many other nesting birds*". Dorr et al. (2014) indicated the breeding population in Florida was approximately 12,000 breeding pairs, which equates to 24,000 breeding adults. Hunter et al. (2006) estimated the breeding population of cormorants in Florida to be 7,000 to 8,000 breeding pairs, which equates to 14,000 to 16,000 breeding adults. Using data from 2012, Wetlands International (2017) estimated the breeding population of *P. a. floridanus* to be between 23,300 and 24,500 cormorants. The number of cormorants observed in the state along routes surveyed during the BBS has shown an increasing trend since 1966 estimated at 0.03% annually, with a 0.19% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Double-crested Cormorants observed along routes surveyed during the BBS in Peninsular Florida (BCR 31) have also shown an increasing trend estimated at 0.04% annually since 1966 (Sauer et al. 2017). In the Eastern BBS Region and the Central BBS Region, the number of Double-crested Cormorants observed along routes of the BBS has increased 9.52% and 6.44% annually, respectively, from 2005 through 2015 (Sauer et al. 2017).

Although Double-crested Cormorants nest in Florida, the largest concentrations occur during the fall, winter, and spring months when the winter migrating population is present (Dorr et al. 2014). The number of Double-crested Cormorants that winter in Florida is unknown and like all bird species, the actual number of Double-crested Cormorants present in the state fluctuates throughout the year and varies from year to year. Since 1966, the number of cormorants observed in areas surveyed during the CBC has shown a slightly decreasing to stable trend in the state (National Audubon Society 2010). CBC data from the 2006 through 2015 surveys show that observers have counted an average of 46,967 cormorants in areas surveyed ranging from a low of 38,398 cormorants to a high of 55,593 cormorants (National Audubon Society 2010).

From FY 2012 through FY 2016, WS has addressed 9,081 cormorants in the state using non-lethal methods to alleviate damage or threats to human health and safety. WS has also lethally taken 958 cormorants in Florida to alleviate damage or threats from FY 2012 through FY 2016 (see Table 4.22). Over 90% of the cormorants addressed by WS from FY 2012 through FY 2016 were addressed using non-lethal methods. Other entities have also addressed Double-crested Cormorants to alleviate damage and threats of damage. From 2012 through 2016, 112 Double-crested Cormorants were lethally removed by other entities to reduce damage risks.

Table 4.22 – Double-crested Cormorants addressed in Florida by all entities, 2012 – 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	593	424	0
2013	2,032	201	28
2014	3,678	230	32
2015	1,979	66	30
2016	799	37	22
TOTAL	**9,081**	**958**	**112**

†Reported by federal fiscal year

‡Reported by calendar year

WS has previously addressed requests for assistance associated with Double-crested Cormorant damage to power plants, county properties, and human health and safety. Currently, requests for assistance received by WS associated with Double-crested Cormorants would primarily be associated with aircraft strike risks at airports and military bases. Aircraft strikes with cormorants can cause substantial damage to aircraft and can cause the catastrophic failure of aircraft systems, especially when multiple birds are ingested into engines.

WS' anticipates the need to lethally take up to 200 cormorants annually to alleviate damage in state. Although WS' annual take of Double-crested Cormorants in Florida has exceeded 200 cormorants from FY 2012 through FY 2014, activities associated with several projects in the State involving damage caused by Double-crested Cormorants are no longer being conducted by WS.

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 Southeast United States Regional Waterbird Conservation Plan is to maintain no more than 15,000 pairs of Double-crested Cormorants with no more than 10,000 breeding pairs in Peninsular Florida (BCR 31) and no more than 4,000 breeding pairs occurring in the South Atlantic Coastal Plain (BCR 27), which includes Florida (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).

As stated previously, Hunter et al. (2006) estimated the breeding population in Peninsular Florida (BCR 31) to range from 14,000 to 16,000 breeding adults, which does not include non-breeding cormorants that are also likely present in the state. Take of up to 200 cormorants by WS would represent 1.4% of a breeding population estimated at 14,000 adult cormorants. Take of up to 200 cormorants by WS would also represent 0.4% of the average number of cormorants observed annually during the CBC conducted from 2006 through 2015 and would not have an adverse effect on the population. Based on the known take of Double-crested Cormorants in the state by WS and other entities, take of up to 200 Cormorants annually by WS to alleviate damage would not adversely affect Double-crested Cormorant populations in Florida.

All take of Double-crested Cormorants by WS would occur as allowed by the USFWS, which would ensure the cumulative take of cormorants from all known sources was considered when establishing population objectives in Florida. The USFWS recently concluded an evaluation of allowed cumulative take levels for double-crested cormorants in the central and eastern United States and determined the allowed cumulative take levels authorized in the central and eastern United States, including allowed cumulative take in Florida, would not impact the double-crested cormorant population (see Section 5.4, Table 5-2, and Appendix 1 in USFWS (2017*b*)).

BROWN PELICAN BIOLOGY AND POPULATION IMPACT ANALYSIS

With their dark feather coloration, large body, long bill, and their large gular pouch, the Brown Pelican is a conspicuous waterbird that is considered a permanent resident along the marine coasts from central North America into northern South America (Shields 2014). Brown Pelicans feed on primarily marine fish and they are well known for their headfirst dives into the water to capture prey, often diving down from as high as 65 feet (Shields 2014). Brown Pelicans typically forage in the shallow waters near the coastline along beaches, sandbars, docks, dredge-spoil islands but can be found on inland waters in Florida (FWC 2003, Shields 2014). Due to many factors, including overharvest, pesticide use, and fisheries collapse, the Brown Pelican was designated as endangered under the ESA in 1970 across the entire range of the species in the United States (Shields 2014; see 50 FR 4938-4945); however, populations of Brown Pelicans in Florida did not suffer the sudden declines observed elsewhere (FWC 2003). Due in part to those less drastic declines in the population observed in Florida and along the Atlantic Coast, the population of pelicans in those areas, including populations in Florida and Alabama, were delisted in 1985 (see 50 FR 4938-4945). Populations elsewhere in the United States were delisted in 2009 (see 74 FR 59444-59472). Today, populations of Brown Pelicans are no longer listed under the ESA but are afforded protection under the MBTA. However, pelicans are considered a "*species of special concern*" by the FWC.

The number of Brown Pelicans observed in areas surveyed within the state during the BBS has shown annual declines since 1966 estimated at -0.47%, with 0.17% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). In Peninsular Florida, the number of pelicans observed in areas surveyed during the BBS has also shown annual declines estimated at -2.14% since 1966, with a -1.63% annual decline estimated from 2005 through 2015 (Sauer et al. 2017). In the Southeastern Coastal Plain region, the number of pelicans observed across all routes of the BBS has increased 4.03% annually since 1966, with a 4.54% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Across all routes surveyed during the BBS, the number of pelicans observed has increased 3.72% annually since 1966 and 5.18% annually from 2005 through 2015 (Sauer et al. 2017). In Florida, nesting generally occurs in trees on coastal islands consisting of a few dozen to several hundred pairs of pelicans, with some colonies containing more than 1,000 nests (Shields 2014, FWC 2003). The breeding population of pelicans in the state likely fluctuates between 8,000 and 12,000 nesting pairs (FWC 2003). Across the southeastern United States, the breeding population of Brown Pelicans has been estimated at 42,551 breeding pairs, with 14,600 pairs occurring in the Southeastern Coastal Plain region, 9,527 pairs occurring in Peninsular

Florida, and 18,424 breeding pairs occurring elsewhere in the southeast (Hunter et al. 2006). The population objective for the southeastern United States is to maintain 40,000 to 60,000 breeding pairs of Brown Pelicans (Hunter et al. 2006).

Of the five tiers of action levels for waterbirds outlined in the Southeast United States Waterbird Conservation Plan, Brown Pelicans were assigned to the "*planning and responsibility*" tier, which includes birds that require some level of planning to maintain sustainable populations in the region (Hunter et al. 2006). The planning and responsibility tier is the second lowest tier in terms of action priority ahead of only the last tier, which includes those waterbirds that are considered above management levels (Hunter et al. 2006). The North American Waterbird Conservation Plan classified the Brown Pelican in a category of conservation concern considered as "*moderate concern*" (Kushlan et al. 2002).

The number of Brown Pelicans observed in Florida in areas surveyed during the CBC has shown a generally stable to slightly decreasing trend since 1966 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 20,515 Brown Pelicans annually in the state. The fewest number of Brown Pelicans observed during the CBC conducted in the state occurred in 2008 when 18,336 Brown Pelicans were observed (National Audubon Society 2010). The highest number of Brown Pelicans observed during the CBC occurred in 2015 when 23,099 Brown Pelicans were counted (National Audubon Society 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 Brown Pelicans 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 Brown Pelicans that could be present in the state. The number of Brown Pelicans observed by surveyors during the CBC would be considered minimum estimates because not all areas of the state are surveyed during the CBC.

Brown Pelicans are highly social during all seasons and can often be found nesting, roosting, flying, and foraging in groups (FWC 2003, Shields 2014). This gregarious behavior and their large size can increase aircraft strike risks at airports within the state. Between January 1990 and August 2016, there have been 11 reported aircraft strikes involving Brown Pelicans within the state (FAA 2017). In 1994, a privately owned aircraft in Florida struck at least one Brown Pelican during flight causing the aircraft to crash, which resulted in the death of the pilot. Most requests for assistance received by WS involving Brown Pelicans are associated with aircraft strike risks.

As shown in Table 4.23, WS has addressed 7,208 Brown Pelicans between FY 2012 and FY 2016 using non-lethal dispersal methods. During this same reporting period, WS has lethally removed one Brown Pelican. Based on the number of Brown Pelicans addressed previously and in anticipation of additional efforts, WS could lethally remove up to 25 Brown Pelicans annually within the state. As stated previously, Brown Pelicans are no longer listed as endangered under the ESA but are protected from take as defined by the MBTA. Therefore, any lethal removal by WS would occur pursuant to the MBTA through the issuance of a depredation permit by the USFWS authorizing the take of pelicans. If a permit were not issued by the USFWS, no lethal removal would occur. WS anticipates continuing to address Brown Pelicans using primarily non-lethal harassment methods.

As stated previously, the breeding population of pelicans likely fluctuates between 8,000 and 12,000 nesting pairs (FWC 2003). If 25 pelicans were lethally removed by WS, take would represent 0.1% to 0.2% of the total breeding population within the state. Between 2006 and 2015, observers conducting surveys for the CBC counted an average of 20,515 Brown Pelicans annually in the state. Take of up to 25 pelicans would represent 0.1% of the average number of pelicans observed in areas surveyed during the CBC from 2006 to 2015. The fewest number of Brown Pelicans observed during the CBC conducted in the state from 2006 to 2015 occurred in 2008 when 18,336 Brown Pelicans were observed (National Audubon Society 2010). Take of up to 25 pelicans would represent 0.1% of the lowest number of pelicans observed during the CBC conducted from 2006 to 2015. As stated previously, the data available from the CBC is intended to provide long-term trending information. However, the information on the actual number of Brown Pelicans 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 pelicans that could be present in the state. The number of Brown Pelicans observed by surveyors during the CBC would be considered a minimum estimate because not all areas of the state are surveyed during the CBC.

Table 4.23 – Number of Brown Pelicans addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	2,337	0
2013	1,828	0
2014	424	1
2015	546	0
2016	2,073	0
TOTAL	**7,208**	**1**

The take of Brown Pelicans by WS to alleviate damage risks would only occur when authorized by the USFWS and only at levels authorized. WS would continue to address pelicans using primarily non-lethal methods. The lethal removal of pelicans would only occur when non-lethal dispersal methods were ineffective at alleviating damage or reducing the risk of damage or when pelicans posed an immediate risk to aircraft and human safety.

GREAT BLUE HERON BIOLOGY AND POPULATION IMPACTS ANALYSIS

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. Herons can be found throughout the year in most of the United States, including Florida (Vennesland and Butler 2011). Great Blue Herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (MANEM Region Waterbird Working Group 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 Region Waterbird Working Group 2006). Great Blue Herons feed mainly on fish but they are also known to capture invertebrates, amphibians, reptiles, birds, and mammals (Vennesland and Butler 2011).

In Florida, herons observed on BBS routes are showing a downward trend estimated at -2.32% annually from 1966 through 2015 (Sauer et al. 2017). In the Peninsular Florida region (BCR 31), the number of herons observed has also shown a declining trend along routes surveyed from 1966 through 2015 estimated at -2.2% annually (Sauer et al. 2017). However, in the Southeastern Coastal Plain region (BCR 27), the number of herons observed in areas surveyed during the BBS has shown an increasing trend estimated at 1.6% annually from 1966 through 2015 (Sauer et al. 2017). The declines in the number of herons observed nesting in Peninsular Florida has been attributed to "*...hydrological disruptions, increasing development pressures, contaminants, and potentially increased disturbance to nesting sites*" (Hunter et al. 2006). 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 Peninsular Florida region (BCR 31), there are an estimated 3,318 breeding pairs of herons (Hunter et al. 2006). In the Southeastern Coastal Plain region (BCR 27), which includes the northern portion of the state, the breeding population of herons has been estimated at 26,700 breeding pairs (Hunter et al. 2006). The number of herons breeding in that portion of the state that lies within the Southeastern Coastal Plain region is unknown.

Herons observed overwintering in Florida have shown a general stable to declining trend since 1966 (National Audubon Society 2010). The average number of herons observed in areas surveyed during the CBC conducted in Florida was 6,345 herons from 2006 through 2015 (National Audubon Society 2010). The highest number of herons counted in areas surveyed occurred in 2010 when 7,182 herons were recorded. The lowest number of herons counted occurred in 2015 when 5,516 herons were observed (National Audubon Society 2010). The data available from the CBC is intended to provide long-term trending information. However, the information on the actual number of herons 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 herons that could be present in the state. The number of herons observed by surveyors during the CBC would be considered minimum estimates because not all areas of the state are surveyed during the CBC.

To alleviate damage, WS has lethally removed 97 Great Blue Herons in Florida and employed non-lethal methods to disperse 3,874 Great Blue Herons from FY 2012 through FY 2016 (see Table 4.24). In addition to the take of Great Blue Herons by WS to alleviate damage or threats, the USFWS has issued depredation permits to other entities for the take of herons. To alleviate damage threats, a total of 27 Great Blue Herons have been lethally removed by other entities in the state from 2012 through 2016. Based on previous requests for assistance, WS could lethally remove up to 50 Great Blue Herons per year in Florida to alleviate damage and threats of damage.

The number of Great Blue Herons present in Florida at any given time likely fluctuates throughout the year. As was stated previously, Hunter et al. (2006) estimated the nesting population in the Peninsular Florida region at 3,318 breeding pairs of herons, which equates to 6,636 adult herons but does not include non-breeding herons that could be present in the state. The number of breeding pairs of herons nesting in that portion of the state considered as part of the Southeastern Coastal Plain region is unknown. Take of up to 50 herons by WS to alleviated damage would represent 0.8% of the estimated breeding population of herons in the Peninsular Florida region of the state.

Table 4.24 – Number of Great Blue Herons addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	774	24	0
2013	651	15	14
2014	476	7	0
2015	904	31	3
2016	1,069	20	10
TOTAL	**3,874**	**97**	**27**

†Reported by federal fiscal year

‡Reported by calendar year

The number of herons observed in the state during the CBC from 2006 through 2015 has ranged from a low of 5,516 herons to a high of 7,182 herons with an average of 6,345 herons observed. Take of up to 50 herons by WS would represent 0.8% of the average number of herons observed in the state during the CBC from 2006 through 2015 with the overall take ranging from 0.7% to 0.9% of the number of herons observed. Between 2012 and 2016, entities other than WS have lethally removed 27 Great Blue Herons in the state under depredation permits issued by the USFWS. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect heron populations. The permitting of the take by the USFWS ensures the cumulative take of herons in the southeastern United States, including the take proposed by WS in Florida under this assessment, would not reach a magnitude where undesired adverse effects occur. The take of herons by WS would occur within allowed levels of take permitted by the USFWS through the issuance of depredation permits.

GREAT EGRET BIOLOGY AND POPULATION IMPACTS ANALYSIS

Great Egrets are large white birds of intermediate size between the larger herons and smaller egrets commonly found in the United States (McCrimmon et al. 2011). Great Egrets can be found in freshwater, estuarine, and marine wetlands (McCrimmon et al. 2011). In Florida, Great Egrets breed throughout the state with the highest number of occurrences being in the central and southern portion of the peninsula (FWC 2003).

The overharvest of Great Egrets that occurred primarily from 1870 to 1910 for plumes and the millinery trade reduced the population in North America by >95% (McCrimmon et al. 2011). During surveys conducted in 1911-1912, the total known nesting population of Great Egrets was estimated at 1,000 to 1,500 breeding pairs in 13 colonies in seven states (McCrimmon et al. 2011). Following regulations that ended plume-hunting, Great Egret populations rapidly recovered with increases reported in the late 1920s and 1930s (McCrimmon et al. 2011).

In the Southeastern Coastal Plain, the numbers of Great Egrets observed across all BBS routes are showing an increasing trend estimated at 1.58% annually since 1966 (Sauer et al. 2017). However, populations of Great Egrets are decreasing slightly in both Peninsular Florida (BCR 31) and Florida with estimated trends of -1.0% and -0.97% since 1966, respectively (Sauer et al. 2017). The average number of Great Egrets observed in areas surveyed during the CBC from 2006 through 2015 is 12,560 egrets. The lowest number of egrets observed during the CBC from 2006 through 2015 occurred in 2011 when 11,124 egrets were recorded. The highest number of egrets recorded in the state during the CBC between 2006 through 2015 occurred in 2013 when 14,117 egrets were observed (National Audubon Society 2010). Overall, the number of Great Egrets observed in areas of the state surveyed during the CBC has shown a slightly declining trend (National Audubon Society 2010).

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

Similar to other waterbirds addressed in this EA, Great Egrets can cause damage to aquaculture resources by consuming aquatic wildlife raised for sale and from the threats associated with disease transmission between aquaculture ponds and facilities. Egrets can also pose strike risks with aircraft at airports in the state. To address damages and threats associated with Great Egrets, the USFWS has issued depredation permits to WS and other entities pursuant to the MBTA that allow the take of egrets to manage damage and threats.

To alleviate damage, WS has lethally removed 314 Great egrets in Florida and employed non-lethal methods to disperse 19,007 Great Egrets from FY 2012 through FY 2016 (see Table 4.25). In addition to the take of Great Egrets by WS to alleviate damage or threats, the USFWS has issued depredation permits to other entities for the take of Great Egrets. To alleviate damage threats, a total of 141 Great Egrets have been lethally removed by other entities in the state between 2012 and 2016 (see table 4.25). Based on previous and current levels of take by WS to alleviate damage and threats of damage associated with

Great Egrets, WS anticipates that up to 200 Great Egrets could be lethally taken by WS in the state to manage damage and threats.

Table 4.25 – Number of Great Egrets addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	2,214	52	5
2013	2,109	50	37
2014	3,688	23	20
2015	5,175	119	38
2016	5,821	70	41
TOTAL	**19,007**	**314**	**141**

†Reported by federal fiscal year

‡Reported by calendar year

The population of Great Egrets in Florida likely fluctuates throughout the year and is likely highest during migration periods. Nesting and winter populations of Great Egrets are currently unknown in Florida. The Southeast United States Regional Waterbird Conservation Plan estimated the Great Egret population at 28,244 breeding pair in the Southeastern Coastal Plain (Hunter et al. 2006). WS' take of up to 200 Great Egrets would represent 0.4% of the estimated breeding population in the Southeastern Coastal Plain.

The number of Great Egrets observed in the state during the CBC from 2006 through 2015 has ranged from a low of 11,124 egrets to a high of 14,117 egrets with an average of 12,560 egrets observed. Take of up to 200 egrets by WS would represent 1.6% of the average number of Great Egrets observed in the state during the CBC from 2006 through 2015 with the overall take ranging from 1.4% to 1.8% of the number of Great Egrets observed. Between 2012 and 2016, entities other than WS have lethally removed 141 Great Egrets in the state under depredation permits issued by the USFWS. Although take by other entities has occurred in the state, the continued take by other entities in the state is not anticipated to increase to a level where cumulative take would adversely affect Great Egret populations.

Based on the limited take that could occur by WS and the permitting of the take by the USFWS, WS' take would have no adverse effects on Great Egret populations in the State. Similar to other migratory birds addressed in this EA, the take of Great Egrets by WS would only occur at the discretion of the USFWS and only at levels permitted by the USFWS. Therefore, all take by WS to alleviate damage or threats associated with Great Egrets would be evaluated pursuant to the objectives of the MBTA.

CATTLE EGRET BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Cattle Egret is a relatively new arrival to the North American continent with the first record for the continental United States occurring in south Florida in 1941 (Telfair II 2006). Today, Cattle Egrets can be found across much of North America, from New England to south Texas (Telfair II 2006). 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 breeding population of Cattle Egrets in Florida is currently unknown. Breeding populations of Cattle Egrets in Florida indicated the number of egrets observed in areas surveyed have shown an annual decreasing trend estimated at -3.6% since 1966 (Sauer et al. 2017). The total population of Cattle Egrets in North America has been estimated to range from 750,000 to 1,500,000 egrets (Hunter et al. 2006). The Southeast United States Regional Waterbird Conservation Plan ranks Cattle Egrets in the "*population control*" action level meaning those species' populations are increasing to a level where damages to economic ventures or adverse 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 habitats relative to other waterbirds (Hunter et al. 2006, Telfair 2006). Cattle Egrets have also been implicated as contributing to the declining trends of Little Blue Herons and Snowy Egrets given the aggressive behavior exhibited by Cattle Egrets and the use of similar nesting habitats (Burger 1978, Hunter et al. 2006, Telfair II 2006). The Cattle Egret population in the southeastern Bird Conservation Regions has been estimated at approximately 350,000 breeding pairs. The Conservation Plan calls for the reduction of Cattle Egret populations in the southeastern Bird Conservation Regions to less than 200,000 breeding pairs of Cattle Egrets. Therefore, the Plan calls for reducing the Cattle Egret population by 300,000 egrets in the southeastern United States (Hunter et al. 2006). The number of Cattle Egrets observed in areas of the state surveyed during the CBC has shown a declining trend (National Audubon Society 2010)

From FY 2012 through FY 2016, 185,522 Cattle Egrets were dispersed by WS and 4,750 Cattle Egrets have been lethally taken by WS to alleviate damage pursuant to depredation permits (see Table 4.26). From FY 2012 through FY 2016, nearly 98% of the Cattle Egrets addressed by WS were dispersed using non-lethal methods. If the number of requests for assistance to manage damage and threats associated with Cattle Egrets increases, WS could take up to 2,000 Cattle Egrets annually in the state to alleviate damage and threats of damage. WS anticipates continuing to address most Cattle Egrets using non-lethal methods.

Table 4.26 – Number of Cattle Egrets addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	71,178	1,394
2013	38,556	1,130
2014	33,847	736
2015	23,090	919
2016	18,851	571
TOTAL	**185,522**	**4,750**

The take of Cattle Egrets is prohibited under the MBTA unless authorized by the USFWS through the issuance of depredation permits. Therefore, the number of egrets taken annually by WS in the state would occur at the discretion of the USFWS based on allowable harvest levels and population information.

As was stated previously, the objective of the Waterbird Conservation Plan for the Southeastern United States is to reduce the breeding population of Cattle Egrets. Take of up to 2,000 egrets annually by WS would represent 0.7% of the population reduction of 300,000 egrets. If the objective of the Plan were met, take of up to 2,000 egrets would represent 0.5% of the estimated 400,000 breeding Cattle Egrets in the southeastern Bird Conservation Regions.

BLACK VULTURE BIOLOGY AND POPULATION IMPACT ANALYSIS

Historically in North America, Black Vultures occurred in the southeastern United States, Texas, Mexico, and parts of Arizona (Wilbur 1983, Buckley 1999). Black Vultures have been expanding their range northward in the eastern United States and now occur as far north as New Jersey, Ohio, Pennsylvania, West Virginia and rarely Connecticut and New York (Wilbur 1983, Rabenhold and Decker 1989, Buckley 1999). 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). In Florida, poultry carcasses from farms are an important component of the diet of Black Vultures (Stewart 1978, Rabenold 1987). 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. (2017), the number of Black Vultures observed in the state during the breeding season has increased at an annual rate of 3.07% from 1966 through 2015 with a 3.14% annual increase occurring from 2005 through 2015. Similar increasing trends have been observed for Black Vultures in the Peninsular Florida region (BCR 31) estimated at 3.22% annually from 1966 through 2015 and 3.19% annually from 2005 through 2015 (Sauer et al. 2017). The number of Black Vultures observed overwintering in the state has shown a general increasing trend since 1966 (National Audubon Society 2010). The number of Black Vultures observed in areas surveyed during the CBC from 2006 through 2015 has ranged from a low of 14,562 vultures observed in 2006 to a high of 22,302 vultures in 2015 (National Audubon Society 2010). Observers counted an average of 19,209 vultures per year in areas surveyed during the CBC conducted from 2006 through 2015. The current population of Black Vultures in the state is unknown.

The Black Vultures addressed by WS and other entities to alleviate damage or threats are shown in Table 4.27. From FY 2012 through FY 2016, WS has lethally taken 621 Black Vultures in the state to alleviate damage and threats. In addition, WS has employed non-lethal harassment methods to disperse 35,513 vultures in the state to address requests for assistance to manage damage. Over 98% of the Black Vultures addressed by WS from FY 2012 through FY 2016 have been addressed using non-lethal harassment methods. The highest level of take of vultures by WS to alleviate damage and threats of damage occurred in FY 2012 when 203 vultures were removed. Between FY 2012 and FY 2016, an average of 124 black vultures per year have been lethally removed by WS in the state, while 7,103 vultures per year have been addressed using non-lethal methods. In total, 398 vultures have been lethally removed in the state by other entities, which represents an average of 80 vultures per year from 2012 through 2016.

As the number of vultures present in the state increases, WS anticipates the number of requests for assistance to manage damage associated with Black Vultures to increase. Subsequently, the number of vultures addressed by WS annually is likely to increase also as requests for assistance increase. Based on the increasing need to address damage associated with Black Vultures in the state, up to 500 Black Vultures could be lethally taken under the proposed action to address damage and threats associated with Black Vultures. Increases in requests for assistance would be associated with vultures roosting on towers, power structures, residential buildings, and threats of aircraft strikes at airports. Vultures repeatedly roosting on man-made structures can lead to accumulations of fecal droppings which can be aesthetically displeasing, can cause corrosive damage, can be slippery, and post threats of disease transmission when occurring in public-use or work areas. In addition, damages occur to residential structures and vehicles from vultures pulling a tearing shingles and weather stripping around windows and cars. Vultures are also known to tear seat cushions on mowers, boats, and other property. The soaring behavior of vultures and their large body size pose risks to aircraft when struck which can cause damage to aircraft and threaten passenger safety.

Table 4.27–Number of Black Vultures addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	5,151	203	72
2013	10,268	191	127
2014	8,097	114	10
2015	5,084	72	60
2016	6,913	41	129
TOTAL	**35,513**	**621**	**398**

†Reported by federal fiscal year

‡Reported by calendar year

Take of up to 500 vultures annually by WS would represent 2.6% of the average number of vultures observed per year from 2006 through 2015 in areas surveyed during the CBC. The lowest count of vultures during the CBC conducted from 2006 through 2015 was 14,562 vultures. Take of up to 500 vultures by WS would represent 3.4% of the lowest vulture count during the CBC occurring from 2006 through 2015. As stated previously, the data available from the CBC is intended to provide long-term trending information. However, the information on the actual number of Black Vultures 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 vultures that could be present in the state. The number of vultures observed by surveyors during the CBC would be considered minimum estimates because the area of the state that is actually surveyed during the CBC is small.

If the number of Black Vultures taken by other entities in Florida remains similar to the number of Black Vultures taken from 2012 through 2016 and if 500 vultures were taken by WS, the annual take of vultures would be 580 vultures. The cumulative take of 580 vultures by all entities would represent 3.0% of the average number of vultures observed in areas surveyed during the CBC in the state from 2006 through 2015 and 4.0% of the lowest number of vultures observed in the state during the CBC conducted from 2006 through 2015.

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

TURKEY VULTURE BIOLOGY AND POPULATION IMPACT ANALYSIS

Turkey Vultures can be found throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenhold and Decker 1989). Turkey vultures can be found throughout the year in Florida (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).

The statewide population of Turkey Vultures is currently unknown but the breeding population has been estimated at 190,000 vultures based on BBS data (Partners in Flight Science Committee 2013). Trending data from the BBS indicates the number of Turkey Vultures observed along BBS routes in the state have shown a decreasing trend estimated at -0.04% annually from 1966 through 2015 (Sauer et al. 2017). Trending data from the BBS indicates the number of Turkey Vultures observed along BBS routes in the state have shown an increasing trend estimated at 0.1% annually from 2005 through 2015 (Sauer et al. 2017). The numbers of Turkey Vultures observed in areas surveyed during the CBC in the state are also showing an increasing trend (National Audubon Society 2010). Between 2006 and 2015, observers in Florida have counted on average 42,125 Turkey Vultures in areas surveyed during the CBC. The lowest reported count occurred in 2006 when 33,036 Turkey Vultures were observed in areas surveyed during the CBC. The highest reported count occurred in 2009 when 53,644 vultures were observed (National Audubon Society 2010).

The take of Turkey Vultures is also prohibited under the MBTA except through the issuance of depredation permits by the USFWS. The number of Turkey Vultures addressed in Florida by all entities to alleviate damage is shown in Table 4.28. Nearly 99% of the Turkey Vultures addressed by WS from FY 2012 through FY 2016 have been addressed using non-lethal harassment methods. From FY 2012 through FY 2016, 131,169 Turkey Vultures have been dispersed using non-lethal methods while WS has lethally taken 1,839 Turkey Vultures in the state to alleviate damage. In total, 368 Turkey Vultures have been lethally taken from 2012 through 2016 by other entities in the state pursuant to depredation permits issued by the USFWS (see table 4.28).

Table 4.28 – Number of Turkey Vultures addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	39,609	530	33
2013	24,797	487	110
2014	16,362	258	56
2015	22,836	338	72
2016	27,565	226	97
TOTAL	**131,169**	**1,839**	**368**

†Reported by federal fiscal year

‡Reported by calendar year

Based on trending data from the BBS and the CBC, the number of Turkey Vultures present in the state continues to increase annually. Based on current population trends for Turkey Vultures in the state, the number of requests for assistance with managing damage associated with Turkey Vultures and the number of vultures that will be addressed to meet those requests is 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 800 Turkey Vultures could be lethally taken annually by WS to alleviate damage and threats.

If up to 800 Turkey Vultures were taken annually by WS, WS' take would represent 0.4% of the estimated statewide breeding population of Turkey Vultures estimated at 190,000 vultures if the population remains at least stable. If take by other entities remains stable, cumulative take of vultures annually by all entities would be 874 vultures. The cumulative take of vultures would represent 0.5% of the statewide breeding population if the population remains at least stable. Cumulative take of up to 874

Turkey Vultures annually would represent 2.1% of the average number of Turkey Vultures observed per year from 2006 through 2015 in areas of the state surveyed during the CBC. The lowest count of Turkey Vultures during the CBC conducted from 2006 through 2015 was 33,036 vultures. Cumulative take of up to 874 vultures would represent 2.7% of the lowest vulture count during the CBC occurring from 2006 through 2015. Permitting of the take by the USFWS pursuant to the MBTA ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for Turkey Vultures in the state.

OSPREY BIOLOGY AND POPULATION IMPACTS ANALYSIS

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Bierregaard et al. 2016). 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 (Bierregaard et al. 2016). Osprey can be located throughout the year in the state (Bierregaard et al. 2016). Under FAC 68A-27.005, the state has designated several wildlife species as species of special concern, which includes the Osprey population in Monroe County, Florida.

Requests for assistance received by WS to alleviate damage or the threat of damage associated with Osprey are often associated with their nesting behavior. Osprey nests are often constructed of large sticks, twigs, and other building materials, which 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 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). Osprey can also pose risks to aircraft when they occur near airports and military bases. Between 1990 and 2015, there have been 292 reported civil aircraft strikes in the United States involving Ospreys causing nearly $803,000 in damages (Dolbeer et al. 2016).

Since 1966, the number of Osprey observed along routes surveyed in the state during the BBS has shown an increasing trend estimated at 3.07% annually with a 2.60% annual increase occurring between 2005 and 2015 (Sauer et al. 2017). The number of Osprey observed in areas of the state surveyed during the CBC has also shown increasing trends (National Audubon Society 2010). Between 2006 and 2015, observers in Florida have counted on average 4,278 Ospreys in areas surveyed during the CBC. The lowest reported count occurred in 2006 when 3,318 Ospreys were observed in areas surveyed during the CBC. The highest reported count occurred in 2012 when 4,928 Ospreys were observed (National Audubon Society 2010). Based on BBS data, the Partners in Flight Science Committee (2013) estimated the statewide population of Ospreys was 30,000 birds.

WS has responded to requests for assistance involving Ospreys previously by providing technical assistance and by providing direct operational assistance. Between FY 2012 and FY 2016, the WS program in Florida addressed 4,055 Ospreys using non-lethal harassment methods. Only 34 Ospreys were lethally taken by WS in the state to alleviate damage or threat of damage between FY 2012 and FY 2016 (see Table 4.29).

Under the proposed action alternative, WS could be requested to use lethal methods to remove Osprey when non-lethal methods were ineffective or were determined to be inappropriate using WS Decision model. An example could include Ospreys that pose an immediate strike threat at an airport where attempts to disperse the Ospreys were 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 Ospreys and in anticipation of additional efforts, WS could lethally take up to 50 Ospreys annually in the state to alleviate damage. In addition, WS could destroy the nests and/or eggs of Ospreys as part of an integrated approach to managing damage. Under the proposed action, up to 20 nests could be destroyed annually by WS. WS' take of nests and/or eggs would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests would not exceed 20 nests annually and would not exceed the level permitted under depredation permits. Impacts due to nest and egg destruction would have little adverse effect on the Osprey population in Florida.

Table 4.29 – Number of Ospreys addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	746	2
2013	889	1
2014	592	0
2015	779	18
2016	1,049	13
TOTAL	**4,055**	**34**

Based on a statewide population estimated at 30,000 Ospreys and if up to 50 Ospreys were taken in any given year, WS' take would represent 0.2% of the estimated population. Take of up to 50 Osprey annually by WS would represent 1.2% of the average number of Ospreys observed per year from 2006 through 2015 in areas of the State surveyed during the CBC. The lowest count of Ospreys during the CBC conducted from 2006 through 2015 was 3,318 Ospreys. Take of up to 50 Ospreys by WS would represent 1.5% of the lowest Osprey count during the CBC occurring from 2006 through 2015.

WS' take would only occur when permitted and only at levels authorized on depredation permits issued by the USFWS. As discussed previously, the state has designated several wildlife species as species of special concern pursuant to FAC 68A-27.005, which includes the osprey population in Monroe County, Florida. The lethal take of wildlife species listed as threatened or endangered by the FWC is prohibited under FAC 68A-27.003 and FAC 68A-27.0011 unless allowed by a specific federal or state permit or authorization. However, under FAC 68A-9.012, the lethal take of wildlife, including those species listed as endangered or threatened designated by the state in FAC 68A-27.003, can occur on properties of airports to alleviate aircraft strike risks when meeting the provisions within FAC 68A-9.012.

SWALLOW-TAILED KITE BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Swallow-tailed Kite is a highly recognizable mid-sized raptor of white and black plumage, with a deeply forked tail. Sexes are indistinguishable by plumage or size and breeding populations are divided in two subspecies, the northern of which breeds in the southeastern United States, primarily Florida with several isolated populations along the Atlantic and gulf coasts, and winters in South America (Meyer 1995). Kites are woodland nesters, preferring woodland with open, uneven structure for nest-tree crown. Nests are usually near the top of one of the tallest trees in the stand, and are typically not reused from year to year (Meyer 1995). Kites are often described as insect eaters, but are also known to prey on frogs, lizards, small snakes, small birds, and small mammals, especially to feed young (Meyer 1995). Nesting groups often forage together, when those flocks occur near air facilities, aircraft strike hazards increase. Between 1990 and 2015, there have been four reported civil aircraft strikes in the United States involving Swallow-tailed Kites (Dolbeer et al. 2016).

According to BBS trend data, Swallow-tailed Kite populations have increased at an annual rate of 5.78% in Florida since 1966 (Sauer et al. 2017). The numbers of Swallow-tailed Kites observed along routes surveyed in Peninsular Florida (BCR 31) and the Southeastern Coastal Plain have also shown increases estimated at 5.49% and 7.2%, respectively, since 1966 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the number of Swallow-tailed Kites present in the Florida during the breeding season to be 1,800 individuals based on BBS data and a global population of 150,000 individuals. BirdLife International (2016*b*) classified the Swallow-tailed Kite as a species of "*least concern*". In Florida, Swallow-tailed Kites are present during the migration periods and can be found nesting from March through June (Meyer 1995). Because the majority of their diet consists of insects along with some small vertebrates, the open areas of airports provide ideal foraging habitat for kites (FWC 2003). Therefore, most requests for assistance received by WS occur at airports where Swallow-tailed Kites pose an aircraft strike risk.

From FY 2012 through FY 2016, 286 Swallow-tailed Kites were addressed by WS using non-lethal harassment methods. During FY 2016, five Swallow-tailed Kites were lethally taken by WS to alleviate damage and threats to human health and safety pursuant to depredation permits (see Table 4.30). Based on the number of requests received to alleviate the threat of damage associated with Swallow-tailed Kites and the number of kites addressed previously to alleviate those threats, WS anticipates that up to 40 individuals could be lethally removed annually in the state to alleviate damage and the threat of damage. The lethal removal of 40 Swallow-tailed Kites would represent 2.2% of the estimated breeding population in Florida, and 0.03% of the global population. Take is likely to occur during the migration periods as fledglings and the presence of individuals from their northern range augment the local breeding population.

Table 4.30 – Number of Swallow-tailed Kites addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	0	0
2013	0	0
2014	6	0
2015	76	0
2016	204	5
TOTAL	**286**	**5**

Like other native bird species, the take of Swallow-tailed Kites 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 Swallow-tailed Kites by WS would only occur at levels authorized by the USFWS, which ensures WS' take, and take by all entities, are considered to achieve the desired population management levels of Swallow-tailed Kites in the state.

MISSISSIPPI KITE BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Mississippi Kite is a crow-sized raptor that breeds in the central and southern Great Plains, in isolated areas of the southwest, and in the southern states from Arkansas and Louisiana to eastern South Carolina. In Florida, breeding populations can be found in the panhandle and north-central portion of the state southward to Levy, Alachua, and Marion Counties (Parker 1999). Kites are woodland nesters, using a variety of habitats throughout the range of the species, including mature forests, shelterbelts, and wooded parks in urban areas. Kites are often gregarious, especially in the western portion of their range. Groups of 10 or more Mississippi Kites can be found near nests and roosts, with urban nests and roosts commonly found in city parks, residential areas, and golf courses (Parker 1999). Foraging flocks of 25 or more Mississippi Kites can be found anytime of the year. Kites are often described as insect eaters, but they are also known to prey on frogs, lizards, small birds, and small mammals (Parker 1999). When those large flocks occur near air facilities, aircraft strike hazards increase. Between 1990 and 2015, there have been six reported civil aircraft strikes in the United States involving Mississippi Kites (Dolbeer et al. 2016). Kites are also known to aggressively defend their nests and often attack people that get too close to their nests, mainly in urban areas (Parker 1999).

The population of Mississippi Kites has seen major fluctuations since the 1850s due to shooting, egg collecting, and deforestation that affected their distribution, especially around the fringes of their range (Parker 1999). However, in the 1940s and 1950s, the population and range of Mississippi Kites began to expand, likely due to their protection under the MBTA, agricultural lands that likely increased their prey base, and tree plantings for shelterbelts in the western portion of their range. Urbanization may also have played a role with range expansion and population increase as Mississippi Kites began utilizing urban habitats for nesting (Parker 1999).

According to BBS trend data, Mississippi Kite populations have increased at an annual rate of 6.65% in Florida since 1966 (Sauer et al. 2017). The numbers of Mississippi Kites observed along routes surveyed in Peninsular Florida (BCR 31) and the Southeastern Coastal Plain have also shown increases estimated at 11.17% and 6.26%, respectively, since 1966 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the number of Mississippi Kites present in the Florida during the breeding season to be 4,000 individuals with a United States population of 300,000 individuals based on BBS data. BirdLife International (2016*c*) classified the Mississippi Kite as a species of "*least concern*". In Florida, Mississippi Kites are present during the migration periods and can be found nesting from May through June in the northern portion of the state. Mississippi Kites are becoming more prevalent in peninsular Florida especially near airport environments. Because the majority of their diet consists of insects along with some small vertebrates, the open areas of airports provide ideal foraging habitat for kites (FWC 2003). Therefore, most requests for assistance received by WS occur at airports where Mississippi Kites pose an aircraft strike risk.

From FY 2012 through FY 2016, 3,083 Mississippi Kites were addressed by WS using non-lethal harassment methods. In addition, 489 Mississippi Kites were lethally taken by WS to alleviate damage and threats to human health and safety pursuant to depredation permits from FY 2012 through FY 2016 (see table 4.31). Based on the number of requests received to alleviate the threat of damage associated with Mississippi Kites and the number of Mississippi Kites addressed previously to alleviate those threats, WS anticipates that up to 300 individuals could be lethally removed annually in the state to alleviate damage and the threat of damage.

Table 4.31 – Number of Mississippi Kites addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	343	28
2013	335	57
2014	269	27
2015	613	176
2016	1,523	201
TOTAL	**3,083**	**489**

The lethal removal of 300 Mississippi Kites would represent 7.5% of the estimated breeding population in Florida, and 0.1% of the population in the United States. Take is likely to occur during the migration periods as fledglings and the presence of individuals from their northern range augment the local breeding population. Therefore, actual take is likely to represent a smaller percentage of the breeding population in the state. Like other native bird species, the take of Mississippi Kites 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 Mississippi Kites by WS would only occur at levels authorized by the

USFWS, which ensures WS' take, and take by all entities, are considered to achieve the desired population management levels of Mississippi Kites in the state.

BALD EAGLE BIOLOGY AND POPULATION IMPACT ANALYSIS

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 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. Certain populations of Bald Eagles were listed as "endangered" under the Endangered Species Preservation Act of 1966, which was extended when the modern Endangered Species Act 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 be 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).

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.

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 were 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.

RED-SHOULDERED HAWK BIOLOGY AND POPULATION IMPACTS ANALYSIS

Red-shouldered Hawks can be found throughout the year in Florida with the population being augmented by migrants in September and October (FWC 2003). Across their range, Red-shouldered Hawks are commonly found in mature, mixed deciduous-coniferous forests, especially in bottomland hardwoods, riparian areas, and flooded deciduous swamps (Dykstra et al. 2008). Red-shouldered Hawks are considered partial migrants with birds in the northern portion of their range moving southward during the fall and winter migration periods (Dykstra et al. 2008). Like other hawk species, Red-shouldered Hawks have a varied diet consisting primarily of small mammal species, but with also feed on birds, crayfish, and insects (Dykstra et al. 2008).

The numbers of Red-shouldered Hawks observed along routes surveyed in the state during the BBS have shown an increasing trend in the state between 1966 through 2015 estimated at 1.5% annually (Sauer et al. 2017). Between 2005 and 2015, the number of Red-shouldered Hawks observed in the state during the BBS has also shown an increasing trend estimated at 0.7% annually (Sauer et al. 2017). Data gathered for Peninsular Florida (BCR 31) and the Southeastern Coastal Plain both show increasing trends from 1966 through 2015 of 1.54% and 2.53%, respectively (Sauer et al. 2017). The numbers of Red-shouldered Hawks present in the state likely increases during the winter as birds begin arriving in the state from their northern range. In areas surveyed during the CBC, the number of Red-shouldered Hawks observed has shown a general increasing trend in the state between 1966 through 2015 (National Audubon Society 2010). The Partners in Flight Science Committee (2013) estimated the statewide breeding population at 240,000 hawks based on BBS data.

Like other raptor species addressed in this EA, most requests received by WS involve damages or threats of damages associated with Red-shouldered Hawks at airports within the state. Between FY 2012 and FY 2016, WS has addressed all requests for assistance associated with threats involving Red-shouldered Hawks using non-lethal dispersal methods. WS has addressed 464 Red-shouldered Hawks in the state between FY 2012 and FY 2016 using non-lethal methods with no Red-shouldered Hawks being lethally taken by WS (see table 4.32). Other entities may address damage threats from Red-shouldered Hawks, however; no Red-shouldered Hawks were taken by other entities in the state from 2012 through 2016.

Table 4.32 – Number of Red-shouldered Hawks addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	101	0
2013	149	0
2014	47	0
2015	82	0
2016	85	0
TOTAL	**464**	**0**

Based on the number of Red-shouldered Hawks addressed annually by WS and in anticipation of additional efforts associated with Red-shouldered Hawks, WS could take up to 25 Red-shouldered Hawks annually in the state to alleviate damage or threats of damage. Take would only occur when authorized by the USFWS through the issuance of depredation permits and only at levels permitted. If the breeding population in the state remains at least stable, an annual take of up to 25 Red-shouldered Hawks would represent 0.01% of the estimated breeding population of 240,000 Red-shouldered Hawks in the state. Based on the limited take that could occur by WS when compared to the estimated breeding population and the permitting of the take by the USFWS, WS' take would have no adverse effects on Red-shouldered Hawk populations in the state.

RED-TAILED HAWK BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Red-tailed Hawk is one of the most widely distributed raptor species in North America with a breeding range extending from northern Canada and Alaska southward to northern and central Mexico (Preston and Beane 2009). Red-tailed Hawks are capable of exploiting a broad range of habitats with the availability of structures for perching, nesting, and the availability of prey items being the key factors. Red-tailed Hawks are most commonly found in open areas interspersed with patches of trees or other similar structures. They are a regular resident with a wide distribution and the largest breeding hawk in Florida (FWC 2003).

Populations of Red-tailed Hawks in North America showed increasing trends during the mid- to late-1900s. Those increases were likely caused by the conversion of forested areas to more open environments for agricultural production (Preston and Beane 2009). In Florida, the number of Red-tailed Hawks observed during the BBS has shown a decreasing trend estimated at -0.73% annually between 1966 and 2015. However, from 2005 through 2015, the number of Red-tailed Hawks observed along routes surveyed in the state during the BBS has shown a slight increasing trend of 0.08% per year (Sauer et al. 2017). In the Southeastern Coastal Plain, the number of Red-tailed Hawks observed in areas surveyed during the BBS has shown an increasing trend of 1.83% annually (Sauer et al. 2017). The breeding population in Florida has been estimated at 8,000 Red-tailed Hawks based on BBS data (Partners in Flight Science Committee 2013). The number of Red-tailed Hawks observed in areas surveyed during the CBC has shown an increasing to stable trend since 1966 (National Audubon Society 2010).

The open grassland habitats of airports and the availability of perching structures often attract Red-tailed Hawks to airports where those birds pose a strike risk with aircraft. Most requests for assistance received by WS in Florida associated with Red-tailed Hawks are associated with threats those hawks pose to aircraft. However, WS does occasional receive requests associated with Red-tailed Hawks where damages or threats of damages to agricultural resources are occurring. For example, Red-tailed Hawks are known to capture and feed on free-ranging chickens.

WS has addressed previous requests for assistance associated with Red-tailed Hawks using both non-lethal dispersal methods and lethal removal. From FY 2012 through FY 2016, 966 Red-tailed Hawks were dispersed by WS and four Red-tailed Hawks have been lethally taken by WS to alleviate damage pursuant to depredation permits. In total, three Red-tailed Hawks were taken by other entities in the state from 2012 through 2016 (see Table 4.33). Lethal removal of Red-tailed Hawks by WS' and all other entities in the state occurred pursuant to depredation permits issued by the USFWS.

Table 4.33 – Number of Red-tailed Hawks addressed in Florida by all entities, 2012 - 2016

Year	Dispersed by WS†	Take by Entity	
		WS' Take†	Other Entities‡
2012	134	0	0
2013	204	0	3
2014	147	0	0
2015	203	4	0
2016	278	0	0
TOTAL	**966**	**4**	**3**

†Reported by federal fiscal year

‡Reported by calendar year

Based on the number of requests received to alleviate the threat of damage associated with Red-tailed Hawks and the number of Red-tailed Hawks addressed previously to alleviate those threats, WS anticipates that up to 25 could be taken annually in the state to alleviate the threat of damage. Based on a breeding population estimated at 8,000 Red-tailed Hawks, WS' take of up to 25 hawks annually would result in the lethal take of 0.3% of the estimated breeding population in the state, if the breeding population remains at least stable. Take by WS would only occur when permitted by the USFWS and only at levels authorized, which ensures any take by WS occurs within allowable limits for the species. The take of Red-tailed Hawks by other entities is not expected to increase above the number of hawks taken between 2012 through 2016. Based on the limited take that could occur by WS and other entities when compared to the estimated breeding population and the permitting of the take by the USFWS, WS' take would have no adverse effects on Red-tailed Hawk populations in the state.

AMERICAN KESTREL BIOLOGY AND POPULATION IMPACTS ANALYSIS

American Kestrels are the smallest and most common North American falcon. Their range includes most of North America, except the far northern portions of Alaska and Canada (Smallwood and Bird 2002). Kestrels are commonly found inhabiting open areas with short ground vegetation where it searches for prey from elevated perches and by hovering above the ground. Prey consists of arthropods and small vertebrates (Smallwood and Bird 2002). Kestrels are often attracted to areas of human activities because of the open areas created and the numerous perching sites (Smallwood and Bird 2002). Kestrels are cavity nesters, using the excavated holes of woodpeckers and other natural cavities in trees (Smallwood and Bird 2002). The availability of suitable cavities is often a limiting factor in parts of the breeding range of the kestrel (Smallwood and Bird 2002).

There are as many as 17 recognized subspecies of kestrels inhabiting North America, Central America, and South America. In the United States and Canada, there are primarily two subspecies present, *F. s. sparverius* and *F. s. paulus*. Although both subspecies of kestrels can be found in Florida during the winter and during the migration periods, only *F. s. paulus*, commonly referred to as the Southeastern

American Kestrel, is known to breed in the state. The Southeastern American Kestrel is considered threatened in Florida by the FWC but is not considered a threatened or endangered species by the USFWS. The Southeastern American Kestrel is considered a year-round resident in the state, while the northern kestrel subspecies that occurs throughout much of North America is only present in the state during the winter and during the migration periods. The Southeastern American Kestrel can be found breeding across the northern portion of the state southward to Highlands and Lee counties. Nesting typically occurs from March through June in Florida (FWC 2003).

American Kestrels observed in areas observed during the BBS are showing a slightly declining trend in Florida estimated at -0.93% annually since 1966, with a -0.58% annual decline occurring from 2005 through 2015 (Sauer et al. 2017). Kestrels observed on BBS routes in the Southeastern Coastal Plain have also shown a declining trend estimated at -1.45% annually since 1966 with the number of kestrels observed from 2005 through 2016 showing a declining trend estimated at -1.28% annually (Sauer et al. 2017). In Peninsular Florida, the number of American Kestrels observed in areas surveyed during the BBS has shown decreasing trends estimated at -1.16% annually since 1966, with a -0.93% annual decrease occurring from 2005 through 2015 (Sauer et al. 2017). The breeding population of kestrels in Florida has been estimated at 11,000 birds with the population across the United States estimated at nearly 1.7 million individuals (Partners in Flight Science Committee 2013). Trend data available from CBC also indicates a general decline in the number of kestrels wintering in Florida (National Audubon Society 2010).

Most requests for assistance associated with kestrels occur at airports where kestrels pose a strike risks to aircraft. As shown in Table 4.34, WS has addressed 5,419 kestrels between FY 2012 and FY 2016 using non-lethal dispersal methods. In addition, WS has live-captured and translocated 41 kestrels to alleviate strike risks in the state. WS has also addressed kestrels using lethal methods to alleviate damage. Between FY 2012 and FY 2016, WS removed 136 kestrels using lethal methods, with the highest take occurring in FY 2013.

Table 4.34 – Number of American Kestrels addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Translocated	Take
2012	697	13	34
2013	1,351	16	71
2014	1,276	0	27
2015	1,270	8	3
2016	825	4	1
TOTAL	**5,419**	**41**	**136**

Based on the number of kestrels addressed previously and based on additional efforts that could occur, WS could live-capture and translocated up to 100 kestrels annually under the proposed action alternative. In addition, WS could lethally remove up to 40 kestrels annually to alleviate requests for assistance.

Normally, the lethal take of wildlife species listed as threatened by the FWC is prohibited under Florida Administrative Code 68A-27.0011. However, under Florida Administrative Code 68A-9.012, the lethal take of wildlife, including those species listed as threatened in the state by the FWC[17], can occur on properties of airports to alleviate aircraft strike risks when provisions within the Code have been met. Provisions include the requiring of the use of non-lethal harassment methods and the reporting of any lethal take to the FWC within five days of take occurring. WS may employ many non-lethal methods to disperse kestrels from airport property to alleviate strike risks (see Appendix B). However, lethal take

[17] See specifically Florida Administrative Code 68A-9.012(2).

could occur pursuant to Florida Administrative Code 68A-9.012(2)(b)(3) when non-lethal harassment methods have failed to disperse kestrels from areas of operations at airports. Under Florida Administrative Code 68A-9.012(2)(b)(1), kestrels could also be lethally removed when posing an imminent threat to aircraft and human safety. The proportion of kestrels found in the state during the migration periods and during the winter that are from the southeastern subspecies would be unknown and difficult to determine. Distinguishing subspecies of kestrels can be difficult, especially without physically handling the bird to identify subtle distinguishing characteristics; therefore, the take of any kestrels by WS would be reported to the FWC within five days of take occurring.

As stated previously, the breeding population in the state has been estimated at 11,000 kestrels (Partners in Flight Science Committee 2013), which would likely represent the breeding population of the southeastern subspecies that occurs in the northern portion of the state. Based on the best available population estimates, WS' take of up to 40 American Kestrels would represent 0.4% of the breeding population of kestrels in the state estimated at 11,000 birds. However, most lethal removal activities would likely occur during the winter when the statewide population would likely be greater than 11,000 kestrels because populations would be augmented by northern migrants arriving in the state. Therefore, the proposed take would likely be a lower proportion of the total population present in the state during the winter. Because the southeastern subspecies breeds in the northern portion of the state, the proportion of the southeastern subspecies that migrates further southward after the breeding season to areas further south in the state is unknown.

PEREGRINE FALCON BIOLOGY AND POPULATION IMPACT ANALYSIS

Historically, the Peregrine Falcon could be found nesting on ledges of cliffs in the mountainous regions of the United States, Canada, and Mexico (White et al. 2002). Today, Peregrine Falcons continue to utilize those nesting habitats but are increasing found nesting in more urban areas where they nest on buildings, bridges, old raptor nests, artificial nest boxes, and other man-made or natural structures (White et al. 2002, Green et al. 2006). They were not common along the Atlantic or Gulf Coasts historically, except during periods of migration.

During the 1950s, populations of Peregrine Falcons in North America began to experience sharp declines, primarily attributed to secondary hazards associated with pesticide use. The population declines become so severe, the Peregrine Falcon was listed as an endangered species under the ESA in 1970. Due to a remarkable recovery effort, the Peregrine Falcon was removed from the endangered species list in 1999 (Green et al. 2006). Monitoring efforts continue to show increasing populations in their historical ranges (White et al. 2002, Green et al. 2006). The number of Peregrine Falcons observed in all areas surveyed during the BBS have shown an increasing trend since 1966 estimated at 2.35% annually, with a 5.84% annual increase occurring from 2005 through 2015 (Sauer et al. 2017).

In Florida, Peregrine Falcons are present during the migration periods as birds move between breeding areas further north and their wintering areas in Central and South America (FWC 2018*b*). During the fall of 2000, more than 2,000 migrating Peregrine Falcons were counted in the Florida Keys (White et al. 2002). The number of Peregrine Falcons observed in Florida in areas surveyed during the CBC has shown a generally stable to slightly increasing trend since 1966 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 68 Peregrine Falcons annually in the state. The fewest number of Peregrine Falcons observed during the CBC conducted in the state from 2006 through 2015 occurred in 2008 when 51 falcons were observed (National Audubon Society 2010). The highest number of Peregrine Falcons observed during the CBC conducted from 2006 through 2015 occurred in 2015 when 90 falcons were counted (National Audubon Society 2010).

Requests for assistance associated with Peregrine Falcons would likely occur at airports where falcons posed a direct strike risk to aircraft and a threat to human safety during the migration periods. As shown in Table 4.35, WS has addressed 85 Peregrine Falcons between FY 2012 and FY 2016, all of which were dispersed using non-lethal harassment methods. However, if populations of Peregrine Falcons continue to increase and aircraft strike hazards associated with falcons continue to occur, WS could be requested to lethally remove falcons to prevent aircraft strikes when non-lethal methods were ineffective at dispersing falcons and reducing strike risks. In most cases, non-lethal harassment methods or live-capture and translocation are effective at dispersing falcons from areas where aircraft strikes could occur. Therefore, WS anticipates the need to lethally remove falcons to reduce aircraft strike risks would occur infrequently. Based on the unlikelihood for the need to lethally remove falcons to alleviate strike risks, WS anticipates that one falcon could be lethally removed over a five-year period to alleviate strike risks. Lethal removal of one falcon per five-year period would only occur if authorized by the USFWS through the issuance of a depredation permit.

Table 4.35 – Number of Peregrine Falcons addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	5	0
2013	9	0
2014	21	0
2015	2	0
2016	48	0
TOTAL	**85**	**0**

The potential lethal removal of one Peregrine Falcon every five years would not reach a magnitude where adverse effects would occur to the species' population. If one falcon were removed, the removal would represent 1.5% of the average number of falcons observed in areas surveyed during the CBC from 2006 through 2015. As stated previously, the data available from the CBC is intended to provide long-term trending information. However, the information on the actual number of Peregrine Falcons 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 Peregrine Falcons that could be present in the state. The number of Peregrine Falcons observed by surveyors during the CBC would be considered a minimum estimate because not all areas of the state are surveyed during the CBC.

WS would continue to address Peregrine Falcons using non-lethal methods and would only use lethal methods if non-lethal methods were ineffective at reducing strike risks. As stated in Chapter 1, if this alternative was selected, WS would monitor activities to ensure those activities occurred within the parameters evaluated in the EA. If the need to lethally remove Peregrine Falcons became more frequent or involved more than one individual every five years, WS would re-evaluate activities associated with falcons through a review of the EA and would conduct the appropriate analysis pursuant to the NEPA. In addition, the permitting of the lethal removal by the USFWS would also ensure any lethal removal conducted by WS occurred within allowable limits to meet population objectives for the species.

MONK PARAKEET BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Monk Parakeet is a native of South America, occurring from Bolivia to southern Brazil to central Argentina. The species has been introduced and become established as a breeding species in the United States and Europe (Burgio et al. 2016). Parakeets are popular as pets in the United States and localized free-ranging populations have become established from purposeful and accidental releases (Burgio et al. 2016). Whether from purposeful or accidental releases by pet owners or pet shops, the first localized populations of Monk Parakeets in United States became established during the 1960s (Burgio et al. 2016).

Florida, Illinois, New York, Rhode Island, and Texas have some of the largest free-ranging populations of Monk Parakeets in the United States (Burgio et al. 2016, Avery et al. 2002*a*).

The Monk Parakeet is the only parrot that builds a stick nest, in a tree or on a man-made structure, rather than using a hole in a tree. In addition to nest building, the species is gregarious and normally nests colonially, building a single large, bulky nest consisting of twigs with separate entrances for each pair. The colonies can become quite large and in exceptional cases, these stick nests may have more than 200 chambers, but most have only 1 to 20 (Burgio et al. 2016). Although the size of nests varies, nests with one chamber normally have a diameter of <0.8 meters while nests consisting of four to 15 chambers have a diameter of >1.5 meters (Burgio et al. 2016). In exceptional cases, compound nests weighing 1,200 kg (2,646 lbs) have been reported (Burgio et al. 2016). Nest maintenance is a year-round activity and all members of the colony, including sexually immature birds will add sticks to the nest (Bull 1973, Burgio et al. 2016).

Nests serve as both a permanent roosting site and nesting site. Parakeets quickly rebuild destroyed nests, even during the non-breeding season (Burgio et al. 2016, Avery et al. 2002*a*). A pair of parakeets can build a nest in less than two weeks. Nests often begin as single nests but often expand each year as the original pair builds onto the nest and other pairs build nests on top of or surrounding the nest (Burgio et al. 2016, Avery et al. 2002*a*). Monk Parakeets often build nests on utility poles and other utility structures (Burgio et al. 2016, Avery et al. 2002*a*, Avery et al. 2006*a*). Parakeet nests can be a threat to the safe operation of electrical transmission structures due to the risk of outages caused when parakeets carrying sticks or sticks from the nest short-circuit transmission equipment. The nests can present a risk of power outages and fire that could result in the loss of power to thousands of customers (Avery et al. 2002*a*, Avery et al. 2006*a*, Pruett-Jones et al. 2007). Because parakeets will quickly rebuild destroyed nests at the same location, the most effective approach to resolving the threat of damage associated with the nest is to remove the parakeets with the nest (Avery et al. 2002*a*, Tillman et al. 2004).

Monk Parakeets have been document breeding in the Miami area since at least 1969 with breeding populations occurring in Dade and Pinellas counties and scattered breeding elsewhere in the state (FWC 2003). Parakeets are often associated with suburban areas in Florida where they nest in trees, on the crossbars of utility poles, and on other man-made structures (FWC 2003). In Florida, the breeding season for Monk Parakeets begins in late winter and early spring with nestlings appearing in nests around the second week of June (Avery et al. 2012). Although breeding populations are known to occur in Florida, no data from the BBS is available for Monk Parakeets, likely due to their use of suburban areas for nesting and their isolated breeding populations.

Monk Parakeets were not reported in the state, by the CBC, until 1973 when six parakeets were counted in two areas surveyed (National Audubon Society 2010). In 2015, observers counted 915 parakeets in 21 areas surveyed (National Audubon Society 2010). Between 1974 and 2003, the number of Monk Parakeets observed in the state showed a general increasing trend; however, since the 2004 survey, the number of parakeets observed has declined (National Audubon Society 2010). Between 2006 and 2015, 1,137 Monk Parakeets have been observed on average in areas surveyed during the CBC. The highest number of parakeets observed in areas surveyed during the CBC occurred during 2006 when 1,833 parakeets were counted. The lowest number observed during the CBC occurred in 2012 when 908 parakeets were counted.

Van Bael et al. (1996) found the population size and geographical range of parakeets was experiencing an exponential growth trend in the United States. In the absence of a control program, Van Bael et al. (1996) estimated the population would continue to increase and expand in the United States. Parakeets are not generally considered migratory in the United States. The statewide population in Florida is currently unknown. Monk Parakeets are considered highly gregarious with colonies of several hundred parakeets often observed, which may be present in the same areas for many years (FWC 2003). Monk Parakeets can compete with native wildlife species for food and natural nesting locations. In addition, large flocks of parakeets cause agricultural damage in areas where the species is native (Burgio et al. 2016). In the United States, parakeets are responsible for causing damage to electrical transmission equipment from their nest building behavior (Avery et al. 2002*a*, Avery et al. 2006*a*). Most requests for assistance received by WS would be associated with nests on utility structures or other structures.

From FY 2012 through FY 2016, WS dispersed 254 Monk Parakeets to alleviate damage (see Table 4.36). Because Monk Parakeets are colonial nesters and often build nests on man-made structures (*e.g.*, utility poles) (Avery et al. 2002*a*), WS could address up to 100 parakeets per year in the state when providing assistance and destroy up to 20 nests annually. Monk Parakeets are not protected from take under the MBTA and take can occur without the need for a depredation permit. The number of Monk Parakeets lethally removed by other entities within the state to alleviate damage is unknown.

Table 4.36 – Number of Monk Parakeets addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	0	0
2013	0	0
2014	254	0
2015	0	0
2016	0	0
TOTAL	**254**	**0**

If 100 Monk Parakeets were lethally removed by WS annually from 2006 through 2015, the removal of parakeets by WS would have been 8.8% of the average number of parakeets observed. Although actual population estimates are not available for Monk Parakeets, WS would conduct removal activities pursuant to Executive Order 13112, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

AMERICAN CROW BIOLOGY AND POPULATION IMPACTS ANALYSIS

American Crows have a wide range and are extremely abundant, being found across the United States (Verbeek and Caffrey 2002). Crows are found in both urban and rural environments and in Florida 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 they can be found throughout the year (Verbeek and Caffrey 2002).

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 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. Because the take of crows can occur without a permit from the USFWS under the blackbird depredation order, there have been no reporting requirements for the take of crows to reduce damage or reduce threats until recently. Therefore, the number of crows taken in the state under the depredation order to alleviate damage or reduce threats has been unknown until recently. Similarly, hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the FWC.

The American Crow breeding population in Florida has been estimated at 420,000 crows statewide based on BBS data (Partners in Flight Science Committee 2013). From 1966 through 2015, trend data from the BBS indicates the number of crows observed in the state during the survey has slightly decreased at an annual rate of -0.75%, with a 0.88% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). The number of crows observed in Florida in areas surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 9,015 crows annually in the state. The fewest number of crows observed during the CBC conducted in the state occurred in 2007 when 5,408 crows were observed (National Audubon Society 2010). The highest number of crows observed during the CBC occurred in 2010 when 11,818 crows were counted (National Audubon Society 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 estimate because not all areas of the state are surveyed during the CBC.

From FY 2012 through FY 2016, WS employed lethal methods to take 523 American Crows in Florida and employed non-lethal methods to disperse 30,424 American Crows (see Table 4.37). The highest level of take by WS occurred in FY 2015 when 174 crows were lethally taken. Based on the requests for assistance received previously and the relative abundance of crows in the state, WS anticipates that up to 300 American Crows could be lethally removed annually to resolve requests for assistance. The number of crows lethally taken by other entities to alleviate damage is currently unknown.

With a statewide population estimated at 420,000 crows, an annual take by WS of 300 crows would represent 0.1% of the estimated population if the population remains stable. Take of up to 300 crows by WS annually would represent 3.3% of the average number of crows observed in the state in areas surveyed during the CBC from 2006 through 2015. Between 2006 and 2015, the lowest number of crows observed during the CBC occurred in 2007 when 5,408 crows were counted. If WS had lethally taken 300 crows in 2007, the take would have represented 5.6% of the number of crows observed. However, the number of crows observed during the CBC would be considered a minimum because not all areas of the state are surveyed.

Table 4.37 – Number of American Crows addressed by WS in Florida, FY 2012 – FY 2016

Year	Dispersed	Take
2012	4,139	102
2013	3,444	50
2014	15,673	132
2015	4,984	174
2016	2,184	65
TOTAL	**30,424**	**523**

As was stated previously, the take of crows by other entities either to alleviate damage or during the annual hunting seasons is currently unknown. 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.

FISH CROW BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Fish Crow can be found from Maine to south Florida and west to south Texas where they commonly occur along tidal marshes, beaches, inland lakes, and river systems (McGowan 2001). 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 lakeshores, 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, McGowan 2001).

Fish Crows are often confused with American Crows with the only reliable distinction between the two species being vocal (McGowan 2001). Crows often form mixed species roosts that can contain both American Crows and Fish Crows. 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 present in the state throughout the year (McGowan 2001, FWC 2003), with the number of crows present in the state increasing during the late fall and winter as crows begin arriving in the state from further north (FWC 2003). The Fish Crow is common on both coasts, including coastal and inland cities (FWC 2003). Although mixed species flocks of Fish Crows and American Crows can form, most flocks of crows or crow roosts encountered in 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 200 Fish Crows could be taken by WS annually under the proposed action. Although not as widely distributed in the state, Fish Crows could be present in flocks of crows addressed by WS. The number of Fish Crows observed during the BBS has shown a decreasing trend in the state since 1966 estimated at -0.63% annually, with a -0.11% annual decline occurring from 2005 through 2015 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of Fish Crows at 120,000 birds based on BBS data.

The number of Fish Crows observed during the CBC has also shown a generally stable trend since 2001 (National Audubon Society 2010). Between 2006 and 2015, observers conducting surveys for the CBC have counted an average of 70,429 Fish Crows annually in the state. The fewest number of crows observed during the CBC conducted in the state occurred in 2008 when 49,662 crows were observed (National Audubon Society 2010). The highest number of crows observed during the CBC occurred in 2009 when 94,192 crows were counted (National Audubon Society 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 because not all areas of the state are surveyed during the CBC.

Between FY 2012 and FY 2016, 138 Fish Crows were lethally taken by WS to alleviate damage and 1,504 crows were dispersed using non-lethal methods by WS (see Table 4.38). 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 and the FWC when causing 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.

Table 4.38 – Number of Fish Crows addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	117	47
2013	375	4
2014	335	30
2015	79	6
2016	598	51
TOTAL	**1,504**	**138**

If up to 200 Fish Crows were lethally taken annually by WS, in Florida, WS' take would represent 0.2% of the estimated statewide population of Fish Crows. Take of up to 200 Fish Crows by WS would represent 0.3% of the average number of Fish Crows observed in areas surveyed during the CBC from 2006 through 2015. If WS had lethally removed 200 Fish Crows annually, the take would have ranged from 0.2% to 0.4% of Fish Crows observed during the CBC from 2006 through 2015. 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 or airport safety, where American Crows and Fish Crows occur in mixed species flocks.

PURPLE MARTIN BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Purple Martin is the largest swallow in North America, feeds exclusively on flying insects, and in eastern North America breeds almost entirely in man-made birdhouses, while its western populations continues to nest almost exclusively in woodpecker holes (Brown and Tarof 2013). The Purple Martin, as a secondary-cavity nester, has suffered from the introduction of European Starlings and House Sparrows, which compete for nest cavities (Brown and Tarof 2013). Although not historically a colonial bird, the conversion of nesting habits to the use of man-made bird houses has increased the social behavior resulting in multiple pairs nesting in the same or adjacent birdhouses (Brown and Tarof 2013).

According to BBS trend data, Purple Martin populations have decreased at an annual rate of -2.27% in Florida since 1966 (Sauer et al. 2017). The numbers of Purple Martins observed along routes surveyed in Peninsular Florida (BCR 31) and the Southeastern Coastal Plain have also shown decreases estimated at -2.54% and -0.81%, respectively, since 1966 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the number of Purple Martins present in Florida during the breeding season to be 250,000 individuals based on BBS data and a global population of 7 million individuals. BirdLife International (2016*d*) classified the Purple Martin as a species of "*least concern*". In Florida, Purple Martins are present during the breeding season and can be found nesting from April through August (Brown and Tarof 2013). Because their diet consists of flying insects, the open areas of airports provide ideal foraging habitat for kites. Therefore, most requests for assistance received by WS occur at airports where Purple Martins pose an aircraft strike risk.

From FY 2012 through FY 2016, 16,629 Purple Martins were addressed by WS using non-lethal harassment methods. From FY 2012 through FY 2016, 140 Purple Martins were lethally taken by WS to alleviate damage and threats to human health and safety pursuant to depredation permits (see Table 4.39).

Table 4.39 – Number of Purple Martins addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	15,122	67
2013	567	26
2014	847	47
2015	53	0
2016	40	0
TOTAL	**16,629**	**140**

Based on the number of requests received to alleviate the threat of damage associated with Purple Martins and the number of martins addressed previously to alleviate those threats, WS anticipates that up to 100 individuals could be lethally removed annually in the state to alleviate damage and the threats of damage. The lethal removal of 100 Purple Martins would represent 0.04% of the estimated breeding population in Florida, and 0.001% of the global population. Like other native bird species, the take of Purple Martins 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 Purple Martins by WS would only occur at levels authorized by the USFWS, which ensures WS' take, and take by all entities, are considered to achieve the desired population management levels of Purple Martins in the state.

TREE SWALLOW BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Tree Swallow occurs in Florida during migration periods and as an winter resident (Winkler et al. 2011). The number of Tree Swallows observed along routes surveyed in the Southeastern Coastal Plain has shown an upward trend between 1966 and 2015 estimated at 4.67% annually, with a 8.07% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Across all BBS routes in the United States, Tree Swallows have exhibited an overall increase of 0.05% since 1966, with a 1.27% annual increase occurring from 2005 through 2015 (Sauer et al. 2017).

The number of Tree Swallows observed in areas surveyed during the CBC has shown a cyclical pattern between 1966 and 2015 (National Audubon Society 2010). During surveys conducted from 2006 through 2015, the average number of swallows observed during the CBC conducted in the state has been 598,937 swallows. The lowest number of swallows observed during the CBC from 2006 through 2015 occurred in 2007 when 82,253 swallows were recorded. The highest number of swallows recorded in the state during the CBC between 2006 and 2015 occurred in 2011 when over 1.8 million swallows were observed (National Audubon Society 2010).

From FY 2012 through FY 2016, 55,602 Tree Swallows were dispersed by WS and 78 Tree Swallows were lethally taken by WS to alleviate damage pursuant to depredation permits (see Table 4.40). Based on the number of requests received to alleviate the threat of damage associated with Tree Swallows and the number of Tree Swallows addressed previously to alleviate those threats, WS anticipates that up to 200 individuals could be taken annually in the state to alleviate the threat of damage.

Table 4.40 – Number of Tree Swallows addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	8,278	0
2013	4,045	0
2014	5,907	6
2015	21,905	72
2016	15,467	0
TOTAL	**55,602**	**78**

Most requests for assistance associated with Tree Swallows occur from airports, where large flocks of Tree Swallows pose an aircraft strike hazard. As stated previously, Tree Swallows are only present in the state during the winter and during the migration periods. Based on the average number of Tree Swallows observed in areas surveyed during the CBC from 2006 through 2015, the annual take of 200 Tree Swallows by WS would present 0.03% of the average. If WS had lethally removed 200 Tree Swallows annually from 2006 through 2015, the take would have ranged from 0.01% to 0.2% of the number of Tree Swallows observed annually during the CBC.

BARN SWALLOW BIOLOGY AND POPULATION IMPACTS ANALYSIS

Barn Swallows are considered one of the most abundant and widespread of the swallow species. Breeding populations are known to occur throughout North America, Europe, and Asia with wintering populations occurring in Central and South America, southern Spain, Morocco, Egypt, Africa, the Middle East, India, Indochina, Malaysia, and Australia (Brown and Brown 1999). In Florida, Barn Swallows occur throughout the state during the migration periods, but are becoming a more frequent breeder in the state, mostly in the northern parts (FWC 2003). Barn Swallows are considered common to abundant in Florida during the migration periods but individuals of the species have been observed throughout the year in the state (FWC 2003). Swallows are most common from April to May and August to October (FWC 2003).

According to BBS trend data, Barn Swallow populations have increased at an annual rate of 4.33% in Florida since 1966 (Sauer et al. 2017). The numbers of Barn Swallows observed along routes surveyed in Peninsular Florida and the Southeastern Coastal Plain have shown decreases estimated at -0.49% and increases estimated at 2.46%, respectively, since 1966 (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the breeding population in the state to be 60,000 swallows using data from the BBS. Barn Swallows have been observed infrequently in those areas surveyed in the state during the CBC.

Requests for WS' assistance with managing damage associated with Barn Swallows usually occurs during migration periods in Florida. During this time, WS has employed both lethal and non-lethal methods to alleviate potentially damaging situations relating to aviation safety. From FY 2012 through FY 2016, 76,800 Barn Swallows were dispersed by WS and 261 Barn Swallows were lethally removed by WS to alleviate damage pursuant to depredation permits (see Table 4.41). Based on the number of requests received to alleviate the threat of damage associated with Barn Swallows and the number of Barn Swallows addressed previously to alleviate those threats, WS anticipates that up to 300 individuals could be taken annually in the state to alleviate the threat of damage.

Table 4.41 – Number of Barn Swallows addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	16,102	50
2013	17,762	86
2014	25,947	70
2015	10,600	28
2015	6,389	27
TOTAL	**76,800**	**261**

If 300 Barn Swallows were lethally removed, WS' take would represent 0.5% of the estimated breeding population in the state. Like many other bird species, the take of Barn Swallows by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits and only at levels permitted. Therefore, the take of Barn Swallows by WS would only occur at levels authorized by the USFWS, which would ensure WS' take, and take by all entities, was considered to achieve the desired population objectives for swallows in the state.

AMERICAN ROBIN BIOLOGY AND POPULATION IMPACTS ANALYSIS

The conspicuous nature of the American Robin and the close association of robins with human habitation, make the robin one of the most recognizable birds in the United States (Vanderhoff et al. 2016). Robins are often the harbinger of spring in many parts of the northern latitudes of North America as large flocks of robins begin arriving (Vanderhoff et al. 2016). Robins feed primarily on invertebrates and fruits throughout the year depending on food availability.

Although breeding populations of robins are known to occur in the northern portion of the state along the panhandle and in localized areas in the central portion of the state, robins are primarily present in the state during the winter when robins from the northern breeding areas immigrate (Vanderhoff et al. 2016). Migrating robins begin arriving in October and leave before April with breeding birds present from mid-April through mid-July (FWC 2003). During the migration periods, robins often form large flocks, which can increase aircraft strike hazards at airports.

In Florida, the number of robins observed during the BBS has shown an increasing trend estimated at 5.02% annually since 1966, with a 7.4% annual increase occurring from 2005 through 2015 (Sauer et al. 2017). Because the breeding population occurs over a small portion of the northern portion of the state and because the breeding population is localized elsewhere, the number of robins in the breeding population of the state is currently unknown. However, the Partners in Flight Science Committee (2013) estimated the breeding population at 2,000 robins based on BBS data. The breeding population of robins in the Southeastern Coastal Plain, which includes the northern portion of the state along with areas of other states, has been estimated at 2.3 million robins (Partners in Flight Science Committee 2013).

The number of robins observed in areas surveyed during the CBC in the state has shown a cyclical pattern but a general overall stable trend (National Audubon Society 2010). Between 2006 and 2015, 111,450 robins have been observed on average per year in areas surveyed during the CBC in the state (National Audubon Society 2010). The range of robins observed in the state during the CBC conducted from 2006 through 2015 has been a low of 75,270 robins to a high of 175,532 robins, which demonstrates the cyclical pattern observed from 1966 through 2015.

The number of American Robins addressed in Florida to alleviate damage or threats by WS is shown in Table 4.42. As shown in Table 4.42, WS has addressed over 25,000 robins in the state to alleviate damage or threats of damage between FY 2012 and FY 2016, primarily at airports where large flocks of robins pose a strike risk to aircraft. Of those robins addressed by WS, over 99% were addressed using non-lethal methods of harassment.

Table 4.42 – Number of American Robins addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	2,234	10
2013	7,900	39
2014	2,277	0
2015	11,171	5
2016	1,925	2
TOTAL	**25,507**	**56**

Based on requests for assistance previously received, WS could lethally remove up to 200 robins annually to alleviate damage or reduce threats in the state. As stated previously, large flocks of American Robins are present in the state during the winter, as well as, during the migration periods and most requests for assistance are associated with large groups of robins at airports. Based on the average number of robins observed in areas surveyed during the CBC from 2006 through 2015, the annual take of 200 American Robins by WS would present 0.2% of the average. If WS had lethally removed 200 robins annually from 2006 through 2015, the annual take would have ranged from 0.1% to 0.3% of the number of robins observed annually from 2006 through 2015 during the CBC. Although robins could be addressed during the breeding season, most lethal removal would occur during the migration periods when robins occur in large flocks.

All take of robins by WS would occur only after a depredation permit has been issued by USFWS and only at levels allowed under the permit. Therefore, the cumulative take of robins in the state would occur at the discretion of the USFWS to meet desired population objectives for robins. Any take by WS and other entities pursuant to depredation permits would occur within take limits to ensure the take of robins occurs within the allowable limits.

EUROPEAN STARLINGS BIOLOGY AND POPULATION IMPACTS ANALYSIS

Colonization of North America by the European Starling began on March 6, 1890 when a member of the Acclimatization Society, released 80 starlings into Central Park in New York. The released birds were able to exploit the habitat resources in the area and become established. By 1918, the distribution range of migrant juveniles extended from Ohio to Alabama; by 1926, the distribution of starlings in the United States had moved westward and encompassed an area from Illinois to Texas; by 1941, further westward expansion had occurred and starlings were known to occur and breed from Idaho to New Mexico; and by 1946, the range of starlings had expanded to California and western Canadian coasts (Miller 1975). In just 50 years, the starling had colonized the United States and expanded into Canada and Mexico and 80 years after the initial introduction had become one of the most common birds in North America (Feare 1984).

In Florida, starlings can be found throughout the year and flocks of many thousands of starlings are frequently observed during the winter when local populations are augmented by birds that breed further north (FWC 2003). Starlings were first documented in the state in Nassau County during 1918 with the first breeding record occurring in Pensacola during 1931 (FWC 2003). From 1966 through 2015, the number of starlings observed along routes surveyed during the BBS has shown a slightly decreasing trend in the state estimated at -0.77% annually, with a -6.28% decline annually from 2005 through 2015 (Sauer et al. 2017). Using data from the BBS, the Partners in Flight Science Committee (2013) estimated the statewide breeding population of starlings at 300,000 birds. The number of starlings observed in those areas surveyed during the CBC in the state has shown a downward trend from 1996 through 2015 (National Audubon Society 2010). Between 2006 and 2015, observers have counted an average of 39,901 starlings in areas surveyed during the CBC, with a high count of 46,932 starlings and a low count of 34,101 starlings.

From FY 2012 through FY 2016, 155,044 European Starlings were dispersed by WS and 1,339 European Starlings were lethally taken by WS to alleviate damage (see Table 4.43). Take of European Starlings by other entities in the state between 2012 and 2016 is unknown because a permit is not required for lethal removal. Based on the flocking behavior of starlings and potential for damage or threats of damage to arise from that behavior, WS could take up to 2,000 starlings annually in the state to alleviate damage or threats of damage. In anticipation of receiving requests for assistance to manage damage and threats associated with a large starling roost, take of up to 2,000 starlings could occur despite the limited take that has occurred previously.

Table 4.43 –Number of European Starlings addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	74,427	625
2013	33,368	135
2014	31,312	249
2015	12,792	230
2016	3,145	100
TOTAL	**155,044**	**1,339**

Take of 2,000 starlings would represent 0.7% of the estimated 300,000 starlings breeding in the state. However, most requests to address large roosts occur during migration periods and during the winter when the population in the state likely increases above the 300,000 starlings estimated to nest in the state. The increase in the statewide population is a result of migrants arriving in the state and the presence of juveniles in the population. Based on the average number of starlings observed in areas surveyed during the CBC from 2006 through 2015, the annual take of 2,000 starlings by WS would present 5.0% of the average. If WS had lethally removed 2,000 starlings annually from 2006 through 2015, the annual take would have ranged from 4.3% to 5.9% of the number of starlings observed annually from 2006 through 2015 during the CBC.

Starlings are not native to Florida and are afforded no protection under the MBTA or any state law. Therefore, a depredation permit from the USFWS or the state is not required to lethally take starlings to alleviate damage or threats of damage. Because the take of starlings to alleviate damage or threats of damage is not reported to the USFWS or the FWC, the lethal take of starlings in the state to alleviate damage or threats of damage by entities other than WS is unknown. Activities conducted by WS associated with starlings would occur pursuant to Executive Order 13112, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

HOUSE SPARROW BIOLOGY AND POPULATION IMPACTS ANALYSIS

House Sparrows were introduced to North America from England in 1850 and sparrows have since spread throughout the continent (Fitzwater 1994). House Sparrows are found in nearly every habitat, except dense forest, alpine, and desert environments. They prefer human-altered habitats and are abundant on farms and in cities and suburbs (Robbins et al. 1983). House Sparrows are not considered migratory in North America and are considered year-round residents wherever they occur, including those sparrows found in Florida (Lowther and Cink 2006). Nesting locations often occur in areas of human activities and are considered "*...fairly gregarious at all times of year*" with nesting occurring in small colonies or clumped distribution (Lowther and Cink 2006). Large flocks of sparrows can also be found in the winter as birds forage and roost together.

The first documented House Sparrow was found in northern Florida at Lake City during 1882 (FWC 2003). By 1930, House Sparrows could be found as far south as Homestead, Florida (FWC 2003). House Sparrows have been found breeding nearly statewide in Florida with nesting only absent from the most rural forests, the Everglades, and portions of the Florida Keys (FWC 2003). In Florida, the number of House Sparrows observed in areas surveyed during the BBS has shown a downward trend between 1966 and 2015 estimated at -7.08% annually (Sauer et al. 2017). More recently, the number of House Sparrows observed between 2005 and 2015 has also shown a declining trend estimated at -8.25% annually (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the breeding population of House Sparrows in the state to be 300,000 birds. Since 1966, the number of House Sparrows observed in areas surveyed during the CBC annually has shown an overall declining trend but has shown a more stable trend since the early 1990s (National Audubon Society 2010).

Robbins (1973) suggested that declines in the sparrow population must be largely attributed to changes in farming practices, which resulted in cleaner operations with little waste grain. One aspect of changing farming practices that might have been a factor would be the considerable decline in small farms and associated disappearance of a multitude of small feedlots, stables, and barns, a primary source of food for House Sparrows in the early part of the 20th century. Ehrlich et al. (1988) suggested that House Sparrow population declines might be linked to the dramatic decrease during the 20th century in the presence of horses as transport animals. Grain rich horse droppings were apparently a major food source for House Sparrows.

House Sparrows are non-indigenous and often have negative effects on native birds, primarily through competition for nesting sites. Therefore, sparrows are considered by many wildlife biologists and ornithologists to be an undesirable component of North American wild and native ecosystems. Any reduction in House Sparrow populations in North America could be considered as providing some benefit to native bird species. House Sparrows are afforded no protection from take under the MBTA or state laws.

Between FY 2012 and FY 2016, WS has employed non-lethal methods to disperse 235 sparrows and lethal methods to remove 27 sparrows in the state to alleviate damage or threats of damage (see Table 4.44). In addition, WS destroyed two house sparrow eggs during FY 2016. Because House Sparrows are afforded no protection from take under the MBTA, no depredation permits are issued for the take of House Sparrows and there is no requirements to report take of sparrows. Therefore, the number of sparrows lethally removed by other entities in the state is unknown. Based on the gregarious behavior of sparrows and in anticipation of receiving additional requests for assistance, WS could take up to 200 House Sparrows in the state annually to alleviate damage or threats of damage.

Table 4.44 – Number of House Sparrows addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	0	14
2013	71	9
2014	0	4
2015	14	0
2016	150	0
TOTAL	**235**	**27**

If up to 200 sparrows were lethally removed by WS annually in the state, the take would represent 0.1% of the statewide breeding population if the population remains at least stable. Under the proposed action, the nests and/or eggs of House Sparrows could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, up to 50 nests could be destroyed annually by WS. WS' take of nests and/or eggs would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests would not exceed 50 annually and would not exceed the level permitted under depredation permits. Impacts due to nest and egg destruction would have little adverse effect on the Sparrow population in Florida. As stated previously, the annual take of House Sparrows by other entities is currently not known. Although the breeding population of House Sparrows appears to be showing a declining trend, the winter population appears to be showing a relatively stable trend since the early 1990s. Because House Sparrows are a non-native species that often competes with native wildlife species for food and habitat, any take could be viewed as providing some benefit to the native environment in Florida. WS' take of House Sparrows to reduce damage and threats would comply with Executive Order 13112.

EASTERN MEADOWLARK BIOLOGY AND POPULATION IMPACTS ANALYSIS

The Eastern Meadowlark epitomizes the open habitats of the eastern United States, where the conspicuous nature and call of the meadowlark is easily recognizable (Jaster et al. 2012). Eastern Meadowlarks can be found throughout the eastern United States but their range can be highly dependent on habitat availability. Meadowlarks can be found throughout the year and nearly statewide in Florida (FWC 2003, Jaster et al. 2012). Eastern Meadowlarks are less common in areas of north Florida where tree farms occur and are absent in the mangrove forests of the southwestern coastal areas and the Florida Keys (FWC 2003).

Meadowlarks are associated with grassy fields, pastures, cultivated areas, groves, open pinewoods, and prairies (FWC 2003, Jaster et al. 2012). 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 Florida. 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 Florida have decreased since 1966 at an estimated rate of -5.65% annually (Sauer et al. 2017). The Partners in Flight Science Committee (2013) estimated the current statewide population at 700,000 individuals. CBC data from 1966 through 2015 shows an overall declining trend for meadowlarks in Florida (National Audubon Society 2010).

As shown in Table 4.45, WS has addressed requests associated with meadowlarks using primarily non-lethal dispersal methods. More than 96% of the meadowlarks addressed by WS from FY 2012 through FY 2016 have been addressed using non-lethal methods. Between FY 2012 and FY 2016, WS has used lethal removal to address 110 meadowlarks per year on average to reduce aircraft strike risks at airports. Based on the number of requests received to alleviate the threat of damage associated with Eastern Meadowlarks and the number of Eastern Meadowlarks addressed previously to alleviate those threats, WS anticipates that up to 500 Eastern Meadowlarks could be taken annually in the state to alleviate the threat of damage.

Table 4.45 – Number of Eastern Meadowlarks addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	2,206	54
2013	2,598	103
2014	3,271	114
2015	2,550	97
2016	4,295	182
TOTAL	**14,920**	**550**

WS' take of up to 500 meadowlarks would represent 0.1% of the estimated breeding population in the State. 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 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.

RED-WINGED BLACKBIRD BIOLOGY AND POPULATION IMPACTS ANALYSIS

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

In Florida, Red-winged Blackbirds are considered year-round residents of the state (Yasukawa and Searcy 1995) with a breeding population estimated at 1.8 million birds (Partners in Flight Science Committee 2013). Trend data from the BBS indicates the number of Red-winged Blackbirds observed in the state during the breeding season has shown a declining trend since 1966 estimated at -4.44% annually (Sauer et al. 2017). More recent trend data from 2005 through 2015 also indicates a downward trend estimated at -4.92% annually (Sauer et al. 2017). The number of Red-winged Blackbirds observed during the CBC in the state has shown an overall downward trend since 1966 (National Audubon Society 2010).

Between 2006 and 2015, the average number of Red-winged Blackbirds observed in areas surveyed during the CBC has totaled approximately 80,000 Red-winged Blackbirds. The highest number of Red-winged Blackbirds recorded during the CBC conducted in Florida between 2006 and 2015 occurred in 2013 when nearly 160,000 Red-winged Blackbirds were recorded (National Audubon Society 2010). The lowest number of Red-winged Blackbirds observed in the state during the CBC conducted between 2006 and 2015 occurred in 2012 when 54,333 Red-winged Blackbirds were recorded (National Audubon Society 2010), which provides an indication of moderate fluctuations in the number of blackbirds present in the state during the winter period.

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

Table 4.46 shows the number of Red-winged Blackbirds addressed by WS from FY 2012 through FY 2016. Over 99% of the blackbirds addressed by WS from FY 2012 through FY 2016 were addressed using non-lethal dispersal methods. In FY 2012, WS dispersed 55,292 Red-winged Blackbirds to address requests for assistance, while in FY 2013 WS dispersed only 480 blackbirds, showing the potential for cyclical assistance needs. Requests for WS' assistance with Red-winged Blackbirds in the state often arise at airports where the flocking behavior of blackbirds can pose aircraft strike risks and threaten human safety. Requests for assistance could also be received when crops or livestock feed were damaged by Red-winged Blackbirds (Dolbeer 1994). Additionally, requests could be received when blackbirds congregate into large roosts.

Table 4.46 –Number of Red-winged Blackbirds addressed by WS in Florida, FY 2012 - FY 2016

Fiscal Year	Dispersed	Take
2012	55,292	20
2013	480	46
2014	1,253	30
2015	1,051	135
2016	1,866	47
TOTAL	**59,942**	**278**

Because blackbirds can be lethally removed without the need for a depredation permit, the number of Red-winged Blackbirds lethally taken by other entities in the state has been unknown because reporting of take to the USFWS was not required in the past. However, with the recent updates to the blackbird depredation order, reporting of take to the USFWS is now required. The take of Red-winged Blackbirds by other entities is expected to be of low magnitude when compared to the statewide estimated population for Florida. Based on the number of requests received to alleviate the threat of damage associated with Red-winged Blackbirds and the number addressed previously to alleviate those threats, WS anticipates that up to 500 could be taken annually in the state to alleviate the threat of damage. With a breeding population estimated at 1.8 million Red-winged Blackbirds, take of up to 500 Red-winged Blackbirds by WS annually would represent 0.03% of the estimated breeding population in the state.

BROWN-HEADED COWBIRD BIOLOGY AND POPULATION IMPACTS ANALYSIS

Brown-headed Cowbirds are another species of the blackbird family commonly found in mixed species flocks during migration periods. Cowbirds are a common summer resident across the United States and southern Canada (Lowther 1993). Breeding populations in the northern range of the cowbird are migratory with cowbirds present year-round in much of the eastern United States and along the west Coast (Lowther 1993). Likely restricted to the range of the bison (*Bison bison*) before the presence of European settlers, cowbirds were likely a common occurrence on the short-grass plains where they fed on insects disturbed by foraging bison (Lowther 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds are still commonly found in open grassland habitats but also inhabit urban and residential areas. Unique in their breeding habits, cowbirds are known as brood parasites meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, of which, 144 species have actually raised cowbird young (Lowther

1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species.

Cowbirds are considered permanent residents that can be found throughout the year, with breeding populations augmented by migrants arriving in the state during the winter (FWC 2003). Historically, cowbirds were primarily winter residents of the state with documented breeding occurring only recently. Cowbirds were first confirmed breeding in the state during 1956 when eggs were found in Pensacola (FWC 2003). By 1980, cowbirds could be commonly found in the panhandle region of the state and could be found in peninsular Florida as far south as Gainesville (FWC 2003). Today, cowbirds are common throughout the mainland, with more scattered occurrences in south Florida (FWC 2003). There has been some concern that the brood parasitism of cowbirds may threaten the breeding populations of the Black-whiskered Vireo, Florida Prairie Warbler, Cuban Yellow Warbler, Florida Grasshopper Sparrow, and the Cape Sable Seaside Sparrow, which nest in southern Florida (FWC 2003). Although the effects of parasitism on those species are unknown, the near extirpation of breeding populations of the Black-whiskered Vireos and the Florida Prairie Warbler from Pinellas and Hillsborough counties during the late-1980s have been attributed to cowbirds (FWC 2003).

During the breeding season, the number of cowbirds observed in Florida during the BBS has shown an increasing trend estimated at 1.49% annually between 1966 and 2015 (Sauer et al. 2017). From 2005 through 2015, the number of cowbirds observed in the state has shown a decreasing trend estimated at -3.32% annually (Sauer et al 2017). The Partners in Flight Science Committee (2013) estimated the statewide breeding population of cowbirds at 600,000 cowbirds based on data from the BBS. In the southeastern coastal plain (BCR 27), cowbirds have shown a slight increasing trend since 1966 estimated at 0.36% annually; however, from 2005 through 2015, the number of cowbirds observed has shown a slight decline estimated at -0.65% annually (Sauer et al. 2017). In Peninsular Florida, the number of cowbirds observed in areas surveyed during the BBS has shown increasing trends estimated at 4.38% annually since 1966, with a -6.44% annual decrease occurring from 2005 through 2015 (Sauer et al. 2017).

Similar to other blackbird species, the number of cowbirds observed during the CBC conducted annually in the state has shown a cyclical pattern (National Audubon Society 2010). Observers on the CBC have recorded on average 12,989 cowbirds each year from 2006 through 2015 (National Audubon Society 2010). During 2015, 9,310 cowbirds were observed during the CBC conducted in the state, which was the lowest number observed from 2006 through 2015 (National Audubon Society 2010). The highest number of cowbirds observed during the CBC conducted from 2006 through 2015 is 22,960 cowbirds, which were recorded during the CBC conducted during 2012 (National Audubon Society 2010).

From FY 2012 through FY 2016, 3,850 Brown-headed Cowbirds were dispersed by WS and 348 Brown-headed Cowbirds were lethally removed by WS to alleviate damage (see Table 4.47). The highest number of cowbirds addressed by WS occurred during FY 2015. Overall, nearly 92% of the cowbirds addressed by WS were dispersed using non-lethal harassment methods. Based on the number of requests received to alleviate the threat of damage associated with Brown-headed Cowbirds and the number of Brown-headed Cowbirds addressed previously to alleviate those threats, WS anticipates that up to 400 cowbirds could be taken annually in the state to alleviate damage.

Based on a statewide breeding population estimated at 600,000 cowbirds, take of up to 400 cowbirds by WS to alleviate damage or threats of damage would represent 0.1% of the estimated breeding population. As stated previously, numbers of cowbirds present in the state increase during the migration periods and the winter months as cowbirds begin arriving from their breeding areas further north. Take of up to 400 cowbirds by WS would represent 3.1% of the average number of cowbirds observed in Florida annually during the CBC conducted from 2006 through 2015. If WS had lethally removed 400 cowbirds annually from 2006 through 2015, the take would have represented 1.7% to 4.3% of the number of cowbirds observed in areas observed during the CBC conducted from 2006 through 2015.

Table 4.47 – Number of Brown-headed Cowbirds addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	899	79
2013	282	2
2014	867	24
2015	1,017	27
2016	785	216
TOTAL	**3,850**	**348**

Like other blackbird species, the take of cowbirds can occur pursuant to the blackbird depredation order without the need for a depredation permit from the USFWS; therefore, the number of cowbirds taken annually by other entities to alleviate damage or threats of damage in the state was previously unknown. However, the take of cowbirds by other entities to alleviate damage or threats is likely minimal in the state. The take of Brown-headed Cowbirds by other entities is expected to be of low magnitude when compared to the statewide estimated population and the trend information available for Florida.

COMMON GRACKLE BIOLOGY AND POPULATION IMPACTS ANALYSIS

Common Grackles are a semi-colonial nesting species often associated with human activities. Characterized by yellow eyes and iridescent bronze or purple plumage, Common Grackles are a common conspicuous bird species found in urban and residential environments (Peer and Bollinger 1997). The breeding range of the Common Grackle includes Canada and the United States east of the Rocky Mountains with grackles found throughout the year in the United States except for the far northern and western portion of the species range in the United States (Peer and Bollinger 1997). Common Grackles have likely benefited from human activities, such as the clearing of forests in the eastern United States, which has provided suitable nesting habitat for grackles. The planting of trees in residential areas has also likely led to an expansion of the species range into the western United States (Peer and Bollinger 1997). The grackle has an extremely varied diet, which includes insects, crayfish, frogs, other small aquatic life, mice, nestling birds, eggs, sprouting and ripened grains, seeds, and fruits (Bull and Farrand, Jr. 1977, Peer and Bollinger 1997). During the migration periods, Common Grackles can be found in mixed species flocks of blackbirds.

Common Grackles are considered an abundant permanent resident in Florida and are frequently found near water, primarily freshwater habitats (FWC 2003). Large numbers of nesting grackles can be found in cypress swamps, pine forests, hammocks, and suburban areas. Orange groves in central Florida also provide ideal nesting sites for grackles (FWC 2003). Grackles generally nest in colonies but may nest individually with nests occurring in trees, bushes, and cattails (FWC 2003). Nesting typically occurs from March through July in Florida (FWC 2003). The breeding population of grackles in the state has been estimated at one million grackles (Partners in Flight Science Committee 2013). The number of grackles observed along BBS routes surveyed in the state has shown a downward trend between 1966 and 2015 estimated at -3.0% annually (Sauer et al. 2017). Between 2005 and 2015, the number of grackles observed during the BBS has also shown a downward trend in the state estimated at -2.55% annually (Sauer et al. 2017). Downward trends have also been estimated for the number of grackles observed during the BBS conducted along routes in the southeastern coastal plain region (BCR 27) estimated at -3.33% annually since 1966 as well as a downward trend across all routes surveyed in the United States estimated at -1.88% annually since 1966 (Sauer et al. 2017).

Most grackles that nest in Florida are thought to be non-migratory, except for the nesting grackles that occur in the Florida Keys that leave in October and return by late February or early March (FWC 2003). During the migration periods and the winter months, migrating grackles from northern nesting areas increase the number of grackles in the state (FWC 2003). The number of Common Grackles observed in areas surveyed during the CBC has shown a cyclical pattern between 1966 and 2015 but an overall increasing trend until approximately 1998 when the number of grackles observed per observer hour has declined (National Audubon Society 2010). During surveys conducted from 2006 through 2015, the average number of grackles observed during the CBC conducted in the state has been 37,065 grackles. The lowest number of grackles observed during the CBC from 2006 through 2015 occurred in 2013 when 29,683 grackles were recorded. The highest number of grackles recorded in the state during the CBC between 2006 and 2015 occurred in 2007 when 49,102 grackles were observed (National Audubon Society 2010).

From FY 2012 through FY 2016, 24,068 Common Grackles were dispersed by WS and 146 Common Grackles were lethally removed by WS to alleviate damage (see Table 4.48). In addition, WS destroyed 46 Common Grackles nests and six eggs during FY 2014. Based on the number of requests received to alleviate threats of damage associated with Common Grackles and the number of Common Grackles addressed previously to alleviate those threats, WS anticipates that up to 200 could be taken annually in the state to alleviate the threat of damage.

Like other blackbird species, the take of Common Grackles can occur under the blackbird depredation order, which allows blackbirds, including Common Grackles, to be taken when committing damage or about to commit damage without the need for a depredation permit from the USFWS.

Table 4.48 – Number of Common Grackles addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	20,866	20
2013	1,043	21
2014	482	6
2015	666	45
2016	1,011	54
TOTAL	**24,068**	**146**

If up to 200 Common Grackles were lethally removed annually by WS, the take would represent 0.02% of the estimated one million Common Grackles breeding within the state. Using the data from the CBC, the lethal removal of up to 200 Common Grackles by WS would represent 0.5% of the average number of grackles observed in areas surveyed from 2006 through 2015. Under the proposed action, the nests and/or eggs of Common Grackles could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, up to 50 nests could be destroyed annually by WS. WS' take of nests and/or eggs would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests would not exceed 50 annually and would not exceed the level permitted under depredation permits. Impacts due to nest and egg destruction would have little adverse effect on the Common Grackle population in Florida. The take of Common Grackles by other entities is expected to be of low magnitude when compared to the statewide estimated population for Florida.

BOAT-TAILED GRACKLE BIOLOGY AND POPULATION IMPACTS ANALYSIS

Boat-tailed Grackles are a large, conspicuous blackbird found in the freshwater and saltwater marshes of the coastal regions of eastern North America usually breeding within 50 km of the tidewater (Post et al. 2014). The mating system of the Boat-tailed Grackle has been identified as harem polygyny, where male grackles defend aggregated females from other male grackles and not territories (Post et al. 2014). Boat-tailed Grackles will eat insects, fish, amphibians, lizards, grain, and on occasion, will eat birds, eggs, and small mammals (FWC 2003, Post et al. 2014).

Boat-tailed Grackles can be found year-round along the coastal regions of Florida and are often associated with human activities where they are omnivorous and opportunistic feeders (FWC 2003, Post et al. 2014). Breeding populations are widespread across peninsular Florida but are less common in the Panhandle portion of the state and is not known to breed in the Florida Keys (FWC 2003). Although primarily associated with saltwater and brackish marshes, the Boat-tailed Grackle can be found near lakes, rivers, and freshwater marshes, as well as, commonly found in urban areas (FWC 2003). Most nesting occurs in marshes or over water in trees, including palms around urban areas (FWC 2003). The breeding season occurs from late February through July, with some nesting documented in the fall (FWC 2003).

The breeding population of Boat-tailed Grackles in the state has been estimated at 1.4 million grackles (Partners in Flight Science Committee 2013). The number of grackles observed along routes surveyed in the state during the BBS has shown a slight downward trend between 1966 and 2015 estimated at -1.15% annually (Sauer et al. 2017). Between 2005 and 2015, the number of grackles observed during the BBS has also shown a downward trend in the state estimated at -1.82% annually (Sauer et al. 2017). Downward trends have also been estimated for the number of grackles observed during the BBS across all routes surveyed in the United States estimated at -0.95% annually since 1966 (Sauer et al. 2017).

Similar to Common Grackles, the number of Boat-tailed Grackles observed in areas surveyed during the CBC has shown a general increasing trend between 1966 and 1998 with the number of grackles observed per hour by observers declining from approximately 1998 through 2015 (National Audubon Society 2010). During surveys conducted from 2006 through 2015, the average number of grackles observed during the CBC conducted in the state has been 28,490 grackles. The lowest number of grackles observed during the CBC from 2006 through 2015 occurred in 2014 when 23,603 grackles were recorded, the highest number of grackles recorded occurred in 2008 when 37,199 grackles were observed (National Audubon Society 2010).

From FY 2012 through FY 2016, 206,630 Boat-tailed Grackles were dispersed by WS and 1,995 Boat-tailed Grackles were lethally removed by WS to alleviate damage (see Table 4.49). The highest number of Boat-tailed Grackles lethally removed by WS from FY 2012 through FY 2016 occurred in FY 2013 when 653 grackles were removed, WS also dispersed 58,775 grackles during the same time period to alleviate damage. Over 95% of the grackles addressed by WS from FY 2012 through FY 2016 were addressed using non-lethal dispersal methods. In addition, WS destroyed six Boat-tailed Grackle nests during FY 2015 and destroyed 15 Boat-tailed Grackle eggs during FY 2016. Like other blackbird species, Boat-tailed Grackles often form gregarious flocks during the spring and fall migration periods that can pose hazards to aircraft at airports and result in agricultural damage from their feeding habits. Based on the number of requests received to alleviate the threat of damage associated with Boat-tailed Grackles and the number of Boat-tailed Grackles addressed previously to alleviate those threats, up to 800 grackles could be lethally removed annually by WS to alleviate the threat of damage.

Take of up to 800 Boat-tailed Grackles annually by WS would represent 0.1% of the estimated breeding population of 1.4 million grackles. Based on the average number of grackles observed in areas surveyed during the CBC from 2006 through 2015, the annual take of 800 grackles by WS would present 2.8% of the average. If WS had lethally removed 800 grackles annually from 2006 through 2015, the take would have ranged from 2.2% to 3.4% of the number of grackles observed. Under the proposed action, the nests and/or eggs of Boat-tailed Grackles could be destroyed by WS as part of an integrated approach to managing damage. Under the proposed action, up to 50 nests could be destroyed annually by WS. WS' take of nests and/or eggs would only occur when permitted by the USFWS through the issuance of depredation permits. WS' take of nests would not exceed 50 annually and would not exceed the level permitted under depredation permits. Impacts due to nest and egg destruction would have little adverse effect on the Boat-tailed Grackle population in Florida.

Table 4.49 – Number of Boat-tailed Grackles addressed by WS in Florida, FY 2012 – FY 2016

Fiscal Year	Dispersed	Take
2012	78,828	600
2013	58,775	653
2014	51,941	498
2015	14,959	151
2016	2,127	93
TOTAL	**206,630**	**1,995**

Because blackbirds can be lethally removed without the need for a depredation permit, the number of Boat-tailed Grackles lethally removed by other entities in the state has been unknown because reporting of take to the USFWS was not required in the past. However, with the recent updates to the blackbird depredation order, reporting of take to the USFWS is now required. The take of Boat-tailed Grackles by other entities is expected to be of low magnitude when compared to the statewide estimated population for Florida.

ADDITIONAL TARGET BIRD SPECIES

WS has addressed limited numbers of additional bird species previously or WS anticipates addressing a limited number of additional bird species under the proposed action alternative. WS would primarily address those species to alleviate aircraft strike risks at airports in the state. Requests for assistance associated with those species would often occur infrequently or would involve only a few individual birds. WS anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. Under the proposed action alternative, WS could receive requests for assistance to use lethal methods to remove those species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model. An example could include birds that pose an immediate strike threat at an airport where attempts to disperse the birds were ineffective. The target bird species that WS could address in limited numbers, after receiving a request for assistance associated with those species, would include those bird species identified in Appendix E[18].

Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, WS would not lethally remove more than 25 individuals annually of any of those species identified in Appendix E. In addition, to alleviate damage or discourage nesting in areas where damages were occurring, WS could destroy up to 10 active nests annually of those species that nest in the State, including any eggs found within the nest. WS does not expect the annual take of those species to occur at any level that would adversely affect populations of those species. Take would be limited to those individuals deemed causing damage or posing a threat. The MBTA protects most of those bird species from take unless the USFWS permits the take pursuant to the MBTA. If the USFWS did not issue a permit, no take would occur by WS. In addition, take could only occur at those levels stipulated in the permit. In addition, the FWC may also require a permit to take those species. As stated previously, when the USFWS issues a depredation permit for a migratory bird species protected by the MBTA, the FWC could issue permits to take the same number of birds authorized by the USFWS or the FWC could issue a permit authorizing the lethal removal of less than the number permitted by the USFWS. However, the take authorized by the FWC cannot exceed the take level authorized by the USFWS.

[18]Appendix E contains a list of the common and scientific names of those bird species that WS could address infrequently and/or in low numbers.

Therefore, the take of those bird species would occur 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 FWC permitting processes. The USFWS and the FWC, as the agencies 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 effects on those bird populations would not have a significant adverse impact on the quality of the human environment. In addition, WS would report annually to the USFWS and/or the FWC any take of the bird species listed in Appendix E in accordance with a federal and state permit.

As part of an integrated approach to managing damage, WS could destroy up to 10 active nests and the associated eggs annually of those species that nest in the State. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success and they will relocate to nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected by active nest destruction, this activity has no long-term effect on breeding adult birds. WS would not use active nest and egg removal as a population management method. WS would use nest and egg destruction to inhibit nesting in an area experiencing damage due to the nesting activity and WS would only employ active nest and egg destruction at a localized level. As with the lethal removal of birds, the destruction of active nests could only occur when authorized by the USFWS and/or the FWC, when required. Therefore, the number of nests that WS would remove annually would occur at the discretion of the USFWS and/or the FWC.

Under FAC 68A-27.003, the State of Florida has designated several wildlife species as threatened or endangered, which includes several bird species addressed in this EA. Appendix D identifies the complete list of species designated as threatened or endangered by the State of Florida. Appendix E identifies those species that WS could address infrequently or in limited numbers that the state has designated as threatened or endangered. The lethal take of wildlife species listed as threatened or endangered by the FWC is prohibited under FAC 68A-27.003 and FAC 68A-27.0011 unless allowed by a specific federal or state permit or authorization. However, under FAC 68A-9.012, the lethal take of wildlife, including those species listed as endangered or threatened designated by the state in FAC 68A-27.003, can occur on properties of airports to alleviate aircraft strike risks when meeting the provisions within FAC 68A-9.012.

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.[19] 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. Those strategies include:

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

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, 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 would 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 and have relatively direct migratory pathways from those areas to the United States.

Sentinel Species: Waterfowl, gamefowl, and poultry flocks reared in backyard facilities may prove to be valuable for early detection and used for surveillance of diseases. Sentinel waterfowl 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 spread through the intestinal tract of waterfowl and can be detected in both feces and the water in which the birds swim, defecate, and feed. This is the principal means of introduction to new birds and potentially to poultry, livestock, and people. Analysis of water and fecal material from habitats can help to identify specific types of diseases and the pathogenicity of those organisms. Environmental sampling is a reasonably cost effective, technologically achievable method 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. The sampling (*e.g.*, drawing blooding, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse effects because 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 sampling of birds result in any take that would not have already occurred in the absence of disease sampling (*e.g.*, hunter harvest).

IMPACTS OF AVIAN INFLUENZA ON BIRD POPULATIONS

Avian influenza is caused by a virus in the Orthomyxovirus group. Viruses in this group vary in the intensity of illness (*i.e*., virulence) they may cause. Wild birds, in particular waterfowl and shorebirds, are considered the natural reservoirs for AI (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2012). 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 that 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).

There are two types of avian influenza viruses, low pathogenic avian influenza and high pathogenic avian influenza (USGS 2013). The low and high refer to the potential of the viruses to kill domestic poultry (USGS 2013). In wild birds, low pathogenic avian influenza rarely causes signs of illness and it is not an important mortality factor for wild birds (Davidson and Nettles 1997, Clark and Hall 2006). In contrast, high pathogenic avian influenza has sickened and killed large numbers of wild birds in China (USGS 2013). However, there have been reports of apparently healthy wild birds being infected with high pathogenic avian influenza (USGS 2013). Previously, high pathogenic strains have only been found to exist in wild waterfowl species in China (Brown et al. 2006, Keawcharoen et al. 2008, USGS 2013).

However, in December 2014, the highly pathogenic avian influenza virus was isolated from a Northern Pintail (*Anas acuta*) in Washington State making it the first detection of the highly pathogenic avian influenza virus in wild birds in North America (USGS 2015*a*). The detection of the highly pathogenic avian influenza virus in North America has coincided with detection of the virus in poultry across the western and central United States (USDA 2015*b*). WS has been one of several agencies and organizations conducting surveillance and monitoring of avian influenza in migratory birds. Between December 8, 2014 and July 15, 2015, the USGS (2015*b*) reported 84 cases of highly pathogenic avian influenza in wild birds across the United States. Most cases have involved waterfowl and raptors (USGS 2015*b*). Many of the 84 cases involved detection of the virus in waterfowl that people harvested during the annual hunting season that agencies have sampled as part of monitoring efforts (USGS 2015*b*). Although mortality events involving the highly pathogenic avian influenza virus have occurred in waterfowl, there have been no reports of major waterfowl die-offs from the virus. In addition, no reports of major die-offs of other bird species have occurred. Therefore, there is no evidence to suggest that the avian influenza virus is or will have an effect on bird populations. As stated previously, most strains of avian influenza do not cause severe illnesses or death in bird populations.

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

Under a technical assistance only alternative, WS would recommend an integrated methods approach similar to the proposed action alternative (Alternative 1); however, WS would not provide direct operational assistance under this alternative. Methods and techniques recommended would be based on WS' Decision Model using information provided from the requester or from a site visit. In some instances, wildlife-related information provided to the requester by WS could result in tolerance or acceptance of the situation. In other instances, damage management options would be discussed and recommended.

When damage management options were discussed, WS could recommend and demonstrate for use both non-lethal and lethal methods legally available for use to alleviate bird damage. Those persons receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action. However, those persons requesting assistance would likely be those people that would implement methods.

Despite no direct involvement by WS in resolving damage and threats associated with birds in the state, those persons experiencing damage caused by birds could continue to alleviate damage by employing those methods legally available. Appendix B contains a discussion of the methods available for use in managing damage and threats associated with birds. With the exception of mesurol, alpha chloralose, and DRC-1339, all methods listed in Appendix B would be available under this alternative, although not all methods would be available for direct implementation by all persons because several chemical methods would only be available to those persons with pesticide applicators licenses[20]. Mesurol, alpha chloralose, and DRC-1339 are only available for use by WS. Therefore, those methods would be unavailable for use under this alternative. However, Starlicide™ Complete could be commercially available as a restricted-use pesticide for managing damage associated with European Starlings, Red-winged Blackbirds, Common Grackles, and Brown-headed Cowbirds at livestock and poultry operations, which contains the same active ingredient as DRC-1339. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Under this alternative, those persons experiencing threats or damage associated with birds in the state could lethally take birds. In order for the property owner or manager to use lethal methods, they must apply for their own depredation permit to take birds from the USFWS and the FWC, when required. Lethal removal of birds could continue to occur without a permit for some species (*e.g*., Monk Parakeets), during hunting seasons for some species (*e.g*., waterfowl), under depredation/control orders for certain species (*e.g*., blackbirds, geese), or through the issuance of depredation permits by the USFWS and/or the FWC. The USFWS can issue permits for those species of birds protected under the MBTA, while the FWC may issue permits for Wild Turkeys and other resident bird species.

Technical assistance could also be provided by WS as part of the application process for issuing a depredation permit by the USFWS under this alternative, when deemed appropriate. WS could evaluate the damage and complete a Migratory Bird Damage Report for the requester, 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 the USFWS review of a completed 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 each bird species. Therefore, under this alternative, the number of birds lethally taken would likely be similar to the other alternatives. Take could be similar because take could occur through the issuance of a depredation permit, take could occur under depredation/control orders, take of non-native bird species could occur without the need for a permit, and take would continue to occur during the harvest season for certain species.

This alternative would place the immediate burden of resolving damage on the people requesting assistance. Those persons experiencing damage or were concerned with threats posed by birds could seek assistance from other governmental agencies, private entities, or conduct damage management on their own. Those persons experiencing damage or threats could take action using those methods legally available to alleviate or prevent bird damage as permitted by federal, state, and local laws and regulations or those persons could take no action. Therefore, any potential effects on bird populations in the state would not occur directly from a program implementing technical assistance only. WS' recommendation of lethal methods, including hunting, under this alternative would not limit the ability of those people interested to harvest birds during the regulated season because the USFWS and/or the FWC determine the number of birds that may be taken during the hunting season, under depredation permits, under depredation orders, and under control orders.

With the oversight of the USFWS and the FWC, it is unlikely that bird populations would be adversely affected by implementation of this alternative. Under this alternative, WS would not be directly involved with damage management actions and direct operational assistance could be provided by other entities, such as the FWC, the USFWS, private entities, and/or municipal authorities. If direct operational assistance was not available from WS or other entities, it is hypothetically possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal take, which could lead to real

[20] Pesticide applicators licenses can be obtained by people who meet FDACS requirements and successfully pass testing requirements.

but unknown effects on other wildlife populations. People have resorted to the illegal use of chemicals and methods to alleviate wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct technical assistance or direct operational assistance to reduce threats to human health and safety, or 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 FWC, the FDACS, and/or private entities.

Despite no involvement by WS in resolving damage and threats associated with birds in the state, those people experiencing damage caused by birds could continue to alleviate damage by employing both non-lethal and lethal methods. Similar to Alternative 2, with the exception of mesurol, alpha chloralose, and DRC-1339, all methods listed in Appendix B would be available under this alternative, although not all methods would be available for direct implementation by all persons because several chemical methods would only be available to those people with pesticide applicators licenses. Mesurol, alpha chloralose, and DRC-1339 would only be available for use by WS and therefore, would be unavailable for use under this alternative. However, a product containing the same active ingredient as DRC-1339 could become commercially available as a restricted-use pesticide for managing damage associated with European Starlings, Red-winged Blackbirds, Common Grackles, and Brown-headed Cowbirds at livestock and poultry operations.

Lethal take of birds could continue to occur without the need for a permit, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS and/or the FWC, when required. The USFWS and/or the FWC can issue permits for those species of birds protected under the MBTA, while the FWC may issue permits for resident bird species, such as Wild Turkeys. WS would have no impact on the ability to harvest birds during a hunting season under this alternative. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Under this alternative, property owners/managers may have difficulty obtaining permits to use lethal methods. As detailed above in Alternative 1, the USFWS requires that permittees contact WS to obtain a recommendation (*i.e.*, technical assistance) on how to address bird damage as part of the permitting process. When completing a Migratory Bird Damage Report for a requester, WS would evaluate the situation and then issue a recommendation describing the damage, species involved, number of individual birds involved, previous actions taken to address the problem, and recommendations on how to address the problem. Under this alternative, WS would not assist the requester in preparing the Migratory Bird Damage Report for submission to the USFWS. The USFWS does not have the mandate or the resources to conduct damage management activities. Therefore, state agencies with responsibilities for migratory birds would likely have to collect the information needed to complete the Migratory Bird Damage Report. If the FWC, the FDACS, or another entity provided the information to the USFWS, they could review the application and make a determination as described in Alternative 1.

In some cases, the number of birds lethally removed under this alternative would likely be similar to the other alternatives. Take would be similar because lethal removal could continue to occur without the need for a permit, during hunting seasons, under depredation/control orders, or through the issuance of depredation permits by the USFWS and/or the FWC. WS' involvement would not be additive to the lethal removal that could occur because the people requesting WS' assistance could conduct bird damage management activities without WS' involvement.

This alternative would place the immediate burden of operational damage management work on the resource owner, other governmental agencies, and/or private businesses. Those people 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.

As previously stated, WS would not be involved with any aspect of addressing damage or threats of damage caused by birds under this alternative. Management actions could be undertaken by a property owner or manager, provided by private entities, provided by volunteer services of private individuals or organizations, or provided by other entities, such as the USFWS and the FWC. If direct operational assistance and technical assistance were not provided by WS or another entity, it is possible that frustration caused by the inability to reduce damage and threats, along with ignorance on how best to reduce damage and threats, could lead to the inappropriate use of legal methods and the use of illegal methods. This may occur if those people or organizations providing technical assistance have less technical knowledge and experience managing wildlife damage than WS. Illegal, unsafe, and environmentally unfriendly actions could lead to real but unknown effects. In the past, people have resorted to the illegal use of chemicals and methods to alleviate wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

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 proposed action/no action alternative would continue the current implementation of an adaptive integrated methods approach utilizing non-lethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats associated with birds in Florida. WS' personnel use a thought process for evaluating and responding to requests for assistance detailed in the WS Decision Model (see WS Directive 2.201) and described by Slate et al. (1992). As part of that thought process, WS' employees would consider the methods available and their potential to disperse, capture, or kill non-targets based on the use pattern of the method.

Personnel from WS would be experienced and trained in wildlife identification to identify damage or recognize damage threats. In addition, WS' employees would be knowledgeable in the use patterns of methods to select the most appropriate methods to address target animals and exclude 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 were 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 effects 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 effects to non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects to non-targets primarily through exclusion, harassment, dispersal, and could include inadvertently live capturing non-target animals. 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 were large enough. The use of auditory and visual dispersal methods used to reduce damage or threats caused by birds would also likely disperse non-targets in the immediate area the methods were employed. Therefore, non-targets could be dispersed from an area while employing non-lethal harassment and dispersal techniques. However, like target species, the potential impacts on non-target species would likely be temporary with target and non-target species often returning after the cessation of dispersal methods. Non-lethal dispersal and harassment methods would not be employed over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Non-lethal harassment and dispersal methods would generally be regarded as having minimal impacts on overall populations of wildlife because individuals of those species would be unharmed. The use of non-lethal harassment and dispersal 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, translocation, and repellents. Live traps (*e.g*., cage traps, walk-in traps, decoy traps) and nets (*e.g*., cannon nets, mist nets, bow nets, dipping nets) restrain birds once captured and would be considered live-capture methods. Live traps and nets have the potential to capture non-target wildlife. Trap and net placement in areas where target species were active and the use of target-specific attractants would likely minimize the capture of non-targets. If live traps and nets were attended to appropriately, any non-targets captured could be released on site unharmed.

Nets could include the use of net guns, net launchers, cannon/rocket nets, drop nets, bow nets, dipping nets, and mist nets. Nets would virtually be selective for target individuals because application would occur by attending personnel, with handling of wildlife occurring after deployment of the net or nets would be checked frequently to address any live-captured wildlife. Therefore, any non-targets captured using nets could 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 net gun/launcher weights, or cannon/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 would be 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 could be abandoned if non-target use of the area was high.

Destruction of eggs and/or nests would not adversely affect non-target species because identification of the eggs and nest would occur prior to efforts to destroy the nest. Non-lethal methods that use auditory and visual stimuli to reduce or prevent damage could be employed to elicit fright responses in target bird species. When employing those methods to disperse or harass target species, any non-targets near those methods when employed would also likely be dispersed from the area. Similarly, any exclusionary device constructed to prevent access by target species would also exclude access to non-target species. The persistent use of non-lethal methods would likely result in the dispersal or abandonment of those areas by both target and non-target species where non-lethal methods were employed. Therefore, any use of non-lethal methods would have similar results on both non-target and target species. Although non-lethal methods do not result in lethal take of non-targets, the use of non-lethal methods could restrict or prevent access of non-targets to beneficial resources. Overall, potential impacts to non-targets from the use of non-lethal methods would not adversely affect populations because those methods would often be temporary.

Only those repellents registered with the EPA pursuant to the FIFRA and registered with the FDACS 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 effects on non-target species when used according to label requirements. Many taste 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 taste repellents are methyl anthranilate and anthraquinone. Methyl anthranilate naturally occurs in grapes. Methyl anthranilate has been used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants, like aloe. Anthraquinone has also been used to make dye. Both chemicals 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 at a 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-targets would be restricted to those wildlife species that would select for the egg baits. Additional label requirements limiting the number of treated eggs per acre and detailing the removal and disposal process for unconsumed or unused treated eggs would further limit the risk to non-target species. Adherence to the label requirements of mesurol would ensure threats to non-targets would be minimal. Avitrol is a flock dispersing method available to manage damage caused by house sparrows, blackbirds, crows, starlings, and pigeons. 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 (Schafer et al. 1974).

The immobilizing drug alpha chloralose could be available to target waterfowl, geese, and pigeons. Immobilizing drugs could be applied through hand baiting that would target specific individuals or groups of target species. Therefore, immobilizing drugs would only be applied after identification of the target occurred prior to application. Pre-baiting and acclimation of the target species would occur prior to the application of alpha chloralose, which would allow for the identification of non-targets that may visit the site prior to application of the bait. All unconsumed bait would be retrieved after the application session had been completed. Because sedation occurs after consumption of the bait, personnel would be present on site at all times to retrieve target species. This constant presence by WS' personnel would allow for continual monitoring of the bait to ensure non-targets were not present. Based on the use pattern of alpha chloralose by WS, no adverse effects to non-targets would be expected from the use of alpha chloralose.

Because products containing the active ingredient nicarbazin could be commercially available and purchased by people with a certified applicators license, the use of the product could occur under any of the alternatives discussed in the EA; therefore, the effects of the use would be similar across all the alternatives if the product were used according to label instructions. Under the proposed action, WS could use or recommend products containing nicarbazin as part of an integrated approach to managing damage associated with geese, domestic waterfowl, and pigeons if products were registered for use in Florida. A product containing the active ingredient nicarbazin is currently registered in the state to manage local pigeon populations. Products containing nicarbazin are not currently registered in the state for use to manage local goose and domestic waterfowl populations. WS' use of nicarbazin under the proposed action would not be additive because the use of the product could occur from other sources, such as private pest management companies or those people experiencing damage could become a certified applicator and apply the bait themselves when the appropriate depredation permits were received[21].

Exposure of non-target wildlife to nicarbazin could occur from direct ingestion of the bait by non-target wildlife or from secondary hazards associated with wildlife consuming birds that have eaten treated bait. Several label restrictions of products containing nicarbazin are intended to reduce risks to non-target wildlife from direct consumption of treated bait (EPA 2005). The labels require an acclimation period that habituates target birds to feeding in one location at a certain time. During baiting periods, the applicator must be present on site until all bait has been consumed. Non-target risks can be further minimized by requirements on where treated baits can be placed. All unconsumed bait must also be retrieved daily, which further reduces threats of non-targets consuming treated bait.

In addition, nicarbazin is only effective in reducing the hatch of eggs when blood levels of 4,4'-dinitrocarbanilide (DNC) are sufficiently elevated in a bird species. When consumed by birds, nicarbazin is broken down into the two base components of DNC and 2-hydroxy-4,6-dimethylpyrimidine (HDP), which are then rapidly excreted. To maintain the high blood levels required to reduce egg hatch, birds must consume nicarbazin daily at a sufficient dosage that appears to be variable depending on the bird species (Yoder et al. 2005, Avery et al. 2006*b*). For example, to reduce egg hatch in Canada Geese, geese must consume nicarbazin at 2,500 ppm compared to 5,000 ppm required to reduce egg hatch in pigeons (Avery et al. 2006*b*, Avery et al. 2008*b*). In pigeons, consuming nicarbazin at a rate that would reduce egg hatch in Canada Geese did not reduce the hatchability of eggs in pigeons (Avery et al. 2006*b*). With the rapid excretion of the two components of nicarbazin (DNC and HDP) in birds, non-targets birds would have to consume nicarbazin daily at sufficient doses to reduce the rate of egg hatching.

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

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

[21]A depredation permit would only be required when managing localized Canada goose populations. A depredation permit would not be required to manage pigeon or domestic waterfowl populations.

Regulation 2007). Given the use restriction of nicarbazin products and the limited locations where bait could be applied, the risks of exposure to non-targets would be extremely low.

Impacts to non-targets from the use of non-lethal methods would be similar to the use of non-lethal methods under any of the alternatives. Non-targets would generally be unharmed from the use of non-lethal methods under any of the alternatives because 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 shooting, lethal traps, egg destruction, and DRC-1339. In addition, birds could also be euthanized once live-captured by other methods. Available methods and the application of those methods to alleviate bird damage are further discussed in Appendix B. In addition, birds could still be lethally removed during the regulated harvest season, through depredation/control orders, and through the issuance of depredation permits under this alternative.

The use of firearms would essentially be selective for target species because birds would be identified prior to application; therefore, no adverse effects to non-targets would be anticipated from use of this method. The euthanasia of birds by WS' personnel would be conducted in accordance with WS Directive 2.505. Chemical methods used for euthanasia would be limited to carbon dioxide administered in an enclosed chamber after birds were live-captured. Because live-capture of birds using other methods would occur prior to the administering of carbon dioxide, 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 would essentially be selective for target species and the unintentional lethal removal of non-targets would not likely increase based on WS' recommendation of the method. Additionally, when appropriate, WS would use suppressed firearms to minimize noise and the associated dispersal effect that could occur from the discharge of a firearm.

As mentioned previously, the avicide DRC-1339 is only available for use by WS and would therefore only be available under the proposed action alternative. However, a product containing the same active ingredient, 3-chloro-p-toluidine hydrochloride ($C_7H_9Cl_2N$), as DRC-1339 could become commercially available as a restricted-use pesticide and would be available under any of the alternatives. A common concern 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 would be pre-baited and monitored for non-target use as outlined in the pre-treatment observations section of the label. If non-targets were observed feeding on the pre-bait, the plots would be abandoned and no baiting would occur at those locations. Treated bait would be mixed with untreated bait per label requirements when applied to bait sites to minimize the likelihood of non-targets finding and consuming bait that had been treated. The bait type selected can also limit the likelihood that non-target species would consume treated bait because some bait types would not be preferred by non-target species.

Once sites were baited, sites would be monitored daily to observe for non-target feeding activity. If non-targets were observed feeding on bait, those sites would be abandoned. By acclimating target bird species to a feeding schedule, baiting could occur at specific times to ensure bait would be quickly consumed by target bird species, especially when large flocks of target species were present. The acclimation period would allow treated bait to be present only when birds were conditioned to be present at the site. An acclimation period would also increase the likelihood that treated bait would be consumed by the target species, which would make it unavailable to non-targets. In addition, when present in large numbers, many bird species 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 would only occur when treated bait was present at a bait location. WS would retrieve all dead birds, to the extent possible, following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

DRC-1339 Primary Hazard Profile - DRC-1339 was selected for reducing bird damage because of its high toxicity to blackbirds (DeCino et al. 1966, West et al. 1967, Schafer 1972) and low toxicity to most mammals, sparrows, and finches (Schafer and Cunningham 1966, Apostolou 1969, Schafer 1972, Schafer et al. 1977, Matteson 1978, Cunningham et al. 1979, Cummings et al. 1992, Sterner et al. 1992). The likelihood of a non-target bird obtaining a lethal dose would be dependent on the frequency of encountering the bait, length of feeding, the bait dilution rate, the bird's propensity to select against the treated bait, and 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})[22] values for starlings, blackbirds, and magpies (Corvidae) range from one to five mg/kg (Eisemann et al. 2003). For American Crows, the median acute lethal dose has been estimated at 1.33 mg/kg (DeCino et al. 1966). The acute oral toxicity (LD_{50}) of DRC-1339 has been estimated for over 55 species of birds (Eisemann et al. 2003). DRC-1339 is toxic to Mourning Doves, pigeons, quail (*Coturnix coturnix*), chickens, and ducks (*Anas* spp.) at ≥5.6 mg/kg (DeCino et al. 1966). In cage trials, Cummings et al. (1992) found that 2% DRC-1339 treated rice did not kill Savannah Sparrows (*Passerculus sandwichensis*). Gallinaceous birds and waterfowl may be more resistant to DRC-1339 than blackbirds, and their large size may reduce the chances of ingesting a lethal dose (DeCino et al. 1966). Avian reproduction does not appear to be affected from ingestion of DRC-1339 treated baits until levels are ingested where toxicity is expressed (USDA 2001).

There have been concerns expressed about the study designs used to derive acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine 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 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

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[22]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.

guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

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

DRC-1339 is rapidly metabolized and excreted; therefore, the avicide does not bioaccumulate, which probably accounts for its low secondary hazard profile (Schafer 1991). For example, cats, owls, and magpies would be at risk only after exclusively eating DRC-1339 poisoned starlings for 30 continuous days (Cunningham et al. 1979). According to the EPA (1995), laboratory studies with raptors indicated no adverse effects when certain raptor species were fed starlings poisoned with 1% DRC-1339 treated baits. Two American Kestrels survived eating 11 and 60 poisoned starlings over 24 and 141 days, respectively. Two Cooper's Hawks ate 191 and 222 starlings with no observable adverse effects. Three Northern Harriers ate 100, 191, and 222 starlings over 75 to 104 days and survived with no apparent detrimental effects. The LD_{50} values established for other avian predators and scavengers such as crows, ravens, and owls indicate these species are acutely more sensitive to DRC-1339 than hawks and kestrels (EPA 1995). 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 around sites baited with DRC-1339. Smith (1999) did not find carcasses of non-targets that exhibited histological signs consistent with DRC-1339 poisoning. 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; therefore, DRC-1339 degrades rapidly when exposed to sunlight, heat, or ultra violet radiation and has a short half-life (EPA 1995). 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.

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 suggest crows can travel as little as four meters (Kilham 1989) 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 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; thus, the avicide 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. Treated bait would be mixed with untreated bait before baiting an area. Mixing treated bait with untreated bait would minimize non-target hazards and reduce the likelihood of the target species developing bait aversion. Because 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 WS would take precautions 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 would be 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 Florida would be expected to be extremely low to non-existent. Non-targets have not been lethally removed by WS during prior activities targeting birds 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 affect non-targets. Methods available to alleviate 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 FWC any non-target take to ensure take by WS is considered as part of management objectives established. The potential impacts to non-targets would be similar to the other alternatives and are considered minimal to non-existent.

The proposed bird damage management could benefit many other wildlife species that were adversely affected by predation or competition for resources. For example, crows are generally very aggressive nesting area colonizers and they will force other species from those 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 because all available methods could possibly be implemented or recommended by WS.

T&E SPECIES EFFECTS

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

Federally Listed Species – WS reviewed the current list of species designated as threatened or endangered in Florida as determined by the USFWS and the National Marine Fisheries Service during the development of this EA. Appendix C contains the list of species currently listed in the state along with common and scientific names.

No take of threatened or endangered species by WS has occurred previously in the state during the implementation of activities and the use of methods to manage the damage that birds cause. 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 nor their critical habitats. As part of the development of the EA, WS consulted with the USFWS pursuant to 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 (L. Williams, State Supervisor and Fish & Wildlife Biologist, USFWS, pers. comm. 2017). Based on the use pattern of the methods and the locations where WS could implement damage management activities, the implementation of Alternative 1 would have no effect on those threatened or endangered species in Florida under the jurisdiction of the National Marine Fisheries Service, including any designated critical habitat. WS would continue to consult with the USFWS and/or the National Marine Fisheries Service to evaluate activities to resolve bird damage to ensure the protection of threatened or endangered species and to comply with the ESA.

State Listed Species – During the development of this EA, WS has reviewed the current list of state listed species designated as threatened or species of special concern by the FWC (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 FWC has concurred with WS' determination for state listed species and WS will follow those recommendations provided during the consultation regarding listed species (B. J. Gruver, Section Leader, Species Conservation Planning, FWC, pers. comm. 2017).

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 people 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 DRC-1339, alpha chloralose, and mesurol, which would only be available for use by WS' employees.

The potential impacts to non-targets under this alternative would be variable and based on several factors. If methods were employed, as recommended by WS, the potential impacts to non-targets would likely be 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. Because identification of targets would occur when employing shooting as a method and if people were familiar with the identifying characteristics of the target bird species, the potential impacts to non-target species would likely be low under this alternative.

Those people 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 people experiencing damage do not implement methods or techniques correctly. Methods or techniques recommended by WS that were implemented incorrectly could lead to an increase in non-target take.

If requesters were provided technical assistance but do not implement any of the recommended actions and take other actions, the potential impacts to non-targets could be higher compared to the proposed action. If those people 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 that were not implemented as recommended or were used inappropriately would likely increase potential impacts to non-targets. Therefore, the potential impacts to non-targets, including T&E species would be variable under a technical assistance only alternative. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of birds, which could lead to unknown effects on local non-target species populations, including some T&E species. When those people 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 (*e.g*., see 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.

Those persons requesting assistance would likely be those people who would use lethal methods because a damage threshold had been met for that individual requester that 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 alleviated by non-lethal methods could 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.

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 because 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 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 could continue to be taken under depredation permits issued by the USFWS and/or the FWC, take could continue to occur during the regulated harvest season, non-native bird species could continue to be taken without the need for a permit, and birds could still be taken under their respective depredation/control orders. Risks to non-targets and T&E species would continue to occur from those people who implement damage management activities on their own or through recommendations by the other federal, state, and private entities. Although some risks would occur from those people that implement bird damage management in the absence of any involvement by WS, those risks would likely be low, and would be 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 because most of those methods described in Appendix B would be available across the alternatives. If those methods available were applied as intended, risks to non-targets would be minimal to non-existent. If methods available were applied incorrectly or applied without knowledge of wildlife behavior, risks to non-target wildlife would be higher under this alternative. If frustration from the lack of available assistance caused those persons experiencing bird damage to use methods that were 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 alleviate wildlife damage that have resulted in the lethal take of non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, FDA 2003).

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

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

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

The cooperator requesting assistance would be made aware through a MOU, work initiation document, or a similar document that those methods agreed upon could potentially be used on property owned or managed by the cooperator. Therefore, the cooperator would be made aware of the use of those methods on property they own or manage prior to the initiation of any project, which would assist with identifying 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 could be employed as part of direct operational assistance by WS would be similar to those risks addressed in the other alternatives.

Although hazards to human safety from non-lethal methods exist, those methods would generally be regarded as safe when used by trained individuals who were experienced in their use. Although some risk of fire and bodily harm would exist from the use of pyrotechnics, lasers, and propane cannons, when used appropriately and in consideration of those risks, those methods can be used with a high degree of safety.

Lethal methods available under the proposed action would include the use of firearms, egg destruction, 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 FWC. Those lethal methods available under the proposed action alternative or similar products would also be available under the other alternatives. Although the avicide DRC-1339 would be 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, a 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 conduct activities would be knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by birds. Prior to and during the utilization of methods, WS' employees would consider risks to human safety based on location and method. Risks to human safety from the use of methods would likely be greater in urban areas when compared to rural areas that were less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occurred on private property in rural areas where access to the property was controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occurred at or near public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety would increase. Activities would generally be conducted when human activity was minimal (*e.g*., early mornings, at night) or in areas where human activities was minimal (*e.g*., in areas closed to the public).

Many of the non-chemical methods available would only be activated when triggered by attending personnel (*e.g*., cannon nets, firearms, pyrotechnics, lasers), are passive live-capture methods (*e.g*., walk-in style live-traps, mist nets), or are passive harassment methods (*e.g*., effigies, exclusion techniques, anti-perching devices, electronic distress calls). The primary safety risk of most non-chemical methods occurs directly to the applicator or those people assisting the applicator. However, risks to others do exist when employing non-chemical methods.

The use of live-capture traps has also been identified as a potential issue. Traps would typically be set in situations where human activity was minimal to ensure public safety. Traps rarely cause serious injury and would only be triggered through direct activation of the device. Live-capture traps available for birds are typically walk-in style traps, such as box/cage traps, nest traps, or decoy traps where birds enter but are unable to exit. Other types of live traps include Bal-Chatri traps that utilize small monofilament nooses to ensnare the talons of raptors, pole traps, padded foothold traps, Dho-gaza traps, and mist nets. 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 from the use of live-traps would be minimal.

Other live-capture devices, such as mist nets, net guns, net launchers, and bow nets pose minor safety hazards to the public because 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 because application occurs directly to target species by trained personnel, which limits the exposure of the public to misuse of the method.

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

All WS' personnel who handle and administer chemical methods would be properly trained in the use of those methods. Training and adherence to agency directives would ensure the safety of employees applying chemical methods. Birds euthanized by WS or lethally removed 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 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 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 were 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. Mesurol is registered by the EPA for use to condition crows not to feed on the eggs of T&E species, but is currently not registered for this purpose in Florida. However, mesurol 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 typically recover. Human safety risks associated with the use of mesurol occur primarily to the mixer and handler during preparation. WS' personnel would follow all label requirements, including the personal protective equipment required to handle and mix bait. When used according to label requirements, the risks to human safety from the use of mesurol would be minimal.

Risks to human safety from the use of avicides could occur through direct exposure of the chemical or exposure to the chemical from birds that have been lethally taken. DRC-1339 is 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. At the time this EA was developed, WS had not registered with the FDACS any formulations of DRC-1339 for use in the state; therefore, WS would not currently use any formulations of DRC-1339. However, WS is evaluating the use of DRC-1339 as a method in this EA in anticipation that situations could arise where the use of DRC-1339 may be an appropriate to alleviate damage associated with large concentrations of blackbirds, starlings, pigeons, and/or gulls. For example, WS could use DRC-1339 to address a large concentration of blackbirds at a feedlot or a large concentration of pigeons at an industrial site. WS would only use formulations of DRC-1339 after the FDACS had approved their use in the state.

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

Several factors would minimize any risk to public health from the use of DRC-1339. For example, the use of DRC-1339 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). DRC-1339 is also highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation and the half-life of DRC-1339 is about 25 hours. In general, DRC-1339 on treated bait material would almost completely be broken down within a week if target birds did not consume the bait or if WS did not retrieve uneaten bait. The avicide DRC-1339 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. For exposure to occur in people from a carcass, a person would need to ingest the internal organs of birds that died from ingesting DRC-1339 bait. Application rates of bait treated with DRC-1339 are extremely low (EPA 1995). Furthermore, the EPA has concluded that, based on mutagenicity (*i.e*., the tendency to cause gene mutations in cells) studies, the avicide DRC-1339 is not a mutagen or a carcinogen (*i.e.*, cancer-causing agent) (EPA 1995).

However, an additional concern associated with the use of the avicide DRC-1339 is the potential exposure of people to crows harvested during the regulated hunting season that have ingested DRC-1339 treated bait. During the development of this EA, the hunting season for crows in the state occurs from mid-August until mid-February the following calendar year with no daily take limit and no possession limit (FWC 2017). Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur in the state during the period of time when hunters could harvest crows. Although baiting could occur in rural areas of the state during those periods, most requests for assistance to manage crow damage during the period of time when hunters can harvest crows in the state would 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 travel to) or could occur near the roost location where crows have been conditioned to feed using pre-baiting. Crows, like other blackbirds, often stage (congregate) in an area prior to entering a roost location. The staging behavior often exhibited by blackbirds occurs consistently and pre-baiting can induce this behavior to occur consistently at a particular location because blackbirds often feed prior to entering a roost location. Pre-baiting 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 pre-baiting can condition crows 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 within 2.5 hours (Peoples and Apostolou 1967) with similar results found for other bird species (Eisemann et al. 2003). Once death occurs, DRC-1339 concentrations appear to be highest in the gastrointestinal tract of birds but some residue could be found in other tissues of carcasses (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 were residues 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 risks to human safety, a hunter would have to harvest a crow that has ingested DRC-1339 and then, ingest tissue of the crow that contained 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 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, parts of the crow would have to be consumed. Thirdly, the tissue consumed would have to contain chemical residues of DRC-1339. Current information indicates that the majority of the chemical is excreted from target bird species within a few hours of ingestion. The highest concentration of the chemical in target bird species 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. Although no information is currently available on the number of people that might consume crows in Florida, the number is likely very few, if any, people are likely consuming crows harvested in Florida or elsewhere. Hunters primarily harvest crows for recreational purposes and people remove crows to alleviate damage in the state; therefore, people are not likely harvesting crows for subsistence.

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 would be administered to target wildlife through consumption of treated bait. Therefore, the current concern, outside of transport and storage, would be the risks directly to the handler and support staff during the handling and distribution of the bait on the ground for consumption.

Threats to human safety from the use of nicarbazin would likely be minimal if labeled directions were followed. The use pattern of nicarbazin would also ensure threats to public safety were minimal. The label requires an acclimation period before placing treated bait, which assists with identifying risks, requires the presence of the applicator at the location until all bait was consumed, and requires any unconsumed bait to 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 (see 21 CFR 556.445). The EPA characterized the risks of human exposure as low when used to reduce egg hatchability 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 were followed, risks to human safety would be low with the primary exposure occurring to those handling and applying the product. When WS and other entities follow the safety procedures required by the label, risks to handlers and applicators would be minimal.

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. Because applicators are present at all times during application of alpha chloralose, the risks to human safety are low. All WS' employees using alpha chloralose would be required to 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 would be the potential for human consumption of meat from waterfowl that have been immobilized using alpha chloralose or have consumed nicarbazin. Because hunters could harvest waterfowl during a regulated harvest season and consume harvested waterfowl, the use of immobilizing drugs and potentially reproductive inhibitors would also be a concern. Prebaiting procedures can condition waterfowl 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 intended use of immobilizing drugs is to live-capture waterfowl. Primarily, 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) would be targeted with immobilizing drugs or reproductive inhibitors. However, it could be possible for target waterfowl to leave the immediate area where baiting was occurring after consuming bait and enter areas where hunting could occur. To mitigate this risk, withdrawal times are often established. A withdrawal time is the period established between when the animal consumed treated bait to when it is safe to consume the meat of the animal by humans. Withdrawal periods are not well defined in free-ranging wildlife species for all drugs. In compliance with FDA use restrictions, the use of alpha chloralose would be prohibited for 30 days prior to and during the hunting season on waterfowl and other game birds that could be hunted. In the event that WS was requested to immobilize waterfowl or use nicarbazin during a period when harvest of waterfowl was occurring or during a period of time where a withdrawal period could overlap with the start of a harvest season, WS would not use immobilizing drugs or nicarbazin. In those cases, other methods would be employed.

The recommendation by WS that certain bird species (*e.g.*, waterfowl) be harvested during the regulated hunting season, which would be established by the FWC 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 FWC 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.

WS could also use paintball guns to disperse target bird species. Paintballs do not actually contain paint, but are marking capsules that consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. Although the ingredients may vary slightly depending on the manufacturer, paintball ingredients may include polyethylene glycol, gelatin, glycerine (glycerol), sorbitol, water, ground pig skin, dipropylene glycol, mineral oil, and dye as the colorant (Donaldson 2003). Paintballs are considered non-toxic to people and do not pose an environmental hazard, as described on product labeling and Material Safety Data Sheets. However, consumption may cause toxicosis in dogs, which is potentially fatal without supportive veterinary treatment (Donaldson 2003). Little is known about the mechanism of action and lethal dose for dogs that consume paintballs, but it is suspected that there is an osmotic diuretic effect resulting in an abnormal electrolyte and fluid balance (Donaldson 2003). Most affected dogs recovered within 24 hours (Donaldson 2003).

The recommendation by WS that certain bird species (*e.g.*, waterfowl) be harvested during the regulated hunting season, which is established by the FWC under frameworks determined by the USFWS, would not increase risks to human safety above those risks already inherent with hunting those species. Recommendations to allow hunting on property owned or managed by a cooperator to reduce local bird densities in order to alleviate damage or threats would not increase risks to human safety. Safety requirements established by the FWC 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 2012 through FY 2016. The risks to human safety from the use of non-lethal and lethal methods, when used appropriately and by trained personnel, would be considered low. Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898 and Executive Order 13045.

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. WS would only provide technical assistance to those people requesting assistance with bird damage and threats. The only methods that would not be available under this alternative would be mesurol, alpha chloralose, and DRC-1339. 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. 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.

The use of chemical methods that are considered non-lethal would also be available under this alternative. Chemical methods available would include repellents. There are few chemical repellents registered for use to manage birds in the state. Most repellents require ingestion of the chemical to achieve the desired effects 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 commonly registered for use to disperse birds include methyl anthranilate, polybutene, and 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 properly, 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 FWC, would not increase risks to human safety above those risks already inherent with hunting birds. Recommendations to allow hunting on property owned or managed by a cooperator to reduce local bird densities, which could then reduce bird damage or threats would not increase risks to human safety. Safety requirements established by the FWC 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 as a method of direct lethal take could occur under this alternative. Safety issues can 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 were employed inappropriately or without regard to human safety, serious injuries or loss of life could occur. Under this alternative, recommendations of the use of firearms by WS would include human safety considerations. Because 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 were employed according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to the proposed action. If methods were 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.

The cooperator requesting assistance would also be 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 because 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 involvement by WS 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 remove birds lethally if permitted by the USFWS and/or the FWC. 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. Because most non-chemical methods available for bird damage management involve the live-capture or harassment of birds, those methods would generally be regarded as posing minimal risks to human safety. Habitat modification and harassment methods would also generally be regarded as posing minimal risks to human safety. Although, some risks to safety would likely occur from the use of pyrotechnics, propane cannons, and exclusion devices, those risks would be minimal when those methods were used appropriately and in consideration of human safety. The only methods that would be available under this alternative that would involve the direct lethal take of birds would be shooting, egg destruction, and live-capture followed by euthanasia. Under this alternative, shooting, egg destruction, and live-capture followed by euthanasia would be available to those persons experiencing damage or threats of damage when required and permitted by the USFWS and/or the FWC. 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 people experiencing damage or threats from birds. Chemical methods that would be available to the 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. Because 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 people 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 were dispersed or removed, the ability of interested persons to observe and enjoy those birds would likely temporarily decline.

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

The use of lethal methods could 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 would be 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 remain if a reasonable effort were made to locate birds outside the area in which damage management activities occurred. Those birds removed by WS would be those birds that could be removed by the person experiencing damage in the absence of assistance by WS.

Activities would only be conducted on properties where a request for assistance was received and activities would only be conducted after an agreement for such services had been agreed upon by the requester. 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.

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

WS' take of birds from FY 2012 through FY 2016 has been of low magnitude when compared to the population estimates, trending data, and other available information. WS' activities would not likely be additive to the birds that would be taken in the absence of WS' involvement. Although birds removed by WS would no longer be present for viewing or enjoying, those birds would likely be taken by the property owner or manager if WS were not involved in the action. Given the limited take proposed by WS under this alternative, when compared to the known sources of mortality of birds and their population information, damage management activities conducted by WS 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 would likely be low.

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

If those people 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 could result in localized reductions in the presence of birds at the location where damage was occurring. The presence of birds where damage was occurring could be reduced where damage management activities were conducted under any of the alternatives. Even the recommendation of non-lethal methods would likely result in the dispersal of birds from the area if those non-lethal methods recommended by WS were employed by those people receiving technical assistance. Therefore, technical assistance provided by WS would not prevent the aesthetic enjoyment of birds because 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 from WS or another entity, the damage level has often reached an unacceptable 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 has been requested and those persons would likely 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 would likely be employed by the requester that would result in the dispersal and/or removal of birds responsible for damage or threatening safety. If those birds causing damage were dispersed or removed by those people 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 were not as diligent in employing those methods as WS would be if conducting an operational program. If those people experiencing damage abandoned the use of those methods, then birds would likely remain in the area and available for viewing and enjoyment by those people interested in doing so. Similar to the other alternatives, the geographical area in which damage management activities occurs would not be 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 people 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 WS 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 people experiencing damage or threats or is provided by other entities. If no action was taken or if activities were not permitted by the USFWS and/or the FWC, then no impact on the aesthetic value of birds would occur under this alternative.

Birds could continue to be dispersed and lethally taken by other entities under this alternative. Lethal take would continue to occur when permitted by the USFWS and the FWC through the issuance of depredation permits. Take could also occur during the regulated harvest season for certain species, pursuant to depredation/control orders, pursuant to depredation permits, and in the case of some species, take could occur any time without the need for a depredation permit.

Because other entities could continue to take birds 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 because WS has no authority to regulate take or the harassment of birds in the state. The USFWS and the FWC, 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, depredation permits, and under the depredation/control orders would be regulated and adjusted by the USFWS and/or the FWC.

Those people experiencing damage or threats would continue to use those methods they feel appropriate to alleviate bird damage or threats, including lethal take. Therefore, WS' involvement in bird damage management would not be additive to the birds that could be lethally removed 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

Humaneness and animal welfare concerns associated with methods available for use to manage bird damage have been identified as an issue. 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/or the FWC, when required. The humaneness and animal welfare concerns of methods available for use in Florida, 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, WS would use non-lethal methods that were 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 drugs, inactive nest destruction, 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 people believe any use of lethal methods to alleviate damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Other people 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 would be to use methods as humanely as possible to address 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 animals addressed when attempting to alleviate 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, many members of the public would consider a cage trap to be a "*humane*" method. Yet, without proper care, live-captured wildlife in a cage trap can be treated inhumanely if not attended to appropriately. Some concern arises from the use of live-capture methods causing stress on the animal, but if used appropriately, the stress is minimal and only temporary. Overall, many people consider the use of non-lethal management methods as humane when used appropriately.

Although some concerns of humaneness and animal welfare could occur from the use of cage traps, nets, immobilizing drugs, reproductive inhibitors, 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 could occur from injuries to animals while restrained, from the stress of the animal while being restrained, or during the application of the method. Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when action is not taken to alleviate conditions that cause pain or distress in animals.

If birds were to be live-captured by WS, WS' personnel would be present on-site during capture events or WS' employees would check methods at least once every 24 hours to ensure WS' employees addressed birds captured quickly to prevent injury. Although stress could occur to an animal restrained in a live-capture device, 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 alleviate or prevent bird damage and threats, when requested. Lethal methods would include shooting, egg destruction, DRC-1339, the recommendation that birds be harvested during the regulated hunting seasons, and euthanasia after birds were live-captured. WS' use of euthanasia methods under the proposed action would follow those methods required by WS' directives (see WS Directive 2.430, WS Directive 2.505).

The euthanasia methods being considered for use under the proposed action for live-captured birds would be cervical dislocation and carbon dioxide. The AVMA guidelines on euthanasia list cervical dislocation, carbon dioxide, and gunshot as conditionally acceptable methods of euthanasia for free-ranging birds that can lead to a humane death (AVMA 2013). The use of cervical dislocation, carbon dioxide, or gunshot for euthanasia would occur after the animal had been live-captured and away from public view. Although the AVMA guidelines list cervical dislocation and gunshot as conditionally acceptable methods of euthanasia for free-ranging wildlife, there is greater potential those methods may not consistently produce a humane death (AVMA 2013). WS' personnel that employ methods to euthanize live-captured birds would be trained in the proper use of those methods to ensure a timely and quick death.

Although the mode of action associated with DRC-1339 is not well understood, it appears to cause death primarily by nephrotoxicity (*i.e.*, toxic effect on the kidneys) in susceptible species and by central nervous system depression in non-susceptible species (DeCino et al. 1966, Westberg 1969, Schafer 1984). DRC-1339 causes irreversible necrosis of the kidney and the affected bird is subsequently unable to excrete uric acid with death occurring from uremic poisoning and congestion of major organs (DeCino et al. 1966, Knittle et al. 1990). The external appearances and behavior of starlings that ingest DRC-1339 slightly above the LD_{50} for starlings appear normal for 20 to 30 hours, but water consumption doubles after 4 to 8 hours and decreases thereafter. Food consumption remains fairly constant until about 4 hours before death, at which time starlings refuse food and water and become listless and inactive. The birds perch with feathers fluffed as in cold weather and appear to doze, but are still responsive to external stimuli. As death nears, breathing rate increases slightly and becomes more difficult. Eventually, the birds no longer respond to external stimuli and become comatose. Death follows 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 probably occur by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternatives. DRC-1339 to manage damage caused by certain species of birds would only be available for use by WS' personnel. A similar product containing the same active ingredient could commercially become available as a restricted use pesticide for use to manage damage associated with blackbirds and starlings; however, DRC-1339 nor a similar product with the same active ingredient is currently registered for use in Florida.

The chemical repellent under the trade name Avitrol acts as a dispersing agent when birds ingest treated bait, 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 but none were observed. Conclusions of the study were that the chemical met the criteria for a humane pesticide.

The use of nicarbazin would generally be considered as a humane method of managing local populations of domestic waterfowl and pigeons. Nicarbazin reduces the hatchability of eggs laid by waterfowl and appears to have no adverse effects on waterfowl. Consuming bait daily did not appear to adversely affect those chicks that hatched from parents fed nicarbazin (Avery et al. 2006*b*, Avery et al. 2008*b*). Nicarbazin has been characterized as a veterinary drug since 1955 by the FDA for use in broiler chickens to treat outbreaks of coccidiosis with no apparent ill effects to chickens. Based on current information and research, the use of nicarbazin would generally be considered humane.

Alpha chloralose could be used by WS as a sedative to live-capture geese and other waterfowl. Although overdosing waterfowl with alpha chloralose can cause death, WS would employ alpha chloralose as a non-lethal method only. When using alpha chloralose, WS' personnel would be present on site to retrieve birds that become sedated. Some concern occurs that waterfowl may drown if sedation occurs while they are loafing on water. WS would ensure that a boat and/or a canoe were available for quick retrieval of birds that become sedated while in the water.

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 people experiencing damage regardless of WS' direct involvement. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives. 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.

Therefore, the goal would be to 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.

People have also expressed concerns over the potential separation of goose families from management actions. Generally, adult geese form pair bonds that they maintain until one of the pair dies; however, geese will form new pairs bonds even when their previous mate is still alive (MacInnes et al. 1974, Mowbray et al. 2002). Goose family units generally migrate together during the fall migration period and spend much of the fall and winter together (Raveling 1968, Raveling 1969, Mowbray et al. 2002). The separation of family units could occur during damage management activities targeting geese. This could occur through translocation, harassment (*e.g.*, pyrotechnics, dogs), and lethal control methods.

Although resident Canada geese can have high adult and juvenile survival rates, especially in urban areas with a reduced number of predators, Canada goose family units often experience change. For example, annual harvest of Canada geese appears to strongly influence annual survival rates of geese (Mowbray et al. 2002). People harvested 35,812 Canada geese in the state during the 2014 hunting season and 19,257 geese during the 2015 hunting season. During the 2014 hunting season, people harvested 5,600 Canada geese in the state during the special September hunting season that specifically targets resident Canada geese in the state. Similarly, people harvested 5,300 resident Canada geese during the 2015 September hunting season for resident Canada geese (Raftovich et al. 2016). In addition, the period between when geese hatch and when they fledge tends to be a period of high mortality in Canada geese (Mowbray et al. 2002). Adults that lose a mate can form new pair bonds and will breed with new mates (Raveling 1988, Mowbray et al. 2002). Although WS' activities could separate geese, adult geese do form new pair bonds and continue to breed with new mates. Although juvenile geese generally migrate with their parents during the fall migration period and spend much of the fall and winter together, juveniles would likely survive if they separate from a parent or both parents.

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

The issue of humaneness of methods under this alternative is likely to be perceived as similar to humaneness issues discussed under the proposed action. This perceived similarity is derived from WS' recommendation of methods that some consider inhumane. WS would not directly be involved with damage management activities under this alternative. However, the recommendation of the use of methods would likely result in the 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 person using the methods to resolve 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 alleviate 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 under Alternative 1.

Those people 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 addressed 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 were not as diligent or timely in checking methods. Similar to Alternative 3, it can be difficult to evaluate the behavior of individual people and determining what may occur under given circumstances. Therefore, only the availability of WS' assistance can be evaluated under this alternative because 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 because pain and distress of birds would likely be higher.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not be involved with any aspect of bird damage management in Florida. Those people experiencing damage or threats associated with birds could use those methods legally available and permitted by the USFWS, the FWC, and other 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 public because 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 humane could be employed in inhumane ways. Methods could be employed inhumanely by those people inexperienced in the use of those methods or if those people were 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 public for use to alleviate damage and threats caused by birds. Therefore, those methods considered inhumane would continue to be available for use under this alternative. If those people experiencing bird damage apply those methods considered humane 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.

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. However, other federal, state, and private entities could also be conducting bird damage management in the state. The take of native migratory bird species requires a depredation permit from the USFWS pursuant to the MBTA, which requires permit holders to report all take occurring under the permit. Take of Canada Geese, Muscovy Ducks, and blackbirds can occur under depredation/control orders without the need for a depredation permit. European Starlings, Rock Pigeons, Eurasian Collared-Doves, House Sparrows, Monk Parakeets, and feral waterfowl can be lethally taken without the need for a depredation permit because 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 damage management activities at adjacent sites within the same period. In addition, commercial pest control companies may conduct damage management activities in the same area. The potential cumulative impacts analyzed below could occur because of WS' damage management program activities over time or because 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 FWC, activities of each agency and the take of birds would be available. 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 through vehicle strikes, aircraft strikes, and illegal take
- 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). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over bird populations, the USFWS and/or the FWC could adjust take levels, including the take by WS, to ensure population objectives for bird species were achieved. Consultation and reporting of take by WS would ensure the USFWS and/or the FWC considered any activities conducted by WS. As stated previously, WS would not use those lethal methods available as population management tools over broad areas. WS would use lethal methods, including the use of DRC-1339, to reduce the number of birds present at a location where damage was occurring by targeting those birds causing damage or posing threats; therefore, the intent of lethal methods would be to manage those birds causing damage and not to manage entire bird populations.

WS' take of birds in Florida from FY 2012 through FY 2016 was of a low magnitude when compared to the total known take and when compared to available population information. The USFWS and the FWC considers all known take when determining population objectives for birds and could adjust the number of birds that could be taken during the regulated hunting season and the number of birds taken for damage management purposes to achieve the population objectives. Any take by WS would occur at the discretion of the USFWS and/or the FWC. Any bird population declines or increases induced through the regulation of take would be the collective objective for bird populations established by the USFWS and/or the FWC. Therefore, the cumulative take of birds annually or over time by WS would occur at the desire of the USFWS and/or the FWC as part of management objectives for birds in the state. No cumulative effects on target bird species would be expected from WS' damage management activities based on the following considerations:

Historical outcomes of WS' damage management activities on wildlife

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

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 lethal take 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. Because 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 often 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 dispersal methods would generally be temporary with non-target species returning after the cessation of those activities. Dispersal and harassment do not involve the lethal take 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 affect non-target wildlife through the lethal take 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 would be employed to confine or restrain target bird species that would be 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 because 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 affect non-target species.

Chemical methods available for use under the proposed action would be taste repellents, nicarbazin, mesurol, alpha chloralose, and DRC-1339, which are described in Appendix B. Except for repellents that would be applied directly to the affected resource, all chemical methods would be employed using baits that would be highly attractive to target species and would be used in areas where exposure to non-targets would be 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 the product label, which would 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 would be 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, would not have cumulative effects 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 were observed feeding on the pre-bait, the plots would be abandoned and no baiting would occur at those locations. Once sites were baited, sites would be monitored daily to observe for non-target feeding activity. If non-targets were observed feeding on bait, those sites would be abandoned. WS would retrieve all dead birds to the extent possible, following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

Only those repellents registered for use in the state by the EPA and the FDACS 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 would be 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 the applicator. When repellents that were registered for use by the EPA in accordance to the FIFRA were applied according to label requirements, no adverse effects to non-targets would be expected.

The active ingredient in numerous commercial repellents is methyl anthranilate, which is a derivative of grapes and sometimes 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 intended to prevent perching. Other bird repellents commonly registered contain the active ingredient anthraquinone, which is a naturally occurring plant extract. Characteristics of those chemicals and potential use patterns indicate that WS use of those products in Florida would have no significant cumulative impacts related to environmental fate when WS uses those products according to label requirements.

The use of immobilizing chemicals, reproductive inhibitors, and euthanasia methods are essentially selective for target species because identification of an individual is made prior to the application of the method. Immobilizing chemicals and reproductive inhibitors would be applied using hand baiting, which targets individuals or groups of target bird species that 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 would be 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 any non-targets to be released if captured. Therefore, the use of immobilizing chemicals, reproductive inhibitors, or euthanasia methods would not affect non-target species.

The methods described in Appendix B have a high level of selectivity and can be employed using SOPs to ensure minimal effects to non-target species. The WS program in Florida did not lethally remove any non-target animals unintentionally during activities to alleviate bird damage from FY 2012 through FY 2017. Based on the methods available to alleviate 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 of non-targets under the proposed action would not cumulatively affect non-target species. WS' has reviewed the T&E species and initiated consultation with the USFWS and the FWC. The USFWS and the FWC has concurred with WS' effects determinations for T&E species.

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 would be used after careful consideration of the safety of those people employing methods and to the public. Capture methods would be employed where human activity was 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 would be agreed upon by the requesting entities, which would be made aware of the safety issues of those methods when entering into a MOU, work initiation document, or another comparable document between WS and the cooperating entity. SOPs would also ensure the safety of the public from those methods used to capture or take wildlife. 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 the safety of the applicator and the public. Based on the use patterns of non-chemical methods, those methods would not cumulatively affect human safety.

Repellents to disperse birds from areas of application are available. All repellents must be registered with the EPA according to the FIFRA and registered for use in the state with the FDACS. 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 the applicator. When repellents were applied according to label requirements, no adverse effects to human safety would be expected.

Chemical methods available for use under the proposed action are repellents, reproductive inhibitors, immobilizing drugs, and euthanasia 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 of the chemical would not have cumulative impacts.

Additional repellents could 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 could be used by WS to manage damage or threats associated with birds in Florida. 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 applied to bait and placed in areas only after pre-baiting has occurred and only in those areas where non-target species are not present or would not be exposed to treated baits. Baits treated with DRC-1339 would be placed on platforms or other hard surfaces where they would seldom be exposed to soil, surface water, and/or ground water. All uneaten bait would be 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 (EPA 1995). Additionally, the relatively small quantity of DRC-1339 that could potentially be used in bird damage management programs in Florida, 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. There are no formulations of DRC-1339 currently registered for use in Florida and DRC-1339 has not been used by WS to manage bird damage in Florida. If DRC-1339 were registered in Florida, the use of DRC-1339 under the proposed action would not be expected to increase to a level that 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 Florida.

WS would only use the immobilizing drug alpha chloralose to capture waterfowl. To capture waterfowl, WS would insert alpha chloralose tablets into a dough ball made out of bread or WS would mix the powder form onto whole kernel corn or into bread baits. After an acclimation period where waterfowl are habituated to feeding on a 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. Because 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 would be required to attend training courses on the proper use of alpha chloralose and employees using alpha chloralose must be certified in the application of alpha chloralose. Training would ensure proper care and handling occurred, ensure that proper doses were administered, and 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 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. Carbon dioxide is considered a moderately rapid form of euthanasia (AVMA 2013). 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 used appropriately, the risks of exposure are minimal. Because carbon dioxide is a common gas found in the environment, the use of and/or recommending the use of carbon dioxide for euthanasia purposes will not have cumulative impacts.

The WS program in Florida has received no reports or documented any adverse effects to human safety from damage management activities conducted in Florida from FY 2012 through FY 2016. No cumulative effects from the use of those methods discussed in Appendix B would be expected given the use patterns of those methods for resolving bird damage in the state. For these reasons, WS concludes that the use of methods would not create an environmental health or safety risk to children from implementing the proposed action. It is not anticipated that the proposed action or the other alternatives would result in any adverse or disproportionate environmental impacts to minorities or persons and populations of low-income people.

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 droppings by high bird densities found under roost areas.

Some people experience a decrease in the 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/or the FWC through the regulating of take after consideration of other known mortality factors. Therefore, WS has no direct impact on the status of the bird population because all take by WS occurs at the discretion of the USFWS and/or the FWC. Because those people seeking assistance could remove birds from areas where damage was occurring with or without a permit from the USFWS and/or the FWC, WS' involvement would have no effect on 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 would not be 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 would employ 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 to ensure SOPs were 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.

CHAPTER 5: RESPONSES TO PUBLIC COMMENTS

WS made the EA available to the public for review and comment by a legal notice published in the *Tallahassee Democrat* newspaper from April 23, 2018 through April 25, 2018. WS also made the EA available to the public for review and comment on the APHIS website on April 18, 2018 and on the federal e-rulemaking portal at the regulations.gov website beginning on April 17, 2018. WS also sent a notice of availability directly to agencies, organizations, and individuals with probable interest in managing bird damage in the state. The public involvement process ended on June 1, 2018.

5.1 SUMMARY OF PUBLIC COMMENTS AND WS' RESPONSES TO THE COMMENTS

During the public comment period, WS received three comment responses related to the draft EA; however, two of the comment responses were from the same commenter and those two comment responses were nearly identical.

Comment – WS wants to kill all wildlife

Response: The WS Decision Model would be the implementing mechanism for a damage management program under applicable alternatives that WS' personnel would adapt to an individual damage situation. When WS receives a request for direct operational assistance, WS would conduct site visits to assess the damage or threats, would identify the cause of the damage, and would apply the Decision Model described by Slate et al. (1992) and WS Directive 2.201 to determine the appropriate methods to resolve or prevent damage. Discussion of the Decision Model and WS' use of the Model occurs in Section 3.1 of the EA. When using the Model, WS would give preference to non-lethal methods when practical and effective (see WS Directive 2.101). Appendix B in the EA discusses many non-lethal methods that WS' personnel could recommend or employ to resolve damage under the applicable alternatives. As discussed in Section 4.1, WS has used non-lethal methods to haze many bird species. For example, WS harassed 574,433 laughing gulls from FY 2012 through FY 2016 in Florida to reduce damage. 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.

Comment – WS sneaks into areas with no notice to anyone

Response: The WS program only provides assistance after receiving a request for such assistance and only after the entity requesting assistance and WS sign a MOU, work initiation document, or another similar document. Therefore, the decision-maker for what activities WS conducts is the entity that owns or manages the affected property. The decision-makers have the discretion to involve others as to what occurs or does not occur on property they own or manage. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree others were involved in the decision-making process would be a decision made by that individual. Section 3.1 in the EA discusses the decision-making process associated with communities, private property owners, and public property managers.

Comment – WS uses lethal methods just for the money

Response: Funding for WS' activities could occur from federal appropriations, through state funding, and/or through money received from the entity requesting assistance. In most cases, those entities requesting assistance would provide the funding for activities conducted by WS. Therefore, the activities that WS' personnel provide would be the basis for funding, not whether WS' employees use non-lethal or lethal methods. If the WS program provided assistance using only non-lethal methods, the program would continue to be mostly fee-based. As shown in Section 4.1, WS has previously used non-lethal methods to address bird damage and, if WS implements Alternative 1, WS would continue to use non-lethal methods as part of an integrated methods approach to resolving bird damage.

Comment – WS only provides assistance to farmers and ignores input from other entities

Response: Although WS could provide assistance to manage damage to agricultural resources caused by birds, WS could also provide assistance to manage damage to property and natural resources caused by birds. In addition, WS could provide assistance to alleviate threats to human health and safety (see Section 1.2). Therefore, WS could provide assistance to a variety of entities. In addition, WS provided the public an opportunity to comment on the draft EA to identify new issues, alternatives, and concerns. WS fully considered the comments to determine whether WS should revisit the EA and, if appropriate, revise the EA prior to issuance of a Decision.

Comment – WS should receive no taxpayer funding; WS should shutdown

Response: WS identified an alternative approach that would require cooperators completely fund activities (see Section 3.2). However, WS did not consider the alternative in detail for the reasons provided in Section 3.2. In those cases where WS receives federal and/or state funding to conduct activities, federal, state, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility.

Comment – Agencies must establish what causes harm to birds to act accordingly, including a need to know what species are most vulnerable to a specific hazard, determine what season of the year birds are most exposed to hazards, and the impacts of birds ingesting pieces of disintegrated balloons

Response: As discussed in Section 2.2, a common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. As discussed in Section 4.1 and Section 4.2, the activities that WS could conduct would be occurring simultaneously, over time, with other natural processes and human generated changes, which can all play a role in the dynamics of bird populations. The evaluation of potential effects of damage management activities on target bird populations in Section 4.1 are inherently cumulative impact analyses because WS considered known sources of mortality of each bird species. In addition, the take of many bird species can only occur when authorized by the USFWS and/or the FWC and only at the levels permitted by the USFWS and/or the FWC. The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the FWC has the authority to manage wildlife populations in the State of Florida. WS would maintain ongoing contact with the USFWS and the FWC to ensure activities occurred within management objectives for target bird species. WS would submit annual activity reports to the USFWS and, when required, to the FWC. Therefore, the USFWS and the FWC would have the opportunity to monitor the total take of birds from all sources and could factor in survival rates from predation, disease, and other mortality data. Ongoing contact with the USFWS and the FWC would assure those agencies have the opportunity to consider local, state, and regional knowledge of bird population trends. The USFWS and the FWC, 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 USFWS and/or the FWC would have the opportunity to adjust the number of birds lethally taken annually through hunting, depredation permits, and under the depredation/control orders based on population information.

Comment – There is a need to conduct assessments to determine the effects of pesticides on birds

Response: The EPA is responsible for implementing and enforcing the FIFRA, which regulates the registration and use of pesticides, including avicides and repellents available for use to manage bird damage. The use of avicides and repellents by WS would be regulated by the EPA through the FIFRA, by the FDACS, and by WS' directives. The WS program would only employ those products that are registered with the EPA and the FDACS. 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. Personnel of WS would follow EPA-approved label directions for all pesticide use (see WS Directive 2.401). In addition, Section 4.1 evaluates the risks to non-target animals associated with those chemical methods that WS could use to manage damage caused by target bird species.

Comment – The need to provide green areas for birds to use that include fresh water and food

Response: As discussed in Section 1.6, the WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with animals. Therefore, establishing green areas for birds, providing fresh water, and food are outside the authority of the WS program.

CHAPTER 6 - LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

6.1 LIST OF PREPARERS

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6.2 LIST OF PERSONS CONSULTED AND REVIEWERS

Roger Shields, Public Hunting Areas Biologist	FWC
Joe Benedict, Waterfowl Management Program Coordinator	FWC
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APPENDIX A
LITERATURE CITED

Addison, L. R., and J. Amernic. 1983. An uneasy truce with the Canada goose. Intern. Wildl. 13:12-14.

Aderman, A. R., and E. P. Hill. 1995. Locations and numbers of double-crested cormorants using winter roosts in the Delta region of Mississippi. Pages 143–151 *in* The double-crested cormorant: biology, conservation and management. D. N. Nettleship and D. C. Duffy, editors. Colonial Waterbirds 18 (Special Publication 1).

Aguilera, E., R. L. Knight, and J. L. Cummings. 1991. An evaluation of two hazing methods for urban Canada geese. Wildlife Society Bulletin 19:32-35.

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

Alexander, D. J. 2000. A review of avian influenza in different bird species. Veterinary Microbiology 74:3–13.

Alexander, D. J. and D. A. Senne. 2008. Newcastle disease and other avian paramyxoviruses, and pneumovirus infections. Pages 75–141 *in* Y. M. Saif, editor. Diseases of Poultry, Twelfth Edition. Blackwell Publishing, Ames, Iowa, USA.

Alge, T. L. 1999. Airport bird threat in North America from large flocking birds, (geese) as viewed by an engine manufacturer. Proceedings of the 1st Joint Birdstrike Committee - USA/Canada. 9 April 1999. Vancouver, British Columbia, Canada.

Allan, J. R. 2002. The costs of bird strikes and bird strike prevention. Pages 147–155 in L. Clark, ed. Proceedings of the National Wildlife Research Center symposium, human conflicts with wildlife: economic considerations, U.S. Department of Agriculture, National Wildlife Research Center, Fort Collins, Colorado, USA.

Allan, J. R., J. S. Kirby, and C. J. Feare. 1995. The biology of Canada geese, Branta Canadensis in relation to the management of feral populations. Wildlife Biology 1:129–143.

Allen, H. A., D. Sammons, R. Brinsfield, and R. Limpert. 1985. The effects of Canada goose grazing on winter wheat: an experimental approach. Proceedings Eastern Wildlife Damage Control Conference 2:135–141.

Allen, R. W., and M. M. Nice. 1952. A study of the breeding biology of the Purple Martin (*Progne subis*). American Midland Naturalist 47:606–665.

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. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. American Veterinary Medical Association. https://www.avma.org/KB/Policies/Pages/Euthanasia-Guidelines.aspx. Accessed July 5, 2017.

Ankney, C. D. 1996. An embarrassment of riches: too many geese. Journal of Wildlife Management 60:217-223.

Anteau, M. J., J.-M. DeVink, D. N. Koons, J. E. Austin, C. M. Custer and A. D. Afton. 2014. Lesser Scaup (*Aythya affinis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/lessca. Accessed July 17, 2017.

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. 1999. Atlantic Flyway resident Canada Goose management plan. Atlantic Flyway Council, Atlantic Flyway Technical Section, Canada goose Committee.

Atlantic Flyway Council. 2011. Atlantic Flyway resident Canada Goose management plan. Atlantic Flyway Council, Atlantic Flyway Technical Section, Canada goose Committee.

Atlantic Flyway Council. 2015. Atlantic Flyway Mute Swan management plan. Atlantic Flyway Council, Atlantic Flyway Technical Section, Snow Goose, Brant, and Swan Committee.

Atlantic Flyway Council and Mississippi Flyway Council. 2010. Atlantic and Mississippi Flyways Double-crested Cormorant management plan. Cormorant Ad hoc Committees, Atlantic and Mississippi Flyway Council, Nongame Migratory Bird Technical Section. 12 pp.

Aubin, T. 1990. Synthetic bird calls and their application to scaring methods. Ibis 132:290-299.

Avery, M. L. 1994. Finding good food and avoiding bad food: does it help to associate with experienced flockmates? Anim. Behav. 48:1371-1378.

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., E. A. Tillman, and J. S. Humphrey. 2008*a*. 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., E. A. Tillman, K. L. Keacher, J. E. Arnett, and K. J. Lundy. 2012. Biology of invasive Monk parakeets in south Florida. Wilson Journal of Ornithology 124:581-588.

Avery, M. L., E. C. Greiner, J. R. Lindsay, J. R. Newman, and S. Pruett-Jones. 2002*a*. Monk parakeet management at electric utility facilities in south Florida. Proceedings of the Vertebrate Pest Conference 20:140–145.

Avery, M. L., J. R. Lindsay, J. R. Newman, S. Pruett-Jones, and E. A. Tillman. 2006*a*. Reducing monk parakeet impacts to electric utility facilities in South Florida. Pp. 125-136 *in* e. C. J. Feare and D. P.Cowan, eds. Advances in vertebrate pest management, Vol IV. Filander Verlag, Furth, Federal Republic of Germany.

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., J. S. Humphrey, E. A. Tillman, K. O. Phares, and J. E. Hatcher. 2002*b*. Dispersing vulture roosts on communication towers. Journal of Raptor Research 36:45–50.

Avery, M. L., J. W. Nelson, and M. A. Cone. 1992. Survey of bird damage to blueberries in North America. Proc. East. Wildl. Damage Control Conf. 5:105-110.

Avery, M. L., K. L. Keacher, and E. A. Tillman. 2006*b*. Development of nicarbazin bait for managing rock pigeon populations. Pp. 116-120 *in* R.M. Timm and J. M. O'Brien eds. Proceedings of the 22nd Vertebrate Pest Conference. University of California-Davis, Davis California 95616.

Avery, M. L., K. L. Keacher, and E. A. Tillman. 2008*b*. Nicarbazin bait reduces reproduction by pigeons (*Columba livia*). Wildlife Research 35:80-85.

Barnes, T. G. 1991. Eastern bluebirds, nesting structure design and placement. College of Agric. Ext. Publ. FOR-52. Univ. of Kentucky, Lexington, Kentucky. 4 pp.

Bateson, P. 1991. Assessment of pain in animals. Animal Behaviour, 42:827-839.

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 American Veterinary Association Panel on Euthanasia. Journal of the American Veterinary Association 218:669–696.

Bechard, M. J., and J. M. Bechard. 1996. Competition for nestboxes between American kestrels and European starlings in an agricultural area of southern Idaho. Pages 155–162 *in* D. M. Bird, D. E. Varland, J. J. Negro. Raptors in human landscapes: adaptations to built and cultivated environments. Academic Press, San Diego, CA, USA.

Becker, P. H. 1995. Effects of coloniality on gull predation on Common Tern (Sterna hirundo) chicks. Colonial Waterbirds 18:11-22.

Bedard, J., and G. Gauthier. 1986. Assessment of fecal output in geese. J. Appl. Ecol. 23:77-90.

Bedard, J., A. Nadeau, and M. Lepage. 1995. Double-crested cormorant culling in the St. Lawrence River Estuary. Colonial Waterbirds 18 (Spec. Pub. 1): 78-85.

Bedard, J., A. Nadeau, and M. Lepage. 1999. Double-crested cormorant culling in the St. 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. Population status of nesting Laughing Gulls in the United States: 1977-1991. Am. Birds 47:220-224.

Belant, J. L., T. W. Seamans, S. W. Gabrey, and R. A. Dolbeer. 1995. Abundance of gulls and other birds at landfills in northern Ohio. Am. Midl. Nat. 134:30-40.

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, L. A. Tyson, and S. K. Ickes. 1996. Repellency of methyl anthranilate to pre-exposed and naive Canada geese. Journal of Wildlife Management 60:923-928.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Stackpole Books. Harrisburg, PA. 540 pp.

Benson, D., S. Browne, and J. Moser. 1982. Evaluation of hand-reared goose stocking. Final Rep. Fed. Aid Project W-39-R, Job No. IV-2,N.Y. state Dep. Environ. Conserv., Bureau of Wildlife, Delmar. 24 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 Report No. 340. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado, USA.

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

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

Bielefeld, R. R., M. G. Brasher, T. E. Moorman, and P. N. Gray. 2010. Mottled Duck (*Anas fulvigula*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/motduc. Accessed July 17, 2017.

Bierregaard, R. O., A. F. Poole, M. S. Martell, P. Pyle and M. A. Patten. 2016. Osprey (*Pandion haliaetus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/osprey. Accessed July 17, 2017.

BirdLife International. 2016*a*. *Chordeiles minor*. The IUCN Red List of Threatened Species 2016: e.T22689714A93244252. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22689714A93244252.en. Accessed April 17, 2018.

BirdLife International. 2016*b*. *Elanoides forficatus*. The IUCN Red List of Threatened Species 2016: e.T22695017A93484824. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695017A93484824.en. Accessed April 17, 2018.

BirdLife International. 2016*c*. *Ictinia mississippiensis*. The IUCN Red List of Threatened Species 2016: e.T22695066A93488215. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695066A93488215.en. Accessed April 17, 2018.

BirdLife International. 2016*d*. *Progne subis*. The IUCN Red List of Threatened Species 2016: e.T22712098A94319217. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22712098A94319217.en. Accessed April 17, 2018.

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

Blancher, P. J., K. V. Rosenberg, A. O. Panjabi, B. Altman, A. R. Couturier, W. E. Thogmartin, and the Partners in Flight Science Committee. 2013. Handbook to the Partners in Flight Population Estimates Database, Version 2.0. PIF Technical Series No 6.

Blanton, K. M., B. U. Constantine, and G. L. Williams. 1991. Efficacy and methodology of urban pigeon control with DRC-1339. Proceedings of the Eastern Wildlife Damage Control Conference 5:58-62.

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

Blokpoel, H., and W. C. Scharf. 1991. The ring-billed gull in the Great Lakes of North America. Proceedings of the International Ornithological Congress 20:2372–2377.

Blunden, J., and D. S. Arndt, Eds. 2013. State of the climate in 2012. Bulletin of the American Meteorological Society 94:S1-S238.

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

Bonner, B. M., W. Lutz, S. Jager, T. Redmann, B. Reinhardt, U. Reichel, V. Krajewski, R. Weiss, J. Wissing, W. Knickmeier, H. Gerlich, U. C. Wend, and E. F. Kaleta. 2004. Do Canada geese (Branta canadensis Linnaeus, 1758) carry infectious agents for birds and man? European Journal of Wildlife Research 50:78–84.

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.

Bradshaw, J. E., and D. O. Trainer. 1966. Some Infectious Diseases of Waterfowl in the Mississippi Flyway. Journal of Wildlife Management 30:5705–76.

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

Breault, A. M., and R. W. McKelvey. 1991. Canada geese in the Fraser Valley. Canadian Wildl. Svc. Tech. Rpt. Series No. 133. 42 pp.

Brigham, R. M., J. Ng, R. G. Poulin, and S. D. Grindal. 2011. Common Nighthawk (*Chordeiles minor*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/comnig. Accessed July 17, 2017.

Brisbin Jr., I. L., and T. B. Mowbray. 2002. American Coot (*Fulica americana*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/y00475. Accessed July 17, 2017.

Brough, T. 1969. The dispersal of starlings from woodland roosts and the use of bio-accoustics. J. Appl. Ecol. 6:403-410.

Brown, C. R., and M. B. Brown. 1999. Barn Swallow (*Hirundo rustica*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/barswa. Accessed July 17, 2017.

Brown, C. R., and S. Tarof. 2013. Purple Martin (*Progne subis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/purmar. Accessed July 17, 2017.

Brown, J. D., D. E. Stallknecht, J. R. Beck, D. L. Suarez, and D. E. Swayne. 2006. Susceptibility of North American ducks and gulls to H5N1 highly pathogenic avian influenza viruses. Emerging Infectious Diseases 12:1663–1670.

Brown, S., C. Hickey, B. Harrington, and R. Gill, editors. 2001. The U.S. Shorebird Conservation Plan, 2nd edition. Manomet Center for Conservation Science, Manomet, MA, USA.

Brown, T. J., M. J. Donaghy, E. A. Keys, G. Ionas, J. J. Learmonth, P. A. McLenachan, and J. K. Clarke. 1999. The Viability of Giardia intestinalis and Giardia muris cysts in seawater. International Journal of Environmental Health Research 9:157–161.

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.

Bruggers, R. L., J. E. Brooks, R. A. Dolbeer, P. P. Woronecki, R. K. Pandit, T. Tarimo, All-India, and M. Hoque. 1986. Responses of pest birds to reflecting tape in agriculture. Wildl. Soc. Bull. 14:161-170.

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.

Buchanan, J. B. 2011. Reactions of Dunlins *Calidris alpine* to Turkey Vultures *Cathartes aura* in western Washington, USA. Wader Study Group Bulletin 118:189-190.

Buckley, N. J. 1999. Black Vulture (*Coragyps atratus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/blkvul. Accessed July 17, 2017.

Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/baleag. Accessed July 17, 2017.

Buhler, R. D., J. D. Lambley, and T. Sim IV. 2001. Pest Risk Analysis for the Monk Parakeet in Kansas. Kansas Dept. Agriculture, Plant Protection Program.

Bull, J. 1973. Exotic birds in the New York City area. Wilson Bulletin 85:501-505.

Bull, J. and J. Farrand, Jr. 1977. The Audubon Society Field Guide to North American Birds, Eastern Region. Alfred A. Knopf, Inc., New York, New York.

Burger, J. 1978. Competition between Cattle Egrets and native North American herons, egrets, and ibises. Condor 80: 15–23.

Burger, J. 2015. Laughing Gull (*Leucophaeus atricilla*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/laugul. Accessed July 17, 2017.

Burgio, K. 2012. University of Connecticut Monk Parakeet Research. Website accessed 9 March 2012. http://www.eeb.uconn.edu/people/burgio/index.htm#start.

Burgio, K. R., C. B. van Rees, K. E. Block, P. Pyle, M. A. Patten, M. F. Spreyer, and E. H. Bucher. 2016. Monk Parakeet (*Myiopsitta monachus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/monpar. Accessed July 17, 2017.

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.

Cabe, P. R. 1993. European Starling (*Sturnus vulgaris*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/eursta. Accessed July 17, 2017.

Cagle, S. 1998. Four streams tagged for water quality. Roanoke Times, Roanoke, Virginia. June 11, 1998.

California Department of Fish and Game. 1991. Final environmental document , Sections 265, 365, 366, 367, 367.5 Title 14, California Code of Regulations regarding bear hunting. State of California, Department of Fish and Game, Sacramento, California, USA.

California Department of Pesticide Regulation. 2007. California Department of Pesticide Regulation Public Report 2007-8. http://www.cdpr.ca.gov/docs/registration/ais/publicreports/5944.pdf. Accessed July 17, 2017.

Campbell, J. M., L. P. Gauriloff, H. M. Domske , and E. C. Obert. 2001. Environmental Correlates with Outbreaks of Type E Avian Botulism in the Great Lakes. Botulism in Lake Erie, Workshop Proceedings, 24–25 January 2001, Erie, Pennsylvania, USA.

Carlson, J. C., A. B. Franklin, D. R. Hyatt, S. E. Pettit, G. M. Linz. 2010. The role of starlings in the spread of Salmonella within concentrated animal feeding operations. Applied Ecology 48:479–486.

Carlson, J. C., G. M. Linz, L. R. Ballweber, S. A. Elmore, S. E. Pettit, A. B. Franklin. 2011*b*. The role of European starlings in the spread of coccidian within concentrated animal feeding operations. Veterinary Parasitology 180:340–343.

Carlson, J. C., R. M. Engeman, D. R. Hyatt, R. L. Gilliland, T. J. DeLiberto, L. Clark, M. J. Bodenchuk, and G. M. Linz. 2011*a*. Efficacy of a European starling control to reduce Salmonella enterica contamination in a concentrated animal feeding operation in the Texas panhandle. BMC Veterinary Research 7:9.

Castelli, P. M., and S. E. Sleggs. 2000. The efficacy of border collies for nuisance goose control. Wildlife Society Bulletin 28:385-293.

CDC. 1998. Cryptosporidiosis: Fact Sheet. Nat. Center for Infect. Dis., Div. Paras. Dis. 3 pp. CDC. 2012. Parasites - Giardia. National Center for Emerging and Zoonotic Infectious Diseases, Division of Foodborne, Waterborne, and Environmental Diseases. <http://www.cdc.gov/parasites/giardia>. Accessed August 18, 2016.

CDC. 2012. Parasites - Giardia. National Center for Emerging and Zoonotic Infectious Diseases, Division of Foodborne, Waterborne, and Environmental Diseases. <http://www.cdc.gov/parasites/giardia>. Accessed August 18, 2016.

CDC. 2014. Campylobacter. National Center for Emerging and Zoonotic Infectious Diseases, Division of Foodborne, Waterborne, and Environmental Diseases. <http://www.cdc.gov/nczved/divisions/dfbmd/diseases/campylobacter>. Accessed August 18, 2016.

CDC. 2015. Parasites - Cryptosporidium (also known as "Crypto"). http://www.cdc.gov/parasites/crypto/index.html. Accessed February 24, 2015.

Center for Food Safety and Applied Nutrition. 2012. Bad Bug Book: Foodborne Pathogenic Microorganisms and Natural Toxins Handbook. Second edition. U.S. Food and Drug Administration, Washington, D.C., USA.

Cernicchiaro, N., D. L. Pearl, S. A. McEwen, L. Harpster, H. J. Homan, G. M. Linz, and J. T. LeJeune. 2012. Association of Wild Bird Density and Farm Management Factors with the Prevalence of E. coli O157 in Dairy Herds in Ohio (2007–2009). Zoonoses and Public Health 59:320–329.

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. 1997. Dermal contact repellents for European Starlings: foot exposure to natural plant products. Journal of Wildlife Management 61:1352-1358.

Clark, L. 2003. A review of pathogens of agricultural and human health interest found in Canada geese. Pages 326-334 in Proceedings of the 10th Wildlife Damage Management Conference (K. A. Fagerstone and G. W. Witmer, Eds.). The Wildlife Society, Fort Collins, Colorado.

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

Clark, L. and R. G. McLean. 2003. A review of pathogens of agricultural and human health interest found in blackbirds. Pages 103-108 *In* G. M. Linz, ed., Management of North American blackbirds. Proceedings of a special symposium of the Wildlife Society 9th Annual Conference. Bismarck, North Dakota, September 27, 2002.

Clark, S. L., and R. L. Jarvis. 1978. Effects of winter grazing by geese on yield of ryegrass seed. Wildlife Society Bulletin 6:84–87.

Cleary, E. C. 1994. Waterfowl. Pages E129–138 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Coates, R. W., M. J. Delwiche, W. P. Gorenzel, and T. P. Salmon. 2012. A model to predict the likelihood of cliff swallow nesting on highway structures in northern California. Human-Wildlife Interactions 6:261–272.

Cole, D., D. J. V. Drum, D. E. Stallknecht, D. G. White, M. D. Lee, S. Ayers, M. Sobsey, and J. J. Maurer. 2005. Free-living Canada geese and antimicrobial resistance. Emerging Infectious Diseases. 11:935-938.

Colley, D. G. 1995. Waterborne Cryptosporidiosis threat addressed. Centers for Disease Control and Prevention. Atlanta, GA. https://wwwnc.cdc.gov/eid/article/1/2/95-2011_article. Accessed July 17, 2017.

Conomy, J. T., J. A. Collazo, J. A. Dubovsky, and W. J. Fleming. 1998. Dabbling duck behavior and aircraft activity in coastal North Carolina. Journal of Wildlife Management 62:1127-1134.

Conover, M. R. 1984. Comparative effectiveness of avitrol, exploders, and hawk-kites in reducing blackbird damage to corn. Journal of Wildlife Management 48:109-116.

Conover, M. R. 1985. (abstract only). Management of nuisance Canada goose flocks. Proc. East. Wildl. Damage Control Conf. 2:155.

Conover, M. R. 1988. Effect of grazing by Canada geese on the winter growth of rye. Journal of Wildlife Management 52:76–80.

Conover, M. R. 1991. Herbivory by Canada geese: diet selection and its effect on lawns. Ecological Applications 1:231–236.

Conover, M. R. 1992. Ecological approach to managing problems caused by urban Canada geese. Proc. Vert. Pest Conf. 15:110-111.

Conover, M. R. 2002. Resolving human-wildlife conflicts: the science of wildlife-damage management. Lewis Publishers, Washington, D.C., USA.

Conover, M. R., and G. Chasko. 1985. Nuisance Canada geese problems in the eastern United States. Wildlife Society Bulletin 13:228–232.

Conover, M. R., and R. A. Dolbeer. 1989. Reflecting tapes fail to reduce blackbird damage to ripening cornfields. Wildlife Society Bulletin 17:441-443.

Conover, M. R., and G. S. Kania. 1991. Characteristics of feeding sites used by urban-suburban flocks of Canada geese in Connecticut. Wildlife Society Bulletin 19:36-38.

Conover, M. R., W. C. Pitt, K. K. Kessler, T. J. Dubow, and W. A. Sanborn. 1995. Review of human injuries, illnesses and economic-based losses caused by wildlife in the United States. Wildlife Society Bulletin 23:407–414.

Cooper, J. A. 1991. Canada goose management at the Minneapolis, St. Paul International Airport. Pp. 175-183 *in* Adams, L.W. and Leedy, D.L., Eds. Wildlife Conservation in Metropolitan Environments. Proceedings of the National Symposium on Urban Wildlife, National Institute for Urban Wildlife, Columbia, Maryland.

Cooper, J. A. 1998. The potential for managing urban Canada geese by modifying habitat. Proc. Vert. Pest Conf. 18:18-25.

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

Coulson, J. C., J. Butterfield, and C. Thomas. 1983. The herring gull *Larus argentatus* as a likely transmitting agent of Salmonella montevideo to sheep and cattle. Journal of Hygiene London 91:437–43.

Coulter, M. C., J. A. Rodgers Jr., J. C. Ogden, and F. C. Depkin. 1999. Wood Stork (*Mycteria americana*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/woosto. Accessed July 17, 2017.

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. Bulletin of Environmental Contamination and Toxicology 63:312–319.

Craven, S., T. Barnes, and G. Kania. 1998. Toward a professional position on the translocation of problem wildlife. Wildlife Society Bulletin 26:171-177.

Craven, S. E., N. J. Stern, E. Line, J. S. Bailey, N. A. Cox and P. Fedorka-Cray. 2000. Determination of the incidence of *salmonella* spp., c*ampylobacter jejuni*, and *clostridium perfringens* in wild birds near broiler chicken houses by sampling intestinal droppings. Avian Diseases 44:715–720.

Crisley, R. D., V. R. Dowell, and R. Angelotti. 1968. Avian botulism in a mixed population of resident ducks in an urban river setting. Bull. Wildl. Dis. Assoc. 4:70-77.

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. 2016. Geese, ducks, and coots. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 22 pp.

Cummings, J. L., J. E. Glahn, E. A. Wilson, J. E. Davis Jr., D. L. Bergman, and G. A. Harper. 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.

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.

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 night herons in the U.S. Great Lakes Region. Journal of Great Lakes Research 28:145–154.

Daniels, M. J, M. R. Hutchings, and A. Greig. 2003. The risk of disease transmission to livestock posed by contamination of farm stored feed by wildlife excreta. Epidemiology and Infection 130:561–568.

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

Davidson, W. R., and V. F. Nettles. 1997. Field manual of wildlife diseases in the southeastern United States. Second edition. Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, The University of Georgia, Athens, Georgia, USA.

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 G. R. Goff. 1987. Valuing wildlife: Economic and social perspectives. Westview Press. Boulder, Colorado, USA.

Decker, D. J., and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildlife Society Bulletin 16:53–57.

Decker, D. J., and L. C. Chase. 1997. Human dimensions of living with wildlife—a management challenge for the 21st century. Wildlife Society Bulletin 25:788–795.

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

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

Delacour, J. 1954. The Waterfowl of the World. Vol. 1. Country Life Ltd., London. 284 pp.

Deliberto, T. J., S. R. Swafford, D. L. Nolte, K. Pedersen, M. W. Lutman, B. B.Schmit, J. A. Baroch, D. J. Kohler, and A. Franklin. 2009. Surveillance for highly pathogenic avian influenza in wild birds in the USA. Integrative Zoology. 4: 426-539.

Depenbusch, B. E., J. S. Drouillard, and C. D. Lee. 2011. Feed depredation by European starlings in a Kansas feedlot. Human–Wildlife Interactions 5:58–65.

DeVault, T. L., J. L. Belant, B. F. Blackwell, and T. W. Seamans. 2011. Interspecific variation in wildlife hazards to aircraft: implications for wildlife hazard management. Wildlife Society Bulletin 35:394-402.

Dill, H. H. and F. B. Lee, eds. 1970. Home Grown Honkers. U.S. Fish and Wildlife Service, Washington, D.C. 154 pp.

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.

Docherty, D. E., and M. Friend. 1999. Newcastle disease. Pages 175–179 *in* M. Friend and J. C. Franson, editors. Field Manual of Wildlife Diseases: general field. U.S. Department of the Interior, U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin, USA.

Dolbeer, R. A. 1994. Blackbirds. Pages E25–32 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

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. Proceedings of the Vertebrate Pest Conference 19:37–43.

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

Dolbeer, R. A., J. L. Belant, and J. L. Sillings. 1993*a*. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport. Wildlife Society Bulletin 21:442-450.

Dolbeer, R. A., J. L. Belant, and L. Clark. 1993*b*. Methyl anduanilate formulations to repel birds from water at airports and food at landfills. Proceedings of the Great Plains Wildlife Damage Control Workshop 11:42-52.

Dolbeer, R. A., and J. L. Seubert. 2006. Canada goose populations and strikes with civil aircraft: positive trends for aviation industry. Proceedings of the 8th Bird Strike Committee-USA/Canada. 21-24 August 2005, St. Louis, Missouri, USA.

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., M. A. Link, and P. P. Woronecki. 1988. Naphthalene shows no repellency for European Starlings. Wildlife Society Bulletin. 16:62-64.

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 Bulletin 90:31–44.

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

Dolbeer, R. A., S. E. Wright, J. R. Weller, and M. J. Begier. 2014. Wildlife Strikes to civil aircraft in the United States 1990–2012, Serial Report 20. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Washington, D.C., USA.

Dolbeer, R. A., S. E. Wright, J. R. Weller, A. L. Anderson, and M. J. Begier. 2015. Wildlife strikes to civil aircraft in the United States 1990–2014, Serial report 21. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Washington, D.C., USA.

Dolbeer, R. A., S. E. Wright, J. Weller, and M. J. Begier. 2016. Wildlife strikes to civil aircraft in the United States, 1990-2015. Federal Aviation Administration, National Wildlife Strike Database, Serial Report #22. Office of Airport Safety and Standards, Washington, D.C.

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.

Dolton, D. D., K. Parker, and R. D. Rau. 2008. Mourning dove population status, 2008. Pages 1-21 *in* Mourning dove, white-winged dove, and band-tailed pigeon population status, 2008. U.S. Fish and Wildlife Service, Laurel, Maryland. USA.

Donaldson, C. W. 2003. Paintball toxicosis in dogs. Veterinary Medicine 98(12): 995-997.

Dorr, B. S., J. J. Hatch, and D. V. Weseloh. 2014. Double-crested Cormorant (*Phalacrocorax auritus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/doccor. Accessed July 17, 2017.

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. D. Titman, and F. McKinney. 2002. Mallard (*Anas platyrhynchos*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/mallar. Accessed July 17, 2017.

Duncan, R. M., and W. I. Jensen. 1976. A relationship between avian carcasses and living invertebrates in the epizootiology of avian botulism. Journal of Wildlife Disease 12:116–126.

Dykstra, C. R., J. L. Hays, and S. T. Crocoll. 2008. Red-shouldered Hawk (*Buteo lineatus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/reshaw. Accessed July 17, 2017.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birders handbook: A field guide to the natural history of North American birds. Simon and Schuster, Inc. New York.

Eisenmann, E. 1963. Is the black vulture migratory? Wilson Bulletin 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.

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). US EPA, Prevention, Pesticides and Toxic Substances. EPA-738-F-96-003.

EPA. 1998. Anthraquinone (122701) Fact Sheet. https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_PC-122701_01-Dec-98.pdf. Accessed July 17, 2017.

EPA. 1999. ECOFRAM terrestrial draft report. Ecological Committee on FIFRA Risk Assessment Methods. U. S. Environmental Protection Agency, Washington, D. C. https://www.epa.gov/sites/production/files/2015-08/documents/terrreport.pdf. Accessed July 17, 2017.

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

EPA. 2016. Climate change on ecosystems. https://www.epa.gov/climate-impacts/climate-impacts-ecosystems. Accessed October 11, 2016.

Eskildsen, U. K., and Vestergard-Jorgensen, P. E. 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. 1988. Report of the EIFAC Working Party on prevention and control of bird predation in aquaculture and fisheries operations. EIFAC Technical Paper 51, Rome, Italy.

Evans, D., J. L. Byford, and R. H. Wainberg. 1984. A characterization of woodpecker damage to houses in east Tennessee. Proceedings of the Eastern Wildlife Damage Control Conference 1:325–329.

Fair, J., E. Paul, and J. Jones, eds. 2010. Guidelines to the use of wild birds in research. Ornithological Council, Washington, D.C., USA.

Fairaizl, S. D. 1992. An integrated approach to the management of urban Canada geese depredations. Verteb. Pest. Conf. 15:105-109.

Fairaizl, S. D., and W. K. Pfeifer. 1988. The lure crop alternative. Great Plains Wildl. Damage Cont. Workshop 8:163-168.

Fallacara, D. M., C. M. Monahan, T. Y. Morishita, and R. F. Wack. 2001. Fecal Shedding and Antimicrobial Susceptibility of Selected Bacterial Pathogens and a Survey of Intestinal Parasites in Free-Living Waterfowl. Avian Diseases 45:128–135.

Fallacara, D. M., C. M. Monahan, T. Y. Morishita, C. A. Bremer and R. F. Wack. 2004. Survey of parasites and bacterial pathogens from free-living waterfowl in zoological settings. Avian Diseases 48:759–767.

Farraway, A., K. Thomas, H. Blokpoel. 1986. Common Tern Egg Predation by Ruddy Turnstones'. The Condor 88:521-522.

Faulkner, C. E. 1966. Blackbird depredations in animal industry: poultry ranges and hog lots. Proceedings of the Bird Control Seminar 3:110–116.

FAA. 2017. National Wildlife Strike Database. http://wildlife.faa.gov/default.aspx. Accessed May 12, 2017.

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

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

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. Birds as vectors of enteric pathogenic bacteria. Journal of Applied Bacteriology 51:13-14.

FWC. 2003. Florida's breeding bird atlas: A collaborative study of Florida's birdlife. http://myfwc.com/bba. Accessed July 17, 2017.

FWC. 2012. Florida's Wildlife Legacy Initiative: Florida's State Wildlife Action Plan. Tallahassee, Florida, USA.

FWC. 2017. Florida 2017-2018 hunting regulations. Florida Fish and Wildlife Commission. Tallahassee, Florida.

FWC. 2018*a*. Wild turkey management program. Florida Fish and Wildlife Conservation Commission website. http://myfwc.com/hunting/by-species/turkey/. Accessed April 17, 2018.

FWC. 2018*b*. Peregrine falcon: *Falco peregrinus*. Florida Fish and Wildlife Conservation Commission website. http://myfwc.com/wildlifehabitats/profiles/birds/raptors-and-vultures/peregrine-falcon/. Accessed April 17, 2018.

Fitzwater, W. D. 1994. House sparrows. Pages E101–108 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Fledger, E. J. Jr., H. H. Prince, and W. C. Johnson. 1987. Effects of grazing by Canada geese on winter wheat yield. Wildlife Society Bulletin 15:402–405.

Fleming, R., P. Eng, and H. Fraser. 2001. The impact of waterfowl on water quality: literature review. Ridgetown College-Univeristy of Guelph, Rigetown, Ontario Canada. 14 pp.

Florida Department of Agriculture and Consumer Services. 2016. Florida Department of Agriculture and Consumer Services, Division of Aquaculture website. http://www.freshfromflorida.com/Divisions-Offices/Aquaculture Accessed May 12, 2017.

Forbes, J. E. 1990. Starlings are expensive nuisance on dairy farms. Agricultural Impact 17:4. Ford, H. S. 1967. Winter starling control in Idaho, Nevada, and Oregon. Proceedings of the 3rd Vertebrate Pest Conference 3:104-110.

Ford, H. S. 1967. Winter starling control in Idaho, Nevada, Oregon. Proceedings: Third Vertebrate Pest Conference 3:104-110.

Forrester, D. J., and M. G. Spalding. 2003. Parasites and Diseases of Wild Birds in Florida. University Press of Florida, Gainsville, Florida, USA.

Fraser, E., and S. Fraser. 2010. A review of the potential health hazards to humans and livestock from Canada geese (*Branta Canadensis*) and cackling geese (*Branta hutchinsii*). Canadian Cooperative Wildlife health Centre, Saskatoon, Saskatchewan, Canada.

Frederick, P. C., and M. W. Collopy. 1989. The role of predation in determining reproductive success of colonially nesting wading birds in the Florida everglades. The Condor 91:860–867.

French, N. P., A. Midwinter, B. Holland, J. Collins-Emerson. R. Pattison, F. Colles, and P. Carter. 2009. Molecular epidemiology of campylobacter jejuni isolates from wild-bird fecal material in children's playgrounds. Applied and Environmental Microbiology 75:779–783.

Friend, M. and J. C. Franson. 1999. Field manual of wildlife diseases: general field procedures and diseases of birds. U.S. Department of the Interior, U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin, USA.

Friend, M., R. G. McLean, and F. J. Dein. 2001. Disease emergence in birds: challenges for the twenty-first century. Auk 118:290–303.

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

Fussell, J. O. 1994. A Birder's Guide to Coastal Connecticut. The University of Connecticut 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.

Gaukler, S. M., G. M. Linz, J. S. Sherwood, H. W. Dyer, W. J. Bleier, Y. M. Wannemuehler, L. K. Nolan, and C. M. Logue. 2009. Escherichia coli, salmonella, and mycobacterium avium subsp. Paratuberculosis in wild European starlings at a Kansas feedlot. Avian Diseases 53:544–551.

Gauthier-Clerc, M., C. Lebarbenchon, and F. Thomas. 2007. Recent expansion of highly pathogenic avian influenza H5N1: a critical review. Ibis 149:202–214.

Gauthier, G. 2014. Bufflehead (*Bucephala albeola*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/buffle. Accessed July 17, 2017.

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. 1981. 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. Proceedings of the Bird Control Seminar 9:125–134.

Glahn, J. F., and D. L. Otis. 1981. Approach for assessing feed loss damage by European Starlings at livestock feedlots. Pages 38–45 *in* Vertebrate Pest Control and Management Materials: Third Conference, Special Technical Bulletin 752. E. W. Schaefer, Jr., and C. R. Walker, editors. American Society for Testing and Materials, West Conshohocken, Pennsylvania, USA.

Glahn, J. F., and D. L. Otis. 1986. Factors influencing blackbird and European Starling damage at livestock feeding operations. 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., B. Dorr, J. B. Harrel, and L. Khoo. 2002. Foraging ecology and depredation management of great blue herons at Mississippi catfish farms. Journal of Wildlife Management 66:194–201.

Glahn, J. F., 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., E. S. Rasmussen, T. Tomsa, and K. J. Preusser. 1999*a*. Distribution and relative impact of avian predators at aquaculture facilities in the northeast United States. North American Journal of Aquaculture 61:340–348.

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., S. K. Timbrook, and D. J. Twedt. 1987. Temporal use patterns of wintering European Starlings at a southeastern livestock farm: implications for damage control. Proc. East. Wildl. Damage Control Conf. 3:194-203.

Glahn, J. F., T. Tomsa, and K. J. Preusser. 1999*b*. Impact of great blue heron predation at trout-rearing facilities in the Northeastern United States. North American Journal of Aquaculture 61:349–354.

Glaser, L. C., I. K. Barker, D. V C. Weseloh, J. Ludwig, R. M. Windingstad, D. W. Key, and T. K. Bollinger. 1999. The 1992 epizootic of Newcastle disease in double-crested cormorants in North America. Journal of Wildlife Diseases 35:319–330.

Gochfeld, M., and J. Burger. 1994. Black Skimmer (*Rhynchops niger*). In: The Birds of North America, No. 108 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists Union.

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

Good, T. P. 1998. Great Black-backed Gull (*Larus marinus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/gbbgul. Accessed July 17, 2017.

Gorenzel, W. P., and T. P. Salmon. 1993. Tape-recorded calls disperse American crows from urban roosts. Wildlife Society Bulletin 21:334-338.

Gorenzel, W. P., and T. P. Salmon. 1994. 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.

Gosser, A. L., M. R. Conover, and T. A. Messmer. 1997. Managing problems caused by urban Canada geese. Berryman Institute Publication 13, Utah state University, Logan 8 pp.

Gough, P. M., and J. W. Beyer. 1981. Bird-vectored diseases. Great Plains Wildlife Damage Control Workshop Proceedings 5:260–272.

Gough, P. M., J. W. Beyer, and R. D. Jorgenson. 1979. Public health problems: TGE. Proceedings of the Bird Control Seminar 8:137–142.

Grabill, B. A. 1977. Reducing starling use of wood duck boxes. Wildlife Society Bulletin 5:67–70.

Graczyk, T. K., M. R. Cranfield, R. Fayer, J. Tout, and J. J. Goodale. 1997. Infectivity of Cryptosporidium parvum oocysts is retailned upon intestinal passage through a migratory waterfowl species (Canada goose, *Branta canadensis*). Tropical Medicine and International Health 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.

Green, M. G., T. Swem, M. Morin, R. Mesta, M. Klee, K. Hollar, R. Hazlewood, P. Delphey, R. Currie, and M. Amaral. 2006. Monitoring results for breeding American Peregrine Falcon (*Falco peregrines anatum*), 2003. U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R1005-2006, Washington D.C.

Guillaumet, A., B. Dorr, G. Wang, J. D. Taylor II, R. B. Chipman, H. Scherr, J. Bowman, K. F. Abraham, T. J. Doyle and E. Cranker. 2011. Determinants of local and migratory movements of Great Lakes Double-crested Cormorants. Behavioral Ecology 22:1096-1103.

Guillemette, M., and P. Brousseau. 2001. Does culling predatory gulls enhance the productivity of breeding common terns? Journal of Applied Ecology 38:1-8.

Hahn, J., and F. D. Clark. 2002. A short history of the cleanup costs associated with major disease outbreaks in the United States. Avian Advice 4:12-13.

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.

Hansen, D. L., S. Ishii, M. J. Sadowsky, and R. E. Hicks. 2009. Escherichia coli populations in Great Lakes waterfowl exhibit spatial stability and temporal shifting. Applied Environmental Microbiology 75:1546–1551.

Hansen, J. S., and J. E. Ongerth. 1991. Effects of time and watershed characteristics on the concentration of Cryptosporidium Cryptosporidium oocysts in river water. Applied Environmental Microbiology 57:2790–2795.

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.

Haselow, D. T., H. Safi, D. Holcomb, N. Smith, K. D. Wagner, B. B. Bolden, and N. S. Harik. 2014. Histoplasmosis associated with a bamboo bonfire — Arkansas, October 2011. Centers for Disease Control and Prevention MMWR, February 28, 2014. 63:165-168.

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.

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.

Heath, S. R., E. H. Dunn, and D. J. Agro. 2009. Black Tern (*Chlidonias niger*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/blkter. Accessed July 17, 2017.

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

Heinrich, J. W., and S. R. Craven. 1990. Evaluation of three damage abatement techniques for Canada geese. Wildlife Society Bulletin 18:405-410.

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.

Heusmann, H. W., W. W. Blandin, and R. E. Turner. 1977. Starling deterrent nesting cylinders in wood duck management. Wildlife Society Bulletin 5:14–18.

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

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

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, R. A., and R. D. Morris. 1976. Nocturnal Predation by a Black-Crowned Night Heron at a Common Tern Colony. The Auk 93:629-633.

Hunter, W. C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. Waterbird Conservation for the Americas.

Hussong, D., J. M. Damare, R. J. Limpert, W. J. L. Sladen, R. M. Weiner, and R.R. Colwell. 1979. Mocrobial impact of Canada Geese (*Branta canadensis*) and whistling swans (*Cygnus columbianus columbianus*) on aquatic ecosystems. Appl. Envir. Microb. 37:14-20.

Hygnstrom, S. E. and S. R. Craven. 1994. Hawks and owls. Pages E53–62 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Ingold, D. J. 1994. Influence of nest site competition between European starlings and woodpeckers. Wilson Bull. 1106:227-241.

International Association of Fish and Wildlife Agencies. 2005. Potential costs of losing hunting and trapping as wildlife management tools. Animal Use Committee, International Association of Fish and Wildlife Agencies, Washington, D.C. 52 pp.

Ivan, J. S., and R. K. Murphy. 2005. What Preys on Piping Plover Eggs and Chicks? Wildlife Society Bulletin 33:113-119.

Jackson, B. J. and J. A. Jackson. 2000. Killdeer (*Charadrius vociferus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/killde. Accessed July 17, 2017.

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. 9 July 1998. Seattle, Washington, USA.

Jarvie, S., H. Blokpoel, and T. Chipperfield. 1997. 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.

Jaster, L. A., W. E. Jensen, and W. E. Lanyon. 2012. Eastern Meadowlark (*Sturnella magna*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/easmea. Accessed July 17, 2017.

Jensen, M. A. 1996. Overview of methods used to reduce gull, geese, raptor, and deer hazards to aircraft at O'Hare International Airport (abstract only). Proc. ann. Meeting Bird Strike Committee, USA.

Johnson, R. J. 1994. American crows. Pages E33–E40 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Johnson, R. J., and J. F. Glahn. 1994. European starlings. Pages E109–120 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

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.

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, W. B., M. Eidson, K. A. Smith, and M. G. Stobierski. 2000. Compendium of Measures To Control Chlamydia psittaci Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), Morbidity, Mortality Report July 14, 2000. National Association of state Public Health Veterinarians 49(RR08):1–17.

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.

Kale, H. W., II, B. Pranty, B. M. Stith, and C. W. Biggs. 1992. The atlas of the breeding birds of Florida. Final Report. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

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. Applied Occupational and Environmental Hygiene 16:905–909.

Kaufman, K. 1996. Lives of North American Birds. Boston: Houghton Mifflin Company. 704 pp.

Kear, J. 1963. The agricultural importance of goose droppings. Wildfowl 14:72-77.

Keawcharoen, J., D. van Riel, G. van Amerongen, T. Bestebroer, W. E. Beyer, R. van Lavieren, A. D. M. E. Osterhaus, R. A. M. Fouchier, and T. Kuiken. 2008. Wild ducks as long-distance vectors of highly pathogenic avian influenza virus (H5N1). Emerging Infectious Diseases 14:600–607.

Keller, J. I, W. G. Shriver, J. Waldenström, P. Griekspoor, and B. Olsen. 2011. Prevalence of Campylobacter in Wild Birds of the Mid-Atlantic Region, USA. Journal of Wildlife Disease 47: 750–754.

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.

Kerpez, T. A., and N. S. Smith. 1990. Competition between European starlings and native woodpeckers for nest cavities in saguaros. Auk. 107:367-375.

Kitchell, J. F., D. E. Schindler, B.R. Herwig, D. M. Post, and M. H. Olson. 1999. Nutrient cycling at the landscape scale: The role of diel foraging migrations by geese at the Bosque del Apache National Wildlife Refuge, New Mexico, Liminol. Oceanog. 44:828-836.

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*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/turvul. Accessed July 17, 2017.

Klett, B. R., D. F. Parkhurst, and F. R. Gaines. 1998. The Kensico Watershed Study: 1993–1995. Pages 563–566 *in* Proceedings Watershed '96. 8–12 June 1996, Baltimore, Maryland, USA.

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.

Kommers, G. D., D. J. King, B. S. Seal, and C. C. Brown. 2001. Virulence of pigeon-origin Newcastle disease virus isolates for domestic chickens. Avian Diseases 45:906–921.

Koopmans, M., B. Wilbrink, M. Conyn, G. Natrop, H. van der Nat, H. Vennema, A. Meijer, J. van Steenbergen, R. Fouchier, A. Osterhaus, and A. Bosman. 2004. Transmission of H7N7 avian influenza A virus to human beings during a large outbreak in commercial poultry farms in the Netherlands. The Lancet 363:587–593.

Korfanty, C., W. G. Miyasaki, and J. L. Harcus. 1999. Review of the population status and management of double-crested cormorants in Ontario. Pages 131–145 *in* Symposium on double-crested cormorants: Population status and management issues in the Midwest. M. E. Tobin, technical coordinator. 9 December 1997, Technical Bulletin 1879. U.S. Department of Agriculture, APHIS, Washington, D.C., USA.

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

Kress, S., E. Weinstein, and I. C. T. Nisbet, eds. 1983. The status of tern populations in northeastern United States and adjacent Canada. Colonial Waterbirds 6:84-106.

Kuhn, R. C., Rock, C. M. & Oshima, K. H. 2002. Occurrence of Cryptosporidium and Giardia in wild ducks along the Rio Grande River valley in southern New Mexico. Applied and Environmental Microbiology 68:161–165.

Kullas, H., M. Coles, J. Rhyan and L. Clark. 2002. Prevalence of Escherichia coli serogroups and human virulence factors in feces of urban Canada geese (*Branta canadensis*). International Journal of Environmental Health Research 12:153–162.

Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliott, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Saliva, B. Sydeman, J. Trapp, J. Wheller, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, D.C., USA.

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. Environmental Health Perspectives 113:793–800.

Leck, C. F. 1984. The status and distribution of New Jersey's birds. New Brunswick, New Jersey, Rutgers University Press.

LeJeune, J. T., J. Homan, G. Linz, and D. L. Pearl. 2008. Role of the European starling in the transmission of E. coli O157 on dairy farms. Proceedings of the Vertebrate Pest Conference 23:31–34.

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. 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.

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.

Lipnick, R., J. A. Cotrouvo, R. N. Hill, R. D. Bruce, D. A. Stitzel, A. P. Walker, I. Chu, M. Goddard, L. Segal, J. A. Springer, and R. C. Meyers. 1995. Comparison of the Up-and-Down, conventional LD_{50}, and Fixed-Dose Acute Toxicity procedure. Food Chemistry and Toxicology 33:223-331.

Locke, L. N. 1987. Chlamydiosis. Pages 107–113 *in* M. Friend and C. J. Laitman, editors. Field Guide to Wildlife Diseases: General Field Procedures and Diseases Migratory Birds, Resource Publication 167. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA.

Lovell, H. B. 1947. Black vultures kill young pigs in Kentucky. Auk 64:131–132.

Lovell, H. B. 1952. Black vulture depredations at Kentucky woodlands. Auk 64:48–49.

Lowney, M. S. 1993. Excluding non-migratory Canada geese with overhead wire grids. Proc. East. Wildl. Damage Cont. Conf. 6:85-88.

Lowney, M. S. 1999. Damage by black and turkey vultures in Virginia, 1990–1996. Wildlife Society Bulletin 27:715–719.

Lowther, P. E. 1993. Brown-headed Cowbird (*Molothrus ater*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/bnhcow. Accessed July 17, 2017.

Lowther, P. E. and C. L. Cink. 2006. House Sparrow (*Passer domesticus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/houspa. Accessed July 17, 2017.

Lowther, P. E. and R. F. Johnston. 2014. Rock Pigeon (*Columba livia*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/rocpig. Accessed July 17, 2017.

Luechtefeld, N. W., M. J. Blaser, L. B. Reller, and W. L. L. Wang. 1980. Isolation of Campylobacter fetus subsp. Jejuni from migratory waterfowl. Journal of Clinical Microbiology 12:406–408.

MacDonald, J. W. and P. D. Brown. 1974. *Salmonella* infection in wild birds in Britain. Veterinary Record 94: 21-322.

MacInnes, C. D., R. A. Davis, R. N. Jones, B. C. Lieff, and A. J. Pakulak. 1974. Reproductive efficiency of McConnell River small Canada geese. Journal of Wildlife Management 38:686-707.

MacKinnon, B., R. Sowden, and S. Dudley, editors. 2004. Sharing the skies: an aviation guide to the management of wildlife hazards. Transport Canada, Aviation Publishing, Ottawa, Ontario, Canada.

Majumdar, S. K., F. J. Brenner, J. E. Huffman, R. G. McLean, A. I. Panah, P. J. F. Pietrobon, S. P. Keeler, and S. E. Shive. 2011. Pandemic Influenza Viruses: Science, Surveillance, and Public Health. Pennsylvania Academy of Science, Easton, Pennsylvania, USA.

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

MANEM Region Waterbird Working Group. 2006. Waterbird Conservation Plan: 2006–2010 Mid-Atlantic / New England / Maritimes Region. A plan for the Waterbird Conservation for the Americas Initiative. http://www.waterbirdconservation.org/pdfs/regional/manem_binder_appendix_1b.pdf. Accessed December 11, 2012.

Manny, B. A., W. C. Johnson, and R. G. Wetzel. 1994. Nutrient additions by waterfowl to lakes and reservoirs: predicting their effects on productivity and water quality. Hydrobiologoia. 279/280:121-132.

Marsh, R. E. 1994. Woodpeckers. Pages E139–145 in S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. <http://digitalcommons.unl.edu/icwdmhandbook/>. Accessed January 28, 2016.

Mason, J. R. 1989. Avoidance of methiocarb-poisoned apples by Red-winged Blackbirds. Journal of Wildlife Management 53:836-840.

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.

Mason, J. R., R. E. Stebbings, and G. P. Winn. 1972. Noctules and European Starlings competing for roosting holes. Journal of Zoology 166:467.

Matteson, R. E. 1978. Acute oral toxicity of DRC-1339 to cardinals (*Cardinalis cardinalis*). U. S. Fish and Wildlife Service, Denver Wildlife Research Center, Bird Damage Research Report 84. 3 pp.

McCrimmon Jr., D. A., J. C. Ogden, and G. T. Bancroft. 2011. Great Egret (*Ardea alba*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/greegr. Accessed July 17, 2017.

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

McGilvrey, F. B., and F. M. Uhler. 1971. A starling deterrent wood duck nest box. Journal of Wildlife Management 35:793-797.

McGowan, K. J. 2001. Fish Crow (*Corvus ossifragus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/fiscro. Accessed July 17, 2017.

McLean, R. G. 2003. The emergence of major avian diseases in North America: west Nile virus and more. Proc. Wildl. Damag. Manage. Conf. 10:300-305.

McRoberts, J. T., M. C. Wallace, and S. W. Eaton. 2014. Wild Turkey (*Meleagris gallopavo*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/wiltur. Accessed July 17, 2017.

Meyer, K. D. 1995. Swallow-tailed Kite (*Elanoides forficatus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/swtkit. Accessed July 17, 2017.

Miller, J. W. 1975. Much ado about European starlings. Natural History 84:38-45.

Miller, R. S., M. L., Farnsworth, J. L. Malmberg. 2012. Diseases of the livestock-wildlife interface: status, challenges, and opportunities in the United States. Preventive Veterinary Medicine, In Press.

Milleson, M. P., S. A. Shwiff, and M. L. Avery. 2006. Vulture-cattle interactions – A survey a Florida ranchers. Proc. Vertebr. Pest Conf. 22:231-238.

Mitterling, L. A. 1965. Bird damage on apples. Proceedings of the American Society for 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.

Moore, A. C., B. L. Herwaldt, G. F. Craun, R. L. Calderon, A. K. Highsmith, and D. D. Juranek. 1994. Waterborne disease in the United States, 1991 and 1992. Journal of the American Water Works Association 86:87–99.

Morris, R. D., D. V. Weseloh, L. R. Wires, C. Pekarik, F. J. Cuthbert, and D. J. Moore. 2011. Population trends of ring-billed gulls breeding in the North American Great Lakes, 1976 to 2009. Waterbirds 34:202–212.

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, special scientific report-Wildlife No. 172. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado, USA. http://hdl.handle.net/2027/mdp.39015001470163?urlappend=%3Bseq=279. Accessed July 17, 2017.

Mott, D. F., and S. K. Timbrook. 1988. Alleviating nuisance Canada goose problems with acoustical stimuli. Proceedings of the Vertebrate Pest Conference 13:301–305.

Mott, D. F., J. F. Glahn, P. L. Smith, D. S. Reinhold, K. J. Bruce, and C. A. Sloan. 1998. An evaluation of winter roost harassment for dispersing double-crested cormorants away from catfish production areas in Mississippi. Wildlife Society Bulletin 26:584-591.

Mowbray, T. B., C. R. Ely, J. S. Sedinger, and R. E. Trost. 2002. Canada Goose (*Branta canadensis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/cangoo. Accessed July 17, 2017.

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. Wildlife Society Bulletin 25:504-514.

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

NASS. 2012. 2012 Census of Agriculture. USDA, National Agricultural Statistics Service, https://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Florida/index.asp. Accessed May 12, 2017.

National Audubon Society. 2010. The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org. Accessed July 10, 2017.

National Wild Turkey Federation. 2010. All about wild turkeys. http://www.nwtf.org/hunt/category/all-about-wild-turkeys. Accessed July 17, 2017.

Nebel, S. and J. M. Cooper. 2008. Least Sandpiper (*Calidris minutilla*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/leasan. Accessed July 17, 2017.

Nehls, H. 2002. Monk Parakeets. Audubon Warbler 66:26.

Nettles V. F., J. M. Wood, and R. G. Webster. 1985. Wildlife Surveillance Associated with an Outbreak of Lethal H5N2 Avian Influenza in Domestic Poultry. Avian Diseases 29:733–741.

Newman, J. R., C. M. Newman, J. R. Lindsay, B. Merchant, M. L. Avery, and S. Pruett-Jones. 2004. Monk Parakeets: an Expanding Problem on Power Lines and Other Electrical Utility Structures. The 8th International Symposium on Environmental Concerns in Rights-of-way Management. Saratoga Springs, New York.

Nickell, W. P. 1967. European Starlings and sparrow hawks occupy same nest box. Jack-Pine Warbler 45:55.

Nielsen, L. 1988. Definitions, considerations, and guidelines for translocation of wild animals. Pp 12-51 *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.

Nisbet, I. C., D. V. Weseloh, C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten. 2017. Herring Gull (*Larus argentatus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/hergul. Accessed July 17, 2017.

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.

O'Connell, T.J., and R.A. Beck. 2003. Gull predation limits nesting success of terns and skimmers on the Virginia barrier islands. Journal of Field Ornithology 74:66-73.

Olesen, N. J., and P. E. Vestergard-Jorgensen. 1982. Can and do herons serve as vectors for Egtved virus? Bulletin of European Association of Fish Pathologists 2:48.

Otis, D. L., J. H. Schulz, D. Miller, R. E. Mirarchi, and T. S. Baskett. 2008. Mourning Dove (*Zenaida macroura*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of

Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/moudov. Accessed July 17, 2017.

Pacha, R. E., G. W. Clark, E. A. Williams, and A. M. Carter. 1988. Migratory birds of central Washington as reservoirs of Campylobacter jejuni. Canadian Journal of Microbiology 34:80–82.

Palmer, S. F., and D. O. Trainer. 1969. Serologic Study of Some Infectious Diseases of Canada Geese. Proceedings of the Annual Conference. Bulletin of the Wildlife Disease Association 5:260–266.

Parker, J. W. 1999. Mississippi Kite (*Ictinia mississippiensis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/miskit. Accessed July 17, 2017.

Parkhurst, J. A., R. P. Brooks, and D. E. Arnold. 1987. A survey of wildlife depredation and control techniques at fish-rearing facilities. Wildlife Society Bulletin 15:386–394.

Parkhurst, J. A., R. P. Brooks, D. E. Arnold. 1992. Assessment of predation at trout hatcheries in Central Pennsylvania. Wildlife Society Bulletin 20:411–419.

Parmalee, P. W., and B. G. Parmalee. 1967. Results of banding studies of the black vulture in eastern North America. Condor 69:146–155.

Partners in Flight Science Committee 2013. Population Estimates Database, version 2013. http://pif.birdconservancy.org/PopEstimates. Accessed July 17, 2017.

Patton, S. R. 1988. Abundance of gulls at Tampa Bay landfills. Wilson Bulletin 100:431-442.

Pedersen, K, and L. Clark. 2007. A review of Shiga toxin *Escherichia coli* and *Salmonella enterica* in cattle and free-ranging birds: potential association and epidemiological links. Human-Wildlife Conflicts 1:68–77.

Pedersen, K., S. R. Swafford, T. J. DeLiberto. 2010. Low Pathogenicity Avian Influenza Subtypes Isolated from Wild Birds in the United States, 2006–2008. Avian Diseases 54:405–410.

Peer, B. D. and E. K. Bollinger. 1997. Common Grackle (*Quiscalus quiscula*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/comgra. Accessed July 17, 2017.

Peiris, J. S. M., M. D. de Jong, and Y. Guan. 2007. Avian Influenza Virus (H5N1): a Threat to Human Health. Clinical Microbiology Reviews 20:243–267.

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 9:539–544.

Pimentel, D., L. Lech, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs associated with nonindigenous species in the United States. BioScience 50:53–65.

Pochop, P. A. 1998. Comparison of white mineral oil and corn oil to reduce hatchability of ring-billed gull eggs. Proc. Vertebr. Pest Conf. 18:411-413.

Pochop, P. A., J. L. Cummings, J. E. Steuber, and C. A. Yoder. 1998. Effectiveness of several oils to reduce hatchability of chicken eggs. Journal of Wildlife Management 62:395-398.

Pollet, I. L., D. Shutler, J. W. Chardine, and J. P. Ryder. 2012. Ring-billed Gull (*Larus delawarensis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/ribgul. Accessed July 17, 2017.

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

Post, W., J. P. Poston, and G. T. Bancroft. 2014. Boat-tailed Grackle (*Quiscalus major*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/botgra. Accessed July 17, 2017.

Pottie, J. J., and H. W. Heusmann. 1979. Taxonomy of resident Canada geese in Massachusetts. Trans. Northeast Fish and Wildlife Conf. 36:132-137.

Powell, L. A., M. J. Conroy, G. D. Balkcom, and U. N. Caudell. 2003. Urban Canada geese in Georgia: assessing a golf course survey and a nuisance relocation program. International Canada Goose Symposium. Pp. 145-149.

Preston, C. R. and R. D. Beane. 2009. Red-tailed Hawk (*Buteo jamaicensis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/rethaw. Accessed July 17, 2017.

Price, I. M., and J. G. Nikum. 1995. Aquaculture and birds: the context for controversy. Pages 33–45 *in* The double-crested cormorant: biology, conservation and management. D. N. Nettleship and D. C. Duffy, editors. Colonial Waterbirds 18 (Special Publication 1).

Pruett-Jones, S., J. R. Newman, C. M. Newman, M. L. Avery, and J. R. Lindsay. 2007. Population viability analysis of monk parakeets in the United States and examination of alternative management strategies. Human-Wildlife Conflicts 1:35–44.

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. 1987. Recruitment to food in Black Vultures: evidence for following from communal roosts. Anim. Behav. 35:1775-1785.

Rabenhold, P. P., and M. D. Decker. 1989. Black and turkey vultures expand their ranges northward. The Eyas. 12:11-15.

Raftovich, R. V., S. C. Chandler, and K. A. Wilkins. 2014. Migratory bird hunting activity and harvest during the 2012-13 and 2013-14 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Raftovich, R. V., S. C. Chandler, and K. A. Wilkins. 2015. Migratory bird hunting activity and harvest during the 2013-14 and 2014-15 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Raftovich, R. V., S. C. Chandler, and K. A. Wilkins. 2016. Migratory bird hunting activity and harvest during the 2014-15 and 2015-16 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Raftovich, R. V., S. C. Chandler, and K. K. Fleming. 2017. Migratory bird hunting activity and harvest during the 2015-16 and 2016-17 hunting seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Raveling, D. G. 1968. Weights of *Branta canadensis* interior during winter. Journal of Wildlife Management 32:412-414.

Raveling, D. G. 1969. Social classes of Canada geese in winter. Journal of Wildlife Management 33:304-318.

Reilly, W. G., G .I. Forbes, G. M. Paterson, and J. C. M. Sharp. 1981. Human and animal salmonellosis in Scotland associated with environmental contamination, 1973–1979. Veterinary Record 108:553–555.

Reinhold, D. S., and C. A. Sloan. 1999. Strategies to reduce double-crested cormorant depredation at aquaculture facilities in Mississippi. Pages 99–105 *in* M. E. Tobin, technical coordinator. Symposium on double-crested cormorants: Population status and management issues in the Midwest. U.S. Department of Agriculture, APHIS, Technical Bulletin 1879, Washington, D.C., USA.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, New York, USA. Partners in Flight website. http://www.partnersinflight.org/cont_plan/ (VERSION: March 2005). Accessed June 19, 2013.

Rimmer, D. W., and R. D. Deblinger. 1990. Use of Predator Exclosures to Protect Piping Plover Nests. Journal of Field Ornithology 61:217-223.

Robbins, C. S. 1973. Introduction, spread, and present abundance of the house sparrow in North America. Ornithol. Monogr. 14:3-9.

Robbins, C. S., B. Bruun, and H. S. Zim. 1983. A guide to field identification birds of North America. Golden books publ. Co., Inc., Racine, Wisconsin. 360 pp.

Robinson, M. 1996. The potential for significant financial loss resulting from bird strikes in or around an airport. Proceedings of the International Bird Strike Committee 23:353–367.

Robinson, J. A., J. M. Reed, J. P. Skorupa, and L. W. Oring. 1999. Black-necked Stilt (*Himantopus mexicanus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/bknsti. Accessed July 17, 2017.

Roffe, T. J. 1987. Avian tuberculosis. Pages 95–99 *in* M. Friend and C. J. Laitman, editors. Field Guide to Wildlife Diseases: General Field Procedures and Diseases Migratory Birds, Resource Publication 167. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA.

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.

Rohwer, F. C., W. P. Johnson and E. R. Loos. 2002. Blue-winged Teal (*Anas discors*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/buwtea. Accessed July 17,2017.

Romagosa, C. M. 2012. Eurasian Collared-Dove (*Streptopelia decaocto*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/eucdov. Accessed July 17, 2017.

Roscoe, D. E. 1999. A survey to estimate the prevalence of *Salmonella* sp., *Shigella* sp., *Yersinia* sp. bacteria and *Cryptosporidia* sp., *Giardia* sp. protozoa in resident Canada geese (*Branta canadensis*) in New Jersey. Project Report. NJ Division of Fish and Wildlife. 13 pp.

Rossbach, R. 1975. Further experiences with the electroacoustic method of driving European starlings from their sleeping areas. Emberiza 2:176-179.

Rowsell, E. V., J. A. Carnie, S. D. Wahbi, A. H. Al-Tai, and K. V. Rowsell. 1979. L-serine dehydratase and L-serine-pyruvate aminotransferase activities in different animal species. Comp. Biochem. Physiol. B Comp. Biochem. 63:543-555.

Royall, W. C., 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.

Rudstam, L. G., A. J. VanDeValk, C. M. Adams, J. T. H. Coleman, J. L. Forney, and M. E. Richmond. 2004. Cormorant predation and the population dynamics of walleye and yellow perch in Oneida Lake. Ecological Applications 14:149-163.

Rusch, D. H., R. E. Malecki, and R. E. Trost. 1995. Canada geese in North America. Pp 26-28 *in* LaRoe, E. T., G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac. Editors. Our Living Resources: A report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. USDI, National Biological Service. Washington, D.C. 530 pp.

Rutledge, M. E., R. M. Siletzky, W. Gu, L. A. Degernes, C. E. Moorman, C. S. DePerno and S. Kathariou. 2013. Characterization of campylobacter from resident Canada geese in an urban environment. Journal of Wildlife Disease 49:1–9.

Sanders, T. A., and K. Parker. 2010. Mourning dove population status, 2010. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

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. Annals of Allergy, Asthma and Immunology 84:84–86.

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

Sauer, J. R., D. K. Niven, J. E. Hines, D. J. Ziolkowski, Jr, K. L. Pardieck, J. E. Fallon, and W. A. Link. 2017. The North American Breeding Bird Survey, Results and Analysis 1966 - 2015. Version 2.07.2017 USGS Patuxent Wildlife Research Center, Laurel, MD.

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, Ohio.

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, Ohio.

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, 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.

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.

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. Transactions North American Wildlife and Natural Resource Conference 54:468–475.

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

Seamans, M. E. 2016. Mourning dove population status, 2016. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

Seamans, M. E., and T. A. Sanders. 2014. Mourning dove population status, 2014. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

Seamans, M. E., R. D. Rau, and T. A. Sanders. 2012. Mourning Dove population status, 2012. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C.

Seamans, T. W. 2004. Response of roosting turkey vultures to a vulture effigy. Ohio Journal of Science 104:136–138.

Seamans, T. W., D. W. Hamershock, and G. E. Bernhardt. 1995. Determination of body density for twelve bird species. Ibis 137:424-428.

Seubert, J. L., and R. A. Dolbeer. 2004. Status of North American Canada Goose populations in relation to strikes with civil aircraft. Proceedings of the 6th Joint Bird Strike Committee. 13–17 September 2004, Baltimore, Maryland, USA.

Shake, W. F. 1967. Starling wood duck interrelationships. M.S. Thesis. Western Illinois University, Macomb.

Sherman, D. E., and A. E. Barras. 2004. Efficacy of a laser device for hazing Canada Geese from urban areas of Northeast Ohio. Ohio Journal of Science 104:38-42.

Shieldcastle, M. C., and L. Martin. 1999. Colonial waterbird nesting on west sister island national wildlife refuge and the arrival of double-crested cormorants. Pages 115–119 *in* Symposium on double-crested cormorants: Population status and management issues in the Midwest. M. E. Tobin, technical coordinator. 9 December 1997, Technical Bulletin 1879. U.S. Department of Agriculture, APHIS, Washington, D.C., USA.

Shields, M. 2014. Brown Pelican (*Pelecanus occidentalis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/brnpel. Accessed July 17, 2017.

Shirota, Y. M., and S. Masake. 1983. Eyespotted balloons are a device to scare gray European starlings. Appl. Ent. Zool. 18:545-549.

Shultz, D. F., J. A. Cooper, and M. C. Zicus. 1988. Fall flock behavior and harvest of Canada geese. Journal of Wildlife Management 52:679-688.

Shwiff, S., and T. Devault. 2009. The economic impact of double-crested cormorants to Central New York. Unpublished report. National Wildlife Research Center, USDA/APHIS/WS, Fort Collins, Colorado.

Silva V. L., J. R. Nicoli, T. C. Nascimento, and C. G. Diniz. 2009. Diarrheagenic Escherichia coli strains recovered from urban pigeons (*Columba livia*) in Brazil and their antimicrobial susceptibility patterns. Current Microbiology 59:302–308.

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

Slate, D. A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Transactions of the North American Wildlife and Natural Resources Conference 57:51–62.

Smallwood, J. A. and D. M. Bird. 2002. American Kestrel (*Falco sparverius*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amekes. Accessed July 17, 2017.

Smith, A. E. 1996. Movement and harvest of Mississippi Flyway Canada Geese. M.S. Thesis. Univ. of Wisc.-Madison. vi, 72 pp.

Smith, A. E., S. R. Craven, and P. D. Curtis. 1999. Managing Canada geese in urban environments. Jack Berryman Institute Publication 16, and Cornell University Cooperative Extension, Ithaca, N.Y. 42 pp.

Smith, 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, K. E., J. R. Fischer, S. E. Little, J. M. Lockhart, and D. E. Stallknecht. 1997. Diseases with implication for human health. Pp 378-399 *in* Field Manual of Wildlife Diseases in the Southeastern United States. W. R. Davidson and V. F. Nettles, eds. Univ. of GA. Athens, Georgia.

Stafford, T. 2003. Pest Risk Assessment for the Monk Parakeet in Oregon. Oregon Department of Agriculture. Salem, OR. Online http://www.oregon.gov/OISC/docs/pdf/monkpara.pdf?ga=t. Accessed 9 March 2012.

Stallknecht, D. E. 2003. Ecology and Epidemiology of Avian Influenza Viruses in Wild Bird Populations: Waterfowl, Shorebirds, Pelicans, Cormorants, Etc.. Avian Diseases 47:61–69.

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.

Stewart, P. A. 1978. Behavioral interactions and niche separation in Black and Turkey vultures. Living Bird 17:79-84.

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.

Summers, R. W. 1985. The effect of scarers on the presence of starlings (*Sturnus vulgaris*) in cherry orchards. Crop Prot. 4:522-528.

Swift, B. L., and M. Felegy. 2009. Response of resident Canada Geese to chasing by border collies. New York State Department of Environmental Conservation, Albany, New York, USA.

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 (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/categr. Accessed July 17, 2017.

Telfair II, R. C., and T. J. Bister. 2004. Long-term breeding success of the cattle egret in Texas. Waterbirds 27:69-78.

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

The Wildlife Society. 2015. Standing position statement: wildlife damage management. The Wildlife Society, Washington., D.C. 2 pp.

Thomas, N. J., D. B. Hunter, C. T Atkinson. 2007. Infectious Diseases of Wild Birds. Blackwell Publishing, Ames, Iowa, USA.

Thorpe, J. 1996. Fatalities and destroyed civil aircraft due to bird strikes: 1912–1995. Proceedings of the International Bird Strike Committee 23:17–31.

Tillman, E. A., A. Van Doom, and M. L. Avery. 2000. Bird damage to tropical fruit in south Florida. Pp. 47-59 *in* M. C. Brittingham, J. Kays, and R. McPeake, eds., The Ninth Wildlife Damage Management Conference Proceedings. October 5-8, 2000, state College, Pennsylvania, USA.

Tillman, E. A., A. C. Genchi, J. R. Lindsay, J. R. Newman, and M. L. Avery. 2004. Evaluation of trapping to reduce Monk Parakeet populations at electric utility facilities. Vertebrate Pest Conference 21:126–129.

Tizard, I. 2004. Salmonellosis in wild birds. Seminars in Avian and Exotic Pet Medicine 13:50–66.

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. Wildlife Society Bulletin 16:300-303.

Treves, A., and L. Naughton-Treves. 2005. Evaluating lethal control in the management of human-wildlife conflict. Pp. 86-106 in R. Woodroffe, S. Thirgood, A. Rabinowitz, eds. People and Wildlife: Conflict or Coexistence. University of Cambridge Press, United Kingdom.

Trail, P. W., and L. F. Baptista. 1993. The impact of brown-headed cowbird parasitism on populations of the Nuttall's white-crowned sparrow. Conservation Biology 7:309–315.

Tweed S. A., D. M. Skowronski, S. T. David, D. A. Larder, M. Petric, W. Lees, Y. Li, J. Katz, M. Krajden, R. Tellier, C. Halpert, M. Hirst, C. Astell, D. Lawrence, and A. Mak. 2004. Human illness from avian influenza H7N3, British Columbia. Emergency Infectious Disease 10:2196–2199.

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 Army Corps of Engineers. 2009. Predation Management Plan for Least Tern and Piping Plover Habitat along the Missouri River. Missouri River Recovery Integrated Science Program.

USAF. 2016. Top 50 USAF Wildlife Strikes by Cost, FY 1995-FY 2016. http://www.safety.af.mil/Portals/71/documents/Aviation/BASH%20Statistics/Top%2050%20USAF%20Wildlife%20Strikes%20by%20Cost.pdf. Accessed May 19, 2017.

USDA. 1999. Fruit Wildlife Damage. United States Department of Agriculture, National Agricultural Statistics Service, Agricultural Statistics Board, Washington, D.C. 5 pp.

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, Maryland.

USDA. 2013. Environmental Assessment: Reducing bird damage in the State of Florida. United States Department of Agriculture, Animal and Plant Protection Service, Wildlife Services, Gainesville, Florida.

USDA. 2015*a*. Final Environmental Impact Statement: Feral swine damage management: A national approach. USDA/APHIS/WS, Riverdale, Maryland, USA.

USDA. 2015*b*. Epidemiologic and other analyses of HPAI-affected poultry flocks: July 15, 2015 Report. United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services. 99 pp.

USFWS. 1981. Domestic Pigeon. United States Department of Interior, United States Fish and Wildlife Service. 4 pp.

USFWS. 1995. Report to Congress: Great Lakes Fishery Resources Restoration Study. 222 pp.

USFWS. 1996. Revised recovery plan for the U.S. breeding population of the wood stork. United States Fish and Wildlife Service, Atlanta, Georgia. 41 pp.

USFWS. 2000. North American Bird Conservation Initiative: Bird Conservation Region Descriptions, A supplement to the North American Bird Conservation Initiative Bird Conservations Region Map. U.S. Department of the Interior, Washington, D.C., USA.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

USFWS. 2005. Final Environmental Impact statement, Resident Canada goose Management. U.S. Department of the Interior, Washington, D.C., USA. http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/cangeese/finaleis.htm. Accessed February 4, 2013.

USFWS. 2007*a*. Final Environmental Impact Statement: Light goose management. United States Fish and Wildlife Service, Division of Migratory Birds. Arlington, Virginia.

USFWS. 2007*b*. Wood stork (*Mycteria americana*) 5-year review: Summary and evaluation. United States Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office, Jacksonville, Florida. 34 pp.

USFWS. 2012. North American Waterfowl Management Plan. U. S. Department of the Interior, Washington, D.C., USA. <http://www.fws.gov/birdhabitat/NAWMP/index.shtm>. Accessed on July 9, 2014.

USFWS. 2016. Programmatic Environmental Impact Statement for the Eagle Rule Revision. U.S. Department of the Interior, Washington, D.C., USA.

USFWS. 2017*a*. Waterfowl population status, 2017. U.S. Department of the Interior, Washington, D.C. USA. 84 pp.

USFWS. 2017*b*. Environmental Assessment for Issuing Depredation Permits for Double-crested Cormorant Management. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA. <https://www.fws.gov/migratorybirds/pdf/management/double-crested-cormorants/CormorantEA.pdf>. Accessed on March 5, 2018.

USGS. 2000. Screening for potential human pathogens in fecal material deposited by resident Canada geese on areas of public utility. Completion report. National Wildlife Health Center, Madison, Wisconsin, USA. 28 pp.

USGS. 2005. Osprey in Oregon and the Pacific Northwest, Fact sheet. U.S. Department of the Interior, Washington, D.C., USA. http://fresc.usgs.gov/ products/fs/fs-153-02.pdf. Accessed January 18, 2012.

USGS. 2013. Highly pathogenic avian influenza H5N1 frequently asked questions. U.S. Department of the Interior, Washington D.C., USA. http://www.nwhc.usgs.gov/disease_information/avian_influenza/frequently_asked_questions.jsp. Accessed July 17, 2017.

USGS. 2015*a*. Highly pathogenic avian influenza detected for the first time in wild birds in North America. GeoHealth Newsletter Volume 12, Number 1.

USGS. 2015*b*. Wild bird highly pathogenic avian influenza cases in the United States. http://www.aphis.usda.gov/wildlife_damage/downloads/WILD%20BIRD%20POSITIVE%20HIGHLY%20PATHOGENIC%20AVIAN%20INFLUENZA%20CASES%20IN%20THE%20UNITED%20STATES.pdf. Accessed August 5, 2016.

Van Bael, S., and S. Pruett-Jones. 1996. Exponential population growth of monk parakeets in the United States. Wilson Bulletin 108:584-588.

VanDeValk, A. J., C. M. Adams, L. G. Rudstam, J. L. Forney, T. E. Brooking, M. Gerken, B. Young, and J. Hooper. 2002. Comparison of angler and cormorant harvest of walleye and yellow perch in Oneida Lake, New York. Transactions of the American Fisheries Society 131:27-39.

Vanderhoff, N., P. Pyle, M. A. Patten, R. Sallabanks, and F. C. James. 2016. American Robin (*Turdus migratorius*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amerob. Accessed July 17, 2017.

Vennesland, R. G. and R. W. Butler. 2011. Great Blue Heron (*Ardea herodias*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/grbher3. Accessed July 17, 2017.

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

Verbeek, N. A. and C. Caffrey. 2002. American Crow (*Corvus brachyrhynchos*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amecro. Accessed July 17, 2017.

VerCauteren, K. C., and D. R. Marks. 2004. Movements of urban Canada geese: implications for nicarbazin treatment programs. Pages 151–156 *in* Proceedings of the 2003 International Canada Goose Symposium. 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. 19–21 March 2003, Madison, Wisconsin, USA.

VerCauteren, K. C., M. M. McLachlan, D. R. Marks, and T. W. Baumann. 2003. Effectiveness of spotlights for hazing Canada geese from open water. International Canada Goose Symposium. Abstract only.

Vermeer, K., D. Power, and G. E. J. Smith. 1988. Habitat selection and nesting biology of roof-nesting glaucous-winged gulls. Colonial 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.

Von Jarchow, B. L. 1943. European starlings frustrate sparrow hawks in nesting attempt. Passenger Pigeon. 5:51.

Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Birds of New Jersey. New Jersey Audubon Society, Bernardsville, New Jersey. 704 pp.

Weber, W. J. 1979. Health Hazards from Pigeons, European Starlings, and English Sparrows. Thompson Publications, Fresno, California, USA.

Weeks, R. J., and A. R. Stickley. 1984. Histoplasmosis and its relation to bird roosts: a review. Bird Damage Research Report No. 330. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado, USA.

Weitzel, N. H. 1988. Nest site competition between the European starling and native breeding birds in northwestern Nevada. Condor. 90:515-517.

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., 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., 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.

Wetlands International. 2017. Waterbird Population Estimates. wpe.wetlands.org. Accessed October 6, 2017.

White, C. M., N. J. Clum, T. J. Cade and W. G. Hunt. 2002. Peregrine Falcon (*Falco peregrinus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/perfal. Accessed July 17, 2017.

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 Wildlife Diseases 25:144-188.

Whitford, P. C. 2003. Use of alarm/alert call playback and human harassment to end Canada goose problems at an Ohio business park. Pp 245-255 *in* K. A. Fagerstone and G.W. Wtimer, eds. Proceedings of the 10th Wildlife Damage Management Conference.

Whoriskey, F. G., and G. J. FitzGerald. 1985. Nest sites of the threespine stickleback: can site characteristics alone protect the nest against egg predators and are nests a limiting resource? Canadian Journal of Zoology 63:1991–1994.

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, Massachusetts.

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.

Willcox , A. S., and W. M. Giuliano. 2012. The Canada goose in Florida. WEC 211. Wildlife Ecology and Conservation Department, Florida Cooperative Extension Service, Instituate of Food and Agricultural Sciences, University of Florida. 4 pp.

Williams, B. M., D. W. Richards, D. P. Stephens, and T. Griffiths. 1977. The transmission of S. livingstone to cattle by the herring gull (*Larus argentatus*). Veterinary Record 100:450–451.

Williams, D. E., and R. M. Corrigan. 1994. Pigeons (rock doves). Pages E87–96 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Williams, R. E. 1983. Integrated management of wintering blackbirds and their economic impact at south Texas feedlots. Dissertation, Texas A&M University, College Station, Texas, USA.

Wilmer, T. J. 1987. Competition between European starlings and kestrels for nest boxes: a review. Raptor Res. Rep. No. 6 pp. 156-159.

Winkler, D. W., K. K. Hallinger, D. R. Ardia, R. J. Robertson, B. J. Stutchbury, and R. R. Cohen. 2011. Tree Swallow (*Tachycineta bicolor*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/treswa. Accessed July 17, 2017.

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.

Wobeser, G., and C. J. Brand. 1982. Chlamydiosis in 2 biologists investigating disease occurrences in wild waterfowl. Wildlife Society Bulletin 10:170–172.

World Health Organization. 1998. Toxicological evaluation of certain veterinary drug residues in foods. World Health Organization, International Programme on Chemical Safety. http://www.inchem.org/documents/jecfa/jecmono/v041je10.htm. Accessed July 17, 2017.

World Health Organization. 2005. Responding to the avian influenza pandemic threat: recommended strategic actions. Communicable Disease Surveillance and Response Global Influenza Programme, World Health Organization, Geneva, Switzerland.

Woronecki, P. P. 1992. Philosophies and methods for controlling nuisance waterfowl populations in urban environments (abstract only). Joint Conf. Am. Assoc. Zoo. Vet./Am. Assoc. Wildl. Vet. 51 pp.

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. 2014. Some significant wildlife strikes to civil aircraft in the United States, January 1990–March 2014. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Sandusky, Ohio. 150 pp.

Wright, S. E., and R. A. Dolbeer. 2005. Percentage of wildlife strikes reported and species identified under a voluntary system. Proceedings of the 7th Joint Bird Strike Committee-USA/Canada. 13-16 September 2005, Vancouver, British Columbia, Canada.

Yasukawa, K. and W. A. Searcy. 1995. Red-winged Blackbird (*Agelaius phoeniceus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/rewbla. Accessed July 17, 2017.

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.

Zucchi, J., and J. H. Bergman. 1975. Long-term habituation to species-specific alarm calls in a song-bird *Fringilla coelebs.* Experientia 31:817-818.

APPENDIX B
METHODS AVAILABLE FOR RESOLVING OR PREVENTING BIRD DAMAGE IN FLORIDA

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

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

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

NON-LETHAL WILDLIFE DAMAGE MANAGEMENT METHODS

Non-lethal methods consist primarily of tools or devices used to disperse or capture a particular animal or a local population of wildlife to alleviate damage and conflicts. Most of the non-lethal methods available to WS would also be available to other entities within the state and could be employed by those entities to alleviate bird damage.

Habitat alteration can be the planting of vegetation unpalatable to wildlife or altering the physical habitat (Conover and Kania 1991, Conover 1992). Conover (1991) found that even hungry Canada Geese refused to eat some ground covers such as common periwinkle (*Vinca minor*), English ivy (*Hedera helix*) and Japanese pachysandra (*Pachysandra terminalis*). Planting less preferred plants or grasses to discourage geese from a specific area could work more effectively if good alternative feeding sites are nearby (Conover 1985). However, the manipulation of turf grass varieties in urban/suburban, heavy use situations such as parks, athletic fields, and golf courses is often not feasible. Varieties of turf grass that grow well and can withstand regular mowing and regular/heavy human use include Kentucky blue grass, red fescue, perennial bent grass, perennial rye grass, and white clover. All of these grasses are appealing to most waterfowl. The turf grass varieties that are not appealing to geese, such as tall fescue, orchard grass, and timothy, do not withstand regular mowing and/or regular/heavy human use.

Fences, hedges, shrubs, boulders, and other structures can be placed at shorelines to impede waterfowl movements. Restricting a bird's ability to move between water and land would deter them from an area, especially during molts (Gosser et al. 1997). However, people are often reluctant to make appropriate landscape modifications to discourage waterfowl activity (Breault and McKelvey 1991, Conover and Kania 1991). Unfortunately, both people and geese appear to find lawn areas near water attractive

(Addison and Amernic 1983), and conflicts between people and geese would likely continue wherever this interface occurs.

Habitat modification can be an integral part of bird damage management. Wildlife production and/or presence are often 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 would be responsible for implementing habitat modifications, and WS would only provide advice on the type of modifications that would provide the best chance of achieving the desired effect. Habitat management would most often be a primary component of 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. For example, habitat management would often be necessary to minimize damage caused by crows, blackbirds, and starlings that form large roosts during late autumn and winter. Bird activity can be greatly reduced at roost sites by removing all the trees, selectively thinning trees, or pruning trees. Habitat modification would be available to all entities.

Supplemental feeding and lure crops are food resources planted or provided to attract wildlife away from more valuable resources (*e*.*g*., crops). Food is provided so that the animals causing damage would consume it rather than the resource being protected. In feeding programs, target wildlife would be offered an alternative food source with a higher appeal with the intention of luring them from feeding on affected resources. This method can be ineffective if other food sources are available. For example, lure crops would largely be ineffective for geese because food resources (*e*.*g*., turf) are readily available. For lure crops to be effective, the ability to keep birds from surrounding fields would be necessary, and the number of alternative feeding sites must be minimal (Fairaizl and Pfeifer 1988). Additionally, lure crops reduce damage for only a short time (Fairaizl and Pfeifer 1988) and damage by birds is generally continuous. The resource owner would be limited in implementing this method contingent upon ownership of or ability to manage the property. Supplemental feeding and the planting of lure crops would be available to other entities within the state.

Modifying human behavior would be methods recommended by WS when providing technical assistance. Recommendations would include modifying the behavior of people that may be attracting or contributing to damage being caused by birds. For example, artificial feeding of waterfowl by people can attract and sustain more birds in an area than could normally be supported by natural food supplies. This unnatural food source can result in an increase in damage caused by waterfowl. Modifying human behavior could include recommending people plant crops that are less attractive or less vulnerable to damage. 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, removal of spilled grain or standing water, and use of bird proof feeders (Johnson and Glahn 1994). Recommendations may include altering planting dates so that crops are less vulnerable to damage when birds may be present. Those recommendations made by WS would be available for implementation by other entities.

Alter aircraft flight patterns could be recommended in cases where the presence of birds at or near airports results in threats to human safety, and when such problems cannot be resolved by other means. However, altering operations at airports to decrease the potential for bird strike hazards would generally not be feasible unless an emergency exists. Otherwise, the expense of interrupted flights and the limitations of existing facilities generally make this practice prohibitive.

Removal of domestic waterfowl could be recommended or implemented by WS and other entities to alleviate damage. Flocks of urban/suburban domestic waterfowl are known to act as decoys and attract other migrating waterfowl (Crisley et al. 1968, Woronecki 1992). Avery (1994) reported that birds learn to locate food sources by watching the behavior of other birds. The removal of domestic waterfowl from water bodies removes birds that act as decoys in attracting other waterfowl. Domestic waterfowl could also carry diseases, which can threaten wild populations. Property or resource owners may be reluctant to remove some or all decoy birds because of the enjoyment of their presence.

Electric fencing could be recommended or implemented by WS and others to alleviate damage caused by waterfowl. The application of electrified fencing would generally be limited to rural settings, due to the possibility/likelihood of interaction with people and pets. Limits of this application arise where there are multiple landowners, the size of the area, and its proximity to bodies of water used by waterfowl. Perceptions from Minnesota on the effectiveness of electric fences were high (Cooper and Keefe 1997). While electric fencing may be effective in repelling waterfowl in some urban settings, its use is often prohibited in many municipalities for human safety reasons. Problems that typically reduce the effectiveness of electric fences include vegetation on fence, flight capable birds, fencing knocked down by other animals (*e.g*., white-tailed deer and dogs), and poor power. Electric fencing would generally be available to all entities.

Barrier fencing could also be recommended or implemented by WS and others. The construction or placement of physical barriers has limited application for birds and would primarily be recommended or employed to alleviate waterfowl damage. Barriers can be temporary or permanent structures. Lawn furniture/ornaments, vehicles, boats, snow fencing, plastic hazard fencing, metal wire fencing, and multiple strand fencing have all been used to limit the movement of Canada Geese. The application of this method would be limited to areas that could be completely enclosed and do not allow waterfowl to land inside enclosures. Similar to most abatement techniques, this method has been most effective when dealing with small numbers of breeding geese and their flightless young along wetlands and/or waterways. Unfortunately, there have been situations where barrier fencing designed to inhibit goose nesting has entrapped young and resulted in starvation (Cooper 1998). The preference for geese to walk or swim, rather than fly, during this time period contributes to the success of barrier fences. Birds that are capable of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993). Barrier fencing would generally be available to all entities.

Surface coverings could be recommended or employed by WS and others to discourage birds from using areas, primarily waterfowl. For example, plastic balls approximately five inches in diameter can be used to cover the surface of a pond and prevent access by waterfowl. A "*ball blanket*" renders a pond unusable for boating, swimming, fishing, and other recreational activities. This method can be very expensive depending on the area covered.

Overhead wire grids consist of wire (*e.g*., fishing line) grid that is stretched over a resource to prevent access by birds. The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. Johnson (1994) found that wire grids could deter crow use of specific areas where they are causing a nuisance. Waterfowl may be excluded from ponds using overhead wire grids (Fairaizl 1992, Lowney 1993) and are most applicable on ponds of two acres or less. Exclusion may be impractical in most settings (*e.g*., commercial agriculture); however, wire grids could be practical in small areas (*e.g.,* personal gardens) or for high-value crops (*e.g*., grapes) (Johnson 1994). A few people would find exclusionary devices such as wire grids unsightly, trashy, and a lowering of the aesthetic value of the neighborhood when used over personal gardens. Wire grids generally render an area unusable by people. The cost of constructing and maintaining wire grids could be burdensome for some people.

Visual scaring techniques such as Mylar tape (highly reflective surface produces flashes of light that startles birds), eyespot balloons (the large eyes supposedly give birds a visual cue that a large predator is present), flags, and/or 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). Reflective tape has been used successfully to repel some birds from crops when spaced at three to five meter intervals (Bruggers et al. 1986, Dolbeer et al. 1986). Mylar flagging has been reported effective at reducing migrant Canada Goose damage to crops (Heinrich and Craven 1990). Other studies have shown reflective tape ineffective (Bruggers et al. 1986, Dolbeer et al. 1986, Tobin et al. 1988, Conover and Dolbeer 1989). 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. Visual scaring techniques can be impractical in many locations and has met with some concerns due to the negative aesthetic appearance presented on the properties where those methods are used.

Dogs can be effective at harassing waterfowl and keeping them off turf and beaches (Conover and Chasko 1985, Castelli and Sleggs 2000). Around water, this technique appears most effective when the body of water to be patrolled is less than two acres in size (Swift and Felegy 2009). Although dogs can be effective in keeping waterfowl off individual properties, they do not contribute to a solution for the larger problem of overabundant goose populations (Castelli and Sleggs 2000). Swift and Felegy (2009) have reported that when harassment with dogs ceases, the number of geese returns to pre-treatment numbers. WS has recommended and encouraged the use of dogs where appropriate.

Scarecrows and effigies often depict predator animals (*e.g*., alligators, owls), people, or mimic distressed target species (*e.g*., dead geese, dead vultures) and they are intended to elicit a flight response from target birds, which disperses those birds from the area. Avery et al. (2002*b*) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Avery et al. (2008*a*) found that effigies could be effective at dispersing crows. However, Conover and Chasko (1985) found an integrated approach (using swan and predator effigies, distress calls, and non-lethal chemical repellents) to be ineffective at scaring or repelling nuisance waterfowl. While Heinrich and Craven (1990) reported that using scarecrows reduced migrant Canada Goose use of agricultural fields in rural areas, their effectiveness in scaring geese from urban/suburban areas was severely limited because geese were not afraid of humans as a result of nearly constant contact with people. In general, scarecrows would be most effective when they were moved frequently, alternated with other methods, and were well maintained. However, scarecrows tend to lose effectiveness over time and become less effective as populations increase (Smith et al. 1999). In general, those methods would be available to all entities.

Alarm or distress calls are electronic devices that mimic the sounds exhibited when target species are in distress, which is intended to cause a flight response and disperse target animals from the area. Alarm calls are given by birds when they detect predators while distress calls are given by birds when they are captured by a predator (Conover 2002). When other birds hear these calls, they know a predator is present or a bird has been captured (Conover 2002). Recordings of both calls have been broadcast in an attempt to scare birds from areas where they are unwanted. Recordings have been effective in scaring starlings from airports and vineyards, gulls from airports and landfills, finches from grain fields, and herons from aquaculture facilities and American crows from roosts (Conover 2002). Aguilera et al. (1991) found distress calls ineffective in causing migratory and resident geese to abandon a pond.

The effectiveness of alarm or distress calls can be reduced as birds become accustomed to the sounds and learn to ignore them. Because alarm or distress calls are given when a bird is being held by a predator or when a predator is present, birds should expect to see a predator when they hear these calls. If they do not, they may become accustomed to alarm or distress calls more quickly. In general, birds tend to habituate to hazing techniques (Zucchi and Bergman 1975, Summers 1985, Aubin 1990). For this reason, scarecrows or effigies should be paired with alarm or distress calls (Conover 2002), pyrotechnics (Mott and Timbrook 1988), or other methods to achieve maximum effectiveness. In some situations, the level of volume required for this method to be effective may disturb local residents or be prohibited by local noise ordinances. Although, Mott and Timbrook (1988) reported distress calls were effective at repelling resident geese 100 meters from the distress unit, the birds would return shortly after the calls stopped. The repellency effect was enhanced when pyrotechnics were used with the distress calls. In some situations, the level of volume required for this method to be effective in urban/suburban areas would be prohibited by local noise ordinances. A similar device, which electronically generates sound, was ineffective at repelling migrant waterfowl (Heinrich and Craven 1990).

Birds hazed from one area where they were causing damage frequently move to another area where they continue to cause damage (Brough 1969, Conover 1984, Summers 1985, Swift and Felegy 2009). Smith et al. (1999) noted that others have reported similar results, stating "*biologists are finding that some techniques (e.g., habitat modifications or scare devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and waterfowl become more accustomed to human activity*". Whitford (2003) used a combination of noise harassment, dogs, nest displacement, and visual harassment to chase geese from an urban park during the nesting season. Birds responded by dispersing and continued harassment with alarm calls prevented recolonization of the site during the nesting season.

Lasers and lights are methods that have been evaluated for a number of species (Glahn et al. 2000, Blackwell et al. 2002). For best results and to disperse numerous birds from a roost, a laser is most effectively used in periods of low light, such as after sunset and before sunrise. In the daytime, the laser can also be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser is much diminished. Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing pigeons and Mallards with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002).

Research on this potential tool has been conducted in a replicated format only for double-crested cormorants (Glahn et al. 2000). Moving the laser light through the tree branches rather than touching birds with the laser light elicited an avoidance response from cormorants (Glahn et al. 2000). During pen trials with lasers, the cormorants were inconsistent in their response with some birds showing no response to the laser (Glahn et al. 2000). The lack of overt response by cormorants to lasers is not clearly understood, but suggests laser light is not a highly aversive agent (Glahn et al. 2000). Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing starlings and cowbirds (Blackwell et al. 2002). Lasers were found to be only moderately effective for harassing geese, with significant reduction in night roosting, but little to no reduction in diurnal activity at the site pre- and post-use (Sherman and Barras 2004). Similar to the use of lasers, application of spotlights to haze birds from night roosts has proven to be a moderately effective method. It is a method that can be incorporated with other methods in integrated management plans (VerCauteren et al. 2003).

Pyrotechnics (screamer shells, bird bombs, and 12-gauge cracker shells) have been used to repel many species of birds (Booth 1994). Aguilera et al. (1991) found 15 mm screamer shells effective at reducing resident and migrant Canada Geese use of areas in Colorado. However, Mott and Timbrook (1988) and Aguilera et al. (1991) doubted the efficacy of harassment and believed that moving the geese simply redistributed the problem to other locations. These devices are sometimes effective but usually only for a short period 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 because of pyrotechnics and propane cannon use.

Fairaizl (1992) and Conomy et al. (1998) found the effectiveness of pyrotechnics highly variable among different flocks of waterfowl. Some flocks in urban areas required continuous harassment throughout the day with frequent discharges of pyrotechnics but the waterfowl usually returned within hours. A minority of resident Canada Goose flocks in Virginia showed no response to pyrotechnics, while some flocks of Canada Geese showed quick response to pyrotechnics during winter months, suggesting migrant geese made up some or all of the flock (Fairaizl 1992). Shultz et al. (1988) reported fidelity of resident Canada Geese to feeding and loafing areas is strong, even when heavy hunting pressure is ongoing. Mott and Timbrook (1988) concluded that the efficacy of harassment with pyrotechnics was partially dependent on availability of alternative loafing and feeding areas. Although one of the more effective methods of frightening geese away, more often than not pyrotechnics simply move geese to other areas. There are also safety and legal implications regarding their use. Discharge of pyrotechnics is inappropriate and prohibited in some urban/suburban areas. Pyrotechnic projectiles can start fires, ricochet off buildings, pose traffic hazards, trigger dogs to bark incessantly, and annoy and possibly injure people. Use of pyrotechnics in certain municipalities would be constrained by local firearm discharge and noise ordinances.

Paintballs and recreational paintball equipment may be used to supplement other harassment methods. Paintballs consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. A paintball marker (or gun) uses compressed CO_2 to propel paintballs an average of 280 feet per second, though they are not very accurate. The discharge of the paintball marker combined with the sound of paintballs hitting the ground or splashing in water may be effective in dispersing birds, especially when combined with other harassment techniques. Although paintballs break easily and velocity rapidly decreases with distance, firing at close range is discouraged to avoid harming birds. As with pyrotechnics, use of paintballs may be restricted in some areas by local ordinances.

Propane cannons produce a noise that is intended to represent a firearm discharge. Cannons are attached to a propane tank and regulated to discharge at certain intervals. Propane cannons are generally inappropriate for urban/suburban areas due to the repeated loud explosions, which many people would consider a serious and unacceptable nuisance and potential health threat (hearing damage). Although a propane cannon can be an effective dispersal tool for birds in agricultural settings, resident waterfowl in urban areas are more tolerant of noise and habituate to propane cannons relatively quickly.

High pressured water spray can serve two purposes: scaring birds from a roost or loafing area and cleaning feces and other particulates from an area. Spray from a high pressure sprayer would be persistent enough to irritate birds and cause them to leave an area, but would not be strong enough to cause physical damage. This method would be preferred when rousing crows or other gregarious bird species from a roost and may even be more acceptable than using loud noises or chemicals. Logistical issues with using this method arise due to the size of the equipment needed and access to water.

Avitrol is a chemical frightening agent (repellent) that can be effective in a single dose when mixed with untreated baits, normally in a 1:9 ratio. However, birds consuming treated baits are generally killed (Johnson and Glahn 1994). Prebaiting is usually necessary to achieve effective bait acceptance by the target species. This chemical has been 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, the affected bird begins to broadcast distress vocalizations and display abnormal flying behavior; thereby, frightening the remaining birds away.

Avitrol is a restricted use pesticide that can only be sold to certified applicators and has been available in several bait formulations where only a small portion of the individual grains carries the chemical. It can be used during anytime of the year, but is used most often during winter and spring. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its availability for intake by organisms from water, is non-accumulative in tissues, and rapidly metabolized by many species (Schafer 1991).

Avitrol is acutely toxic to avian and mammalian species; however, blackbirds are more sensitive to the chemical and there is little evidence of chronic toxicity. Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning and during field use; only magpies and crows appear to have been affected (Schafer 1991). However, a laboratory study by Schafer et al. (1974) showed that magpies exposed to two to 3.2 times the published LD_{50} in contaminated prey for 20 days were not adversely affected and three American Kestrels that were fed contaminated blackbirds for seven to 45 days were not adversely affected. Some hazards may occur to predatory species consuming unabsorbed chemical in the gastrointestinal tract of affected or dead birds (Schafer 1981, Holler and Shafer 1982).

Methyl anthranilate has been used as an artificial grape flavoring in foods and soft drinks for human consumption. Methyl anthranilate could be used or recommended by WS as a bird repellent and would be available for use by other entities. Methyl anthranilate has been shown to be a promising repellent for many bird species, including waterfowl (Dolbeer et al. 1993*b*). Cummings et al. (1995) found the effectiveness of methyl anthranilate declined significantly after 7 days. Belant et al. (1996) found methyl anthranilate ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. Methyl anthranilate has also been investigated 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)[23], nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L)[24], and of relatively low toxicity to fish and other invertebrates. Methyl anthranilate is naturally occurring in concord grapes and in the blossoms of several species of flowers (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 methyl anthranilate are generally considered expensive. A potentially more cost effective method of methyl anthranilate 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 three to five times after the initial treatment before the birds abandon a treatment site.

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 T&E 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.

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[23] 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.

[24] 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.

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 would be posted with warning signs at access points to exclude people from T&E species nesting areas. Treated eggs would not be placed in locations where T&E 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.

Particulate feed additives have been investigated for their bird-repellent characteristics. In pen trials, European Starlings rejected grain to which charcoal particles were adhered. If further research finds this method to be effective and economical in field application, it might become available as a bird repellent on livestock feed. Charcoal feed additives have been explored for use in reducing methane production in livestock and should have no adverse effects on livestock, on meat or milk production, or on human consumers of meat or dairy products.

Other chemical repellents have shown bird repellent capabilities. Anthraquinone is a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism. Anthraquinone 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). Compounds extracted from common spices used in cooking and applied to perches in cage tests have been shown repellent characteristics against roosting European Starlings (Clark 1997). Naphthalene (mothballs) was found to be ineffective in repelling European Starlings (Dolbeer et al. 1988).

Live traps generally allow target bird species to enter inside the trap but prevent them from exiting the trap. Bird live-captured in traps could be translocated or euthanized. Live traps include:

Bow nets are normally used for raptors but may also be used for European Starlings, shorebirds, and other species using visual bait and/or conspecific decoys. Bow nets are remotely triggered from a nearby observation site. Once the net is triggered, the net envelopes the target birds inside the net similar to a suitcase when closed.

Box/cage traps come in a variety of styles to live-capture birds. A visual attractant or bait is generally placed inside the trap to attract target bird species. Target bird species enter the trap to through one-way doors to access the bait or attractant but are then unable to exit.

Decoy traps are similar in design to the Australian Crow Trap as reported by McCracken (1972) and Johnson and Glahn (1994) or typical pigeon traps. 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 the trap through one-way doors and are unable to exit. Active decoy traps are monitored daily, every other day, or as appropriate if food, water, and shelter are provided, to remove and euthanize excess birds and to replenish bait and water.

Drop nets could be suspended over a pre-baited site and manually or remotely triggered to drop on target animals or manually dropped on target birds from a high site such as a bridge or rooftop. Decoys may also be used to enhance the effectiveness of drop nets.

Cannon nets are normally used for larger birds, such as geese or pigeons and use mortar projectiles or compressed air to propel a net up and over birds that have been baited to a particular site.

Foothold traps could be employed to live-captures birds, primarily raptors. Johnson (1994) found that trapping with modified foothold traps could be effective in areas where a small resident crow population is present. No. 0 or 1 foothold traps with padded jaws were used to trap individual birds in areas habitually used by crows. Foothold traps could also be used atop poles to capture raptors. Pole traps are designed to live-capture raptors as they land atop a pole to perch. When landing atop the pole, raptors are captured in modified foothold traps. Traps are attached to a guide wire that runs from the trap down the pole to the ground. Once live-captured by the foothold trap, the trap and raptor slide down the guide wire to the ground for handling. Traps would be monitored a minimum of twice each day to ensure raptors captured were addressed timely.

Nest box traps are effective in capturing local breeding and post breeding European Starlings and other targeted secondary cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976) and operate similar to other live-capture traps. Nest box traps allow birds to enter but not exit.

Nest/walk-in traps are similar to box or decoy traps. They are placed over an active nest or baited with food and allow the target bird to pass through a funnel, one-way, or drop down door that confines the target. Nest and walk-in traps are effective in capturing ground nesting birds such as cormorants, ducks, geese, and ground feeding birds such as Rock Pigeons and Mourning Doves.

Mist nets are more commonly used for capturing small-sized birds but can be used to capture larger birds, such as ducks and smaller raptors. It was introduced into the United States in the 1950s from Asia and the Mediterranean where it was used to capture birds for the market (Day et al. 1980). The mist net is a fine black silk or nylon net usually 3 to 10 feet wide and 25 to 35 feet long. Net mesh size determines the bird species that could be caught and overlapping pockets in the net cause birds to entangle themselves when they fly into the net. Decoys and electronic calls may also be used to enhance the effectiveness of mist nets.

Net guns/launchers are normally used for flocking birds such as waterfowl and European Starlings. They use a firearm blank or compressed air to propel a weighted net up and over birds, which have been baited to a particular site or birds that do not avoid people. Net guns are manually discharged while net launchers are remotely discharged from a nearby observation site.

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

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

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

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. The solubility and mobility are believed to be moderate and environmental persistence is believed to be low. Bioaccumulation in plants and animal tissue is believed to be low. Alpha-chloralose is used in other countries as an avian and mammalian toxicant. The compound is slowly metabolized, with recovery occurring a few hours after administration (Schafer 1991). The dose used for immobilization is designed to be about two to 30 times lower than the LD_{50}. Mammalian data indicate higher LD_{50} values than birds. Toxicity to aquatic organisms is unknown (Woronecki et al. 1990) but the compound is not generally soluble in water and therefore should remain unavailable to aquatic organisms. Factors supporting the determination of this low potential included the lack of exposure to pets, non-target species and the public, and the low toxicity of the active ingredient. Other supporting rationale for this determination included relatively low total annual use and a limited number of potential exposure pathways. The agent is currently approved for use by WS as an Investigative New Animal Drug by the FDA rather than a pesticide.

Inactive 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 that 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.

Live-capture and translocation could be accomplished using methods to live-capture some bird species for translocating and releasing those birds in other areas. WS could employ those methods in Florida when the target animal(s) can legally be translocated or can be captured and handled with relative safety by WS' personnel.

Smith (1996) reported that groups of juvenile geese relocated from urban to rural settings could effectively eliminate these geese from urban areas, retain them at the release site, include them in the sport harvest, and expose them to higher natural mortality. Smith (1996) also reported that multiple survival models indicated that survival estimates of relocated juveniles were half of those of urban captured and released birds. The relocation of resident geese from metropolitan communities can assist in the reduction of overabundant populations (Cooper and Keefe 1997), and translocating geese has generally been accepted by the public as a method of reducing goose populations to socially acceptable levels (Fairaizl 1992, Powell et al. 2003). In areas where interest in hunting is high, the potential exists for moving nuisance geese to areas more accessible by hunters. In addition, the removal of geese posing or likely to pose a hazard to air safety at airports has been demonstrated to reduce the population of local geese and decrease the number of flights through the airport operations airspace, resulting in increased air safety at the Minneapolis-St. Paul International Airport (Cooper 1991).

Live capture and handling of birds poses an additional level of human health and safety threat if target birds are aggressive, large, or extremely sensitive to the close proximity of humans. For that reason, WS may limit this method to specific situations and certain species. In addition, moving damage-causing individuals to other locations can typically result in damage at the new location, or the translocated individuals can move from the relocation site to areas where they are unwanted. In addition, translocation can facilitate the spread of diseases from one area to another. High population densities of some animals may make this a poor wildlife management strategy for those species. Translocation would be evaluated by WS on a case-by-case basis. Translocation would only occur with the prior authorization of the USFWS and/or the FWC.

Nicarbazin is an EPA registered reproductive inhibitor that can be used to reduce egg production and viability in Canada Geese and Rock Pigeons. 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, and 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 four to six 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. This is reached after the second day without bait consumption. Consequently, the bait must be offered to the birds each day of the nesting period to effectively limit reproduction effectively.

LETHAL WILDLIFE DAMAGE MANAGEMENT METHODS

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 typically 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. 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. WS' firearm use and safety would comply with WS Directive 2.615.

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 FWC 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.

Cervical dislocation is sometimes used to euthanize birds that 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 considers this technique as a conditionally acceptable method of euthanasia and states that cervical dislocation when properly executed may be a humane technique for euthanasia of poultry and other small birds (AVMA 2013). Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (Beaver et al. 2001).

Carbon dioxide is sometimes used to euthanize birds that are captured in live traps. Live birds are placed in a container such as a plastic 5-gallon bucket or chamber and sealed shut. Carbon dioxide 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 (AVMA 2013). Carbon dioxide gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is the gas released by dry ice. The use of carbon dioxide by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

Snap traps are modified rat snap traps used to remove individual European Starlings, and other cavity using birds. The trap treadle is baited with peanut butter or other food attractants and attached near the damage area. 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.

Active Nest destruction is the removal of nesting materials during the nesting cycle when eggs are present in the nest. 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 that 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.

Egg addling/destruction are methods 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).

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.

DRC-1339 has proven to be an effective method of starling, blackbird, gull, and pigeon control at feedlots, dairies, airports, and in urban areas for the last 30 years (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 1981, Glahn et al. 1987) and dispersing crow roosts in urban/suburban areas (Boyd and Hall 1987). Blanton et al. (1991) reports that DRC-1339 appears to be a very effective, selective, and safe means of urban pigeon population reduction. Glahn and Wilson (1992) noted that baiting with DRC-1339 is a cost-effective method of reducing damage by blackbirds to sprouting rice.

DRC-1339 is a slow acting avicide that is registered with the EPA for reducing damage from several species of birds, including blackbirds, starlings, pigeons, crows, ravens, magpies, and gulls. DRC-1339 was developed as an avicide because of its differential toxicity to mammals. DRC-1339 is highly toxic to sensitive species but only slightly toxic to non-sensitive birds, predatory birds, and mammals (Schafer 1981, Schafer 1991, Johnston et al. 1999). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/bird to cause death (Royall et al. 1967). Most bird species that are responsible for damage, including starlings, blackbirds, pigeons, crows, magpies, and ravens are highly sensitive to DRC-1339. Many other bird species such as raptors, sparrows, and eagles are classified as non-sensitive (Schafer 1981). Numerous studies show that DRC-1339 poses minimal risk of primary poisoning to non-target and T&E species (EPA 1995). Secondary poisoning has not been observed with DRC-1339 treated baits, except with crows eating gut contents of pigeons (Krebs 1974). During research studies, carcasses of birds that died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds 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 1984, Schafer 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. Currently, DRC-1339 has several EPA Registration Labels (56228-10, 56228-17, 56228-28, 56228-29, and 56228-30) depending on the application or species involved in the damage management project.

APPENDIX C
FEDERAL THREATENED AND ENDANGERED SPECIES
LISTINGS AND OCCURRENCES FOR FLORIDA

Notes:
This list was updated to be current as of 3/20/2018. Results are based on where the species is believed to or known to occur. The FWS feels utilizing this data set is a better representation of species occurrence. Note: there may be other federally listed species that are not currently known or expected to occur in this state but are covered by the ESA wherever they are found; Thus if new surveys detected them in this state they are still covered by the ESA. The FWS is using the best information available on this date to generate this list.
This report shows listed species or populations believed to or known to occur in Florida
This list does not include experimental populations and similarity of appearance listings.
This list includes species or populations under the sole jurisdiction of the National Marine Fisheries Service.

Listed species -- 137 listings
Animals -- 68 listings
StatusSpecies/Listing Name

T	Bankclimber, purple (mussel) Wherever found (*Elliptoideus sloatianus*)
E	bat, Florida bonneted Wherever found (*Eumops floridanus*)
E	Bat, gray Wherever found (*Myotis grisescens*)
E	Bat, Indiana Wherever found (*Myotis sodalis*)
E	Bean, Choctaw Wherever found (*Villosa choctawensis*)
E	Butterfly, Bartram's hairstreak Wherever found (*Strymon acis bartrami*)
E	Butterfly, Florida leafwing Wherever found (*Anaea troglodyta floridalis*)
E	Butterfly, Miami Blue Wherever found (*Cyclargus* (=*Hemiargus*) *thomasi bethunebakeri*)
E	Butterfly, Schaus swallowtail Wherever found (*Heraclides aristodemus ponceanus*)
T	Caracara, Audubon's crested FL pop. (*Polyborus plancus audubonii*)
T	Coral, elkhorn Wherever found (*Acropora palmata*)
T	Coral, staghorn Wherever found (*Acropora cervicornis*)
T	Crocodile, American U.S.A. (FL) (*Crocodylus acutus*)
T	Darter, Okaloosa Wherever found (*Etheostoma okaloosae*)
E	Deer, key Wherever found (*Odocoileus virginianus clavium*)
E	Ebonyshell, round Wherever found (*Fusconaia rotulata*)
E	Kidneyshell, southern Wherever found (*Ptychobranchus jonesi*)
E	Kite, Everglade snail Wherever found (*Rostrhamus sociabilis plumbeus*)
T	Knot, red Wherever found (*Calidris canutus rufa*)
T	Manatee, West Indian Wherever found (*Trichechus manatus*)
E	Moccasinshell, Gulf Wherever found (*Medionidus penicillatus*)
E	Moccasinshell, Ochlockonee Wherever found (*Medionidus simpsonianus*)
T	Moccasinshell, Suwannee Wherever found (*Medionidus walkeri*)
E	Mouse, Anastasia Island beach Wherever found (*Peromyscus polionotus phasma*)
E	Mouse, Choctawhatchee beach Wherever found (*Peromyscus polionotus allophrys*)
E	Mouse, Key Largo cotton Wherever found (*Peromyscus gossypinus allapaticola*)
E	Mouse, Perdido Key beach Wherever found (*Peromyscus polionotus trissyllepsis*)
T	Mouse, southeastern beach wherever found (*Peromyscus polionotus niveiventris*)
E	Mouse, St. Andrew beach Wherever found (*Peromyscus polionotus peninsularis*)
E	Panther, Florida Wherever found (*Puma* (=*Felis*) *concolor coryi*)
T	Pigtoe, fuzzy Wherever found (*Pleurobema strodeanum*)
T	Pigtoe, narrow Wherever found (*Fusconaia escambia*)

StatusSpecies/Listing Name

E Pigtoe, oval Wherever found (*Pleurobema pyriforme*)
T Pigtoe, tapered Wherever found (*Fusconaia burkei*)

T Plover, piping [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. (*Charadrius melodus*)
E Pocketbook, shinyrayed Wherever found (*Lampsilis subangulata*)
E Rabbit, Lower Keys marsh Wherever found (*Sylvilagus palustris hefneri*)
E Rice rat lower FL Keys (*Oryzomys palustris natator*)
T Salamander, frosted flatwoods Wherever found (*Ambystoma cingulatum*)
E salamander, Reticulated flatwoods Wherever found (*Ambystoma bishopi*)
T sandshell, Southern Wherever found (*Hamiota australis*)
E Sawfish, smalltooth US DPS - Smalltooth sawfish originating from U.S. waters. (*Pristis pectinata*)
T scrub-jay, Florida Wherever found (*Aphelocoma coerulescens*)
T Sea turtle, green North Atlantic DPS (*Chelonia mydas*)
E Sea turtle, hawksbill Wherever found (*Eretmochelys imbricata*)
E Sea turtle, Kemp's ridley Wherever found (*Lepidochelys kempii*)
E Sea turtle, leatherback Wherever found (*Dermochelys coriacea*)
T Sea turtle, loggerhead Northwest Atlantic Ocean DPS (*Caretta caretta*)
T Shrimp, Squirrel Chimney Cave Wherever found (*Palaemonetes cummingi*)
T Skink, bluetail mole Wherever found (*Eumeces egregius lividus*)
T Skink, sand Wherever found (*Neoseps reynoldsi*)
T Slabshell, Chipola Wherever found (*Elliptio chipolaensis*)
T Snail, Stock Island tree Wherever found (*Orthalicus reses* (not incl. *nesodryas*))
T Snake, Atlantic salt marsh Wherever found (*Nerodia clarkii taeniata*)
T Snake, eastern indigo Wherever found (*Drymarchon corais couperi*)
E Sparrow, Cape Sable seaside Wherever found (*Ammodramus maritimus mirabilis*)
E Sparrow, Florida grasshopper Wherever found (*Ammodramus savannarum floridanus*)
T Stork, wood AL, FL, GA, MS, NC, SC (*Mycteria americana*)
T Sturgeon (Gulf subspecies), Atlantic Wherever found (*Acipenser oxyrinchus* (=*oxyrhynchus*) *desotoi*)
T Tern, roseate Western Hemisphere except NE U.S. (*Sterna dougallii dougallii*)
E Threeridge, fat (mussel) Wherever found (*Amblema neislerii*)
E Tiger beetle, Miami Wherever found (*Cicindelidia floridana*)
E Vole, Florida salt marsh Wherever found (*Microtus pennsylvanicus dukecampbelli*)
E Warbler, Kirtland's Wherever found (*Setophaga kirtlandii* (= *Dendroica kirtlandii*))
E Warbler (=wood), Bachman's Wherever found (*Vermivora bachmanii*)
E Wolf, red Wherever found, except where listed as an experimental population (*Canis rufus*)
E Woodpecker, red-cockaded Wherever found (*Picoides borealis*)
E Woodrat, Key Largo Wherever found (*Neotoma floridana smalli*)

Plants -- 69 listings
Status Species/Listing Name

E Aster, Florida golden (*Chrysopsis floridana*)
E Beargrass, Britton's (*Nolina brittoniana*)
E Beauty, Harper's (*Harperocallis flava*)
E Bellflower, Brooksville (*Campanula robinsiae*)
T Birds-in-a-nest, white (*Macbridea alba*)
E Blazingstar, scrub (*Liatris ohlingerae*)

Status	Species/Listing Name
T	Bonamia, Florida (*Bonamia grandiflora*)
E	Brickell-bush, Florida (*Brickellia mosieri*)
T	Buckwheat, scrub (*Eriogonum longifolium* var. *gnaphalifolium*)
T	Bully, Everglades (*Sideroxylon reclinatum* ssp. *austrofloridense*)
T	Butterwort, Godfrey's (*Pinguicula ionantha*)
E	Cactus, Florida semaphore (*Consolea corallicola*)
E	Cactus, Key tree (*Pilosocereus robinii*)
E	Campion, fringed (*Silene polypetala*)
E	Chaffseed, American (*Schwalbea americana*)
E	Cladonia, Florida perforate (*Cladonia perforata*)
T	Crabgrass, Florida pineland (*Digitaria pauciflora*)
E	fern, Florida bristle (*Trichomanes punctatum* ssp. *floridanum*)
E	Flax, Carter's small-flowered (*Linum carteri carteri*)
E	Flax, sand (*Linum arenicola*)
E	Fringe-tree, pygmy (*Chionanthus pygmaeus*)
T	Gooseberry, Miccosukee (*Ribes echinellum*)
E	Gourd, Okeechobee (*Cucurbita okeechobeensis* ssp. *okeechobeensis*)
E	Harebells, Avon Park (*Crotalaria avonensis*)
E	Hypericum, highlands scrub (*Hypericum cumulicola*)
E	Jacquemontia, beach (*Jacquemontia reclinata*)
E	Lead-plant, Crenulate (*Amorpha crenulata*)
E	Lupine, scrub (*Lupinus aridorum*)
E	Meadowrue, Cooley's (*Thalictrum cooleyi*)
E	Milkpea, Small's (*Galactia smallii*)
E	Mint, Garrett's (*Dicerandra christmanii*)
E	Mint, Lakela's (*Dicerandra immaculata*)
E	Mint, longspurred (*Dicerandra cornutissima*)
E	Mint, scrub (*Dicerandra frutescens*)
E	Mustard, Carter's (*Warea carteri*)
E	Pawpaw, beautiful (*Deeringothamnus pulchellus*)
E	Pawpaw, four-petal (*Asimina tetramera*)
E	Pawpaw, Rugel's (*Deeringothamnus rugelii*)
E	Pea, Big Pine partridge (*Chamaecrista lineata keyensis*)
T	Pigeon wings (*Clitoria fragrans*)
E	Pinkroot, gentian (*Spigelia gentianoides*)
E	Plum, scrub (*Prunus geniculata*)
E	Polygala, Lewton's (*Polygala lewtonii*)
E	Polygala, tiny (*Polygala smallii*)
E	Prairie-clover, Florida (*Dalea carthagenensis floridana*)
E	Prickly-apple, aboriginal (*Harrisia* (=*Cereus*) *aboriginum* (=*gracilis*))
E	Prickly-apple, fragrant (*Cereus eriophorus* var. *fragrans*)
E	Remya, Maui (*Remya mauiensis*)
E	Rhododendron, Chapman (*Rhododendron chapmanii*)
E	Rosemary, Apalachicola (*Conradina glabra*)
E	Rosemary, Etonia (*Conradina etonia*)
E	Rosemary, short-leaved (*Conradina brevifolia*)
E	Sandlace (*Polygonella myriophylla*)
T	Sandmat, pineland (*Chamaesyce deltoidea pinetorum*)
T	Seagrass, Johnson's (*Halophila johnsonii*)

Status	Species/Listing Name
T	silverbush, Blodgett's (*Argythamnia blodgettii*)
T	Skullcap, Florida (*Scutellaria floridana*)
E	Snakeroot (*Eryngium cuneifolium*)
E	Spurge, deltoid (*Chamaesyce deltoidea* ssp. *deltoidea*)
T	Spurge, Garber's (*Chamaesyce garberi*)
T	Spurge, telephus (*Euphorbia telephioid*es)
E	Spurge, wedge (*Chamaesyce deltoidea serpyllum*)
E	Thoroughwort, Cape Sable (*Chromolaena frustrata*)
E	Torreya, Florida (*Torreya taxifolia*)
E	Warea, wide-leaf (*Warea amplexifolia*)
E	Water-willow, Cooley's (*Justicia cooleyi*)
T	Whitlow-wort, papery (*Paronychia chartacea*)
E	Wireweed (*Polygonella basiramia*)
E	Ziziphus, Florida (*Ziziphus celata*)

APPENDIX D
STATE THREATENED AND ENDANGERED SPECIES (3-30-2018)

VERTEBRATES

AMPHIBIANS

Common Name	Scientific Name	Status
Florida bog frog	*Lithobates okaloosae*	ST
Frosted flatwoods salamander	*Ambystoma cingulatum*	FT
Georgia blind salamander	*Haideotriton wallacei*	ST
Reticulated flatwoods salamander	*Ambystoma bishopi*	FE

BIRDS

Common Name	*Scientific Name*	Status
American oystercatcher	*Haematopus palliatus*	ST
Audubon's crested caracara	*Polyborus plancus audubonii*	FT
Bachman's wood warbler	*Vermivora bachmanii*	FE
Black skimmer	*Rynchops niger*	ST
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	FE
Eskimo curlew	*Numenius borealis*	FE
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	FE
Florida burrowing owl	*Athene cunicularia floridana*	ST
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	FE
Florida sandhill crane	*Antigone canadensis pratensis*	ST
Florida scrub-jay	*Aphelocoma coerulescens*	FT
Ivory-billed woodpecker	*Campephilus principalis*	FE
Kirtland's warbler (Kirtland's wood warbler)	*Setophaga kirtlandii (Dendroica kirtlandii)*	FE
Least tern	*Sternula antillarum*	ST
Little blue heron	*Egretta caerulea*	ST
Marian's marsh wren	*Cistothorus palustris marianae*	ST
Osprey[2]	*Pandion haliaetus*	SSC
Piping plover	*Charadrius melodus*	FT
Red-cockaded woodpecker	*Picoides borealis*	FE
Reddish egret	*Egretta rufescens*	ST
Roseate spoonbill	*Platalea ajaja*	ST
Roseate tern	*Sterna dougallii dougallii*	FT
Rufa red knot	*Calidris canutus rufa*	FT
Scott's seaside sparrow	*Ammodramus maritimus peninsulae*	ST
Snowy plover	*Charadrius nivosus*	ST
Southeastern American kestrel	*Falco sparverius paulus*	ST
Tricolored heron	*Egretta tricolor*	ST

Common Name	Scientific Name	Status
Wakulla seaside sparrow	*Ammodramus maritimus juncicola*	ST
White-crowned pigeon	*Patagioenas leucocephala*	ST
Whooping crane	*Grus americana*	FXN
Worthington's marsh wren	*Cistothorus palustris griseus*	ST
Wood stork	*Mycteria americana*	FT

FISH

Common Name	Scientific Name	Status
Atlantic sturgeon	*Acipenser oxyrinchus*	FE
Blackmouth shiner	*Notropis melanostomus*	ST
Bluenose shiner	*Pteronotropis welaka*	ST
Crystal darter	*Crystallaria asprella*	ST
Gulf sturgeon	*Acipenser oxyrinchus [=oxyrhynchus] desotoi*	FT[1]
Harlequin darter	*Etheostoma histrio*	SSC
Key silverside	*Menidia conchorum*	ST
Okaloosa darter	*Etheostoma okalossae*	FT
Saltmarsh topminnow	*Fundulus jenkinsi*	ST
Shortnose sturgeon	*Acipenser brevirostrum*	FE[1]
Smalltooth sawfish	*Pristis pectinate*	FE
Southern tessellated darter	*Etheostoma olmstedi maculaticeps*	ST

MAMMALS

Common Name	*Scientific Name*	Status
Anastasia Island beach mouse	*Peromyscus polionotus phasma*	FE
Big Cypress fox squirrel	*Sciurus niger avicennia*	ST
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	FE
Everglades mink	*Neovison vison evergladensis*	ST
Finback whale	*Balaenoptera physalus*	FE[1]
Florida bonneted bat	*Eumops floridanus*	FE
Florida panther	*Puma [=Felis] concolor coryi*	FE
Florida salt marsh vole	*Microtus pennsylvanicus dukecampbelli*	FE
Gray bat	*Myotis grisescens*	FE
Gray wolf	*Canis lupus*	FE[3]
Homosassa shrew	*Sorex longirostris eonis*	SSC
Humpback whale	*Megaptera novaeangliae*	FE[1]
Indiana bat	*Myotis sodalis*	FE
Key deer	*Odocoileus virginianus clavium*	FE
Key Largo cotton mouse	*Peromyscus gossypinus allapaticola*	FE
Key Largo woodrat	*Neotoma floridana smalli*	FE
Lower Keys rabbit	*Sylvilagus palustris hefneri*	FE

Common Name	Scientific Name	Status
North Atlantic right whale	*Eubalaena glacialis*	FE[1]
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	FE
Red wolf	*Canis rufus*	FE
Rice rat	*Oryzomys palustris natator*	FE[4]
Sanibel [Island] rice rat	*Oryzomys palustris sanibeli*	ST
Sei whale	*Balaenoptera borealis*	FE[1]
Sherman's fox squirrel	*Sciurus niger shermani*	SSC
Sherman's short-tailed shrew	*Blarina shermani*	ST
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	FT
Sperm whale	*Physeter catodon [=macrocephalus]*	FE[1]
St. Andrew beach mouse	*Peromyscus polionotus peninsularis*	FE
West Indian manatee (Florida manatee)	*Trichechus manatus* (*Trichechus manatus latirostris*)	FT[1]

REPTILES

Common Name	Scientific Name	Status
Alligator snapping turtle	*Macrochelys temminckii*	SSC
American alligator	*Alligator mississippiensis*	FT(S/A)
American crocodile	*Crocodylus acutus*	FT
Atlantic salt marsh snake	*Nerodia clarkii taeniata*	FT
Barbour's map turtle	*Graptemys barbouri*	ST
Bluetail mole skink	*Eumeces egregius lividus*	FT
Eastern indigo snake	*Drymarchon corais couperi*	FT
Florida brown snake[1]	*Storeria victa*	ST
Florida Keys mole skink	*Eumeces egregius egregius*	ST
Florida pine snake	*Pituophis melanoleucus mugitus*	ST
Gopher tortoise	*Gopherus polyphemus*	ST
Green sea turtle	*Chelonia mydas*	FT[1]
Hawksbill sea turtle	*Eretmochelys imbricata*	FE[1]
Kemp's ridley sea turtle	*Lepidochelys kempii*	FE[1]
Key ringneck snake	*Diadophis punctatus acricus*	ST
Leatherback sea turtle	*Dermochelys coriacea*	FE[1]
Loggerhead sea turtle	*Caretta caretta*	FT[1]
Rim rock crowned snake	*Tantilla oolitica*	ST
Sand skink	*Neoseps reynoldsi*	FT
Short-tailed snake	*Stilosoma extenuatum*	ST

INVERTEBRATES

CORALS

Common Name	***Scientific Name***	**Status**
Boulder star coral	*Orbicella franksi*	FT
Elkhorn coral	*Acropora palmata*	FT
Lobed star coral	*Orbicella annularis*	FT
Mountainous star coral	*Orbicella faveolata*	FT
Pillar coral	*Dendrogyra cylindricus*	FT
Rough cactus coral	*Mycetophyllia ferox*	FT
Staghorn coral	*Acropora cervicornis*	FT

CRUSTACEANS

Common Name	**Scientific Name**	**Status**
Black Creek crayfish	*Procambarus pictus*	ST
Panama City crayfish	*Procambarus econfinae*	SSC
Santa Fe [Cave] crayfish	*Procambarus erythrops*	ST
Squirrel Chimney Cave shrimp	*Palaemonetes cummingi*	FT

INSECTS

Common Name	**Scientific Name**	**Status**
American burying beetle	*Nicrophorus americanus*	FE
Bartram's scrub-hairstreak	*Strymon acisbartrami*	FE
Cassius blue butterfly	*Leptotes cassius theonus*	FT(S/A)
Ceraunus blue butterfly	*Hemiargus ceraunus antibubastus*	FT(S/A)
Florida leafwing butterfly	*Anaea troglodyta floridalis*	FE
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	FE
Miami tiger beetle	*Cicindelidia floridana*	FE
Nickerbean blue butterfly	*Cyclargus ammon*	FT(S/A)
Schaus' swallowtail butterfly	*Heraclides aristodemus ponceanus*	FE

MOLLUSKS

Common Name	***Scientific Name***	**Status**
Chipola slabshell (mussel)	*Elliptio chiplolaensis*	FT
Choctaw bean	*Villosa choctawensis*	FE
Fat threeridge (mussel)	*Amblema neislerii*	FE
Fuzzy pigtoe	*Pleurobema strodeanum*	FT
Gulf moccasinshell (mussel)	*Medionidus penicillatus*	FE
Narrow pigtoe	*Fusconai escambia*	FT
Ochlockonee moccasinshell (mussel)	*Medionidus simpsonianus*	FE
Oval pigtoe (mussel)	*Pleurobema pyriforme*	FE
Purple bankclimber (mussel)	*Elliptoideus sloatianus*	FT
Round ebonyshell	*Fusconaia rotulata*	FE

Common Name	***Scientific Name***	**Status**
Shinyrayed pocketbook (mussel)	*Lampsilis subangulata*	FE
Southern kidneyshell	*Ptychobranchus jonesi*	FE
Southern sandshell	*Hamiota australis*	FT
Stock Island tree snail	*Orthalicus reses [not incl. nesodryas]*	FT
Suwannee moccasinshell	*Medionidus walker*	FT
Tapered pigtoe	*Fusconaia burki*	FT

List Abbreviations
FWC = Florida Fish and Wildlife Conservation Commission
FE = Federally-designated Endangered
FT = Federally-designated Threatened
FXN = Federally-designated Threatened Nonessential Experimental Population
FT(S/A) = Federally-designated Threatened species due to similarity of appearance
ST = State-designated Threatened
SSC = State Species of Special Concern

List Notations
1 A species for which the FWC does not have constitutional authority.
2 Monroe County population only.
3 Not documented in Florida.
4 Lower keys population only.

APPENDIX E
ADDITIONAL TARGET SPECIES THAT WS COULD ADDRESS IN FLORIDA

In addition to the bird species identified in Chapter 1, WS could also receive requests for assistance to manage damage and threats of damage associated with several other bird species but those requests would occur infrequently or the requests would involve only a few individual birds. Damages and threats of damages associated with those species would occur primarily at airports where those species pose a threat of aircraft strikes. WS anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. Under Alternative 1, WS could receive requests for assistance to use lethal methods to remove those species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model. An example could include birds that pose an immediate strike threat at an airport where attempts to disperse the birds were ineffective.

Those species that the WS program in Florida could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage include Black-bellied Whistling Duck (*Dendrocygna autumnalis*), Snow Goose (*Anser caerulescens*), Wood Duck (*Aix sponsa*), Northern Shoveler (*Spatula clypeata*), Northern Pintail (*Anas acuta*), Green-winged Teal (*Anas crecca*), Redhead (*Aythya Americana*), Ring-necked Duck (*Aythya collaris*), Hooded Merganser (*Lophodytes cucullatus*), Common Merganser (*Mergus merganser*), Red-breasted Merganser (*Mergus serrator*), Ruddy Duck (*Oxyura jamaicensis*), Northern Bobwhite (*Colinus virginianus*), Pied-billed Grebe (*Podilymbus podiceps*), Common Ground-Dove (*Columbina passerina*), Chimney Swift (*Chaetura pelagica*), Common Gallinule (*Gallinula galeata*), Sandhill Crane (*Antigone canadensis*), American Oystercatcher (*Haematopus palliatus*), Black-bellied Plover (*Pluvialis squatarola*), American Golden Plover (*Pluvialis dominica*), Wilson's Plover (*Charadrius wilsonia*), Semipalmated Plover (*Charadrius semipalmatus*), Upland Sandpiper (*Bartramia longicauda*), Ruddy Turnstone (*Arenaria interpres*), Sanderling (*Calidris alba*), Buff-breasted Sandpiper (*Calidris subruficollis*), Pectoral Sandpiper (*Calidris melanotos*), Short-billed Dowitcher (*Limnodromus griseus*), American Woodcock (*Scolopax minor*), Wilson's Snipe (*Gallinago delicata*), Spotted Sandpiper (*Actitis macularius*), Solitary Sandpiper (*Tringa solitaria*), Lesser Yellowlegs (*Tringa flavipes*), Willet (*Tringa semipalmata*), Greater Yellowlegs (*Tringa melanoleuca*), Lesser Black-backed Gull (*Larus fuscus*), Great Black-backed Gull (*Larus marinus*), Least Tern (*Sternula antillarum*), Gull-billed Tern (*Gelochelidon nilotica*), Common Tern (*Sterna hirundo*), Royal Tern (*Thalasseus maximus*), Sandwich Tern (*Thalasseus sandvicensis*), Common Loon (*Gavia immer*), Anhinga (*Anhinga anhinga*), American White Pelican (*Pelecanus erythrorhynchos*), American Bitterns (*Botaurus lentiginosus*), Snowy Egret (*Egretta thula*), Little Blue Heron (*Egretta caerulea*), Tricolored Heron (*Egretta tricolor*), Green Heron (*Butorides virescens*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Yellow-crowned Night-Heron (*Nyctanassa violacea*), White Ibis (*Eudocimus albus*), Glossy Ibis (*Plegadis falcinellus*), Roseate Spoonbill (*Platalea ajaja*), Northern Harrier (*Circus hudsonius*), Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*Accipiter cooperii*), Broad-winged Hawk (*Buteo platypterus*), Eastern Screech-Owl (*Megascops asio*), Great Horned Owl (*Bubo virginianus*), Barred Owl (*Strix varia*), Belted Kingfisher (*Megaceryle alcyon*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Downy Woodpecker (*Picoides pubescens*), Pileated Woodpecker (*Dryocopus pileatus*), Eastern Kingbird (*Tyrannus tyrannus*), Loggerhead Shrike (*Lanius ludovicianus*), Blue Jay (*Cyanocitta cristata*), Bank Swallow (*Riparia riparia*), Cliff Swallow (*Petrochelidon pyrrhonota*), Cave Swallow (*Petrochelidon fulva*), Gray Catbird (*Dumetella carolinensis*), Northern Mockingbird (*Mimus polyglottos*), Common Myna (*Acridotheres tristis*), Cedar Waxwing (*Bombycilla cedrorum*), House Finch (*Haemorhous mexicanus*), Bobolink (*Dolichonyx oryzivorus*), Rusty Blackbird (*Euphagus carolinus*), and the Northern Cardinal (*Cardinalis cardinalis*).

Many of those bird species can cause damage to or pose threats to a variety of resources. The bird species associated with requests for assistance that WS could receive and the resource types those bird species primarily damage in Florida occur in Table E-1. Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, WS would not lethally remove more than 25 individuals annually of any of those species identified in Table E-1.

Table E-1: Additional bird species that WS could address in Florida and the resource types damaged by those species

Species	Resource* A	N	P	H	Species	Resource A	N	P	H
Black-bellied Whistling Duck			X	X	Royal Tern			X	X
Snow Goose			X	X	Sandwich Tern			X	X
Wood Duck			X	X	Common Loon			X	X
Northern Shoveler			X	X	Anhinga			X	X
Northern Pintail			X	X	American White Pelican	X		X	X
Green-winged Teal			X	X	American Bittern			X	X
Redhead			X	X	Snowy Egret	X	X	X	X
Ring-necked Duck			X	X	Little Blue Heron	X	X	X	X
Hooded Merganser			X	X	Tricolored Heron	X	X	X	X
Common Merganser			X	X	Green Heron	X	X	X	X
Red-breasted Merganser			X	X	Black-crowned Night-Heron	X	X	X	X
Ruddy Duck			X	X	Yellow-crowned Night-heron	X	X	X	X
Northern Bobwhite			X	X	White Ibis			X	X
Pied-billed Grebe			X	X	Glossy Ibis			X	X
Common Ground-Dove			X	X	Roseate Spoonbill			X	X
Chimney Swift			X	X	Northern Harrier	X	X	X	X
Common Gallinule			X	X	Sharp-shinned Hawk	X	X	X	X
Sandhill Crane	X		X	X	Cooper's Hawk	X	X	X	X
American Oystercatcher			X	X	Broad-winged Hawk	X	X	X	X
Black-bellied Plover			X	X	Eastern Screech-Owl	X	X	X	X
American Golden Plover			X	X	Great Horned Owl	X	X	X	X
Wilson's Plover			X	X	Barred Owl	X	X	X	X
Semipalmated Plover			X	X	Belted Kingfisher	X	X	X	X
Upland Sandpiper			X	X	Red-headed Woodpecker			X	X
Ruddy Turnstone			X	X	Downy Woodpecker			X	X
Sanderling			X	X	Pileated Woodpecker			X	X
Buff-breasted Sandpiper			X	X	Eastern Kingbird			X	X
Pectoral Sandpiper			X	X	Loggerhead Shrike			X	X
Short-billed Dowitcher			X	X	Blue Jay			X	X
American Woodcock			X	X	Bank Swallow			X	X
Wilson's Snipe			X	X	Cliff Swallow			X	X
Spotted Sandpiper			X	X	Cave Swallow			X	X
Solitary Sandpiper			X	X	Gray Catbird			X	X
Lesser Yellowlegs			X	X	Northern Mockingbird			X	X
Willet			X	X	Common Myna		X	X	X
Greater Yellowlegs			X	X	Cedar Waxwing			X	X
Lesser Black-backed Gull	X	X	X	X	House Finch			X	X
Great Black-backed Gull	X	X	X	X	Bobolink			X	X
Least Tern			X	X	Rusty Blackbird			X	X
Gull-billed Tern			X	X	Northern Cardinal			X	X
Common Tern			X	X					

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

People can harvest Black-bellied Whistling Ducks, Wood Ducks, Northern Pintail, Green-winged Teal, Redheads, Ring-necked Ducks, Snow Geese, Northern Shoveler, Ruddy Ducks, Common Gallinule, Hooded Mergansers, Common Mergansers, Red-breasted Mergansers, Northern Bobwhite, Wilson's Snipe, and American Woodcock in the State during annual hunting seasons.

Most requests for assistance associated with waterfowl species occur near airports where waterfowl and other waterbirds may aggregate in large numbers in wet areas or on large bodies of water in close proximity to active runways, posing a strike risk and threat to human safety. Assistance may also be requested by fish hatcheries in the State that are receiving damage from fish-eating birds, such as mergansers, or from urban parks with large resident waterfowl populations that may be accumulating feces in public areas or behaving aggressively toward visitors. In addition, waterfowl may sometimes be used as bioindicators to assess environmental quality and, thus, individuals of these species are frequently sampled for environmental toxins, viruses, and/or bacterial organisms. When compared to the annual take levels of these species from hunting, WS' take of up to 25 individuals a year would have little impact on the population or hunter harvest.

In addition, to alleviate damage or discourage nesting in areas where damages were occurring, WS could destroy up to 10 active nests annually of those species listed in Table E-1 that nest in the State, including eggs in those nests. The destruction of active nests (those nests containing eggs or nestlings) can only occur when the USFWS and/or the FWC permits those activities and only at the levels they permit. People can destroy inactive nests (those nests that do not contain eggs or nestlings) without the need for a depredation permit from the USFWS or the FWC. People often use nest destruction to alleviate damage associated with the nesting activities and/or to discourage nesting in an area where damage occur or could occur. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success and they will relocate to nest elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individuals affected by nest destruction, this activity has no long-term effect on breeding adult birds. WS does not use nest destruction as a population management method. WS uses nest destruction to inhibit nesting in an area experiencing damage due to or associated with the nesting activity and those activities only occur at a localized level. If WS' personnel encounter eggs and/or nestlings in an active nest, WS could destroy the eggs by egg addling, egg oiling, shaking the egg, or by breaking the eggs open. If WS' personnel encountered nestlings in an active nest, WS' personnel would euthanize those nestlings in accordance with WS Directive 2.505. For the purposes of the analysis for those target bird species addressed in Appendix E, WS will consider nestlings euthanized as part of the cumulative take of a target bird species.

WS does not expect the annual take of those species identified in Table E-1 to occur at any level that would adversely affect populations of those species. Take would be limited to those individuals deemed causing damage or posing a threat. The MBTA protects most of those bird species from take unless the USFWS permits the take pursuant to the MBTA. In addition, the FWC may also require a permit to lethally take those bird species. If the USFWS and/or the FWC did not issue a permit, no take would occur by WS. In addition, take could only occur at those levels stipulated in a permit. Therefore, the take of those bird species would occur in accordance with applicable state and federal laws and regulations authorizing take of migratory birds and their active nests and eggs, including the USFWS and/or the FWC permitting processes. The USFWS and/or the FWC, as the agencies 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 effects on those bird populations would not have a significant adverse effect on the quality of the human environment. In addition, WS would report annually to the USFWS and/or the FWC any take of the bird species listed in Table E-1 in accordance with a federal and/or state permit.

Under FAC 68A-27.003, the State of Florida has designated several wildlife species as threatened or endangered, which includes several bird species addressed in this EA. Table E-2 identifies those bird species designated by the State of Florida as threatened or endangered that WS could address infrequently or in limited numbers. Requests for assistance associated with those species would primarily occur at airports in the State. Table E-2 is not a complete list of species designated by the State of Florida as threatened or endangered (see Appendix D). Table E-2 only includes those bird species that WS could address infrequently or in limited numbers. Chapter 4 identifies other bird species the FWC has designated as threatened or endangered that WS could address to alleviate damage or threats of damage. The lethal take of wildlife species listed as threatened or endangered by the FWC is prohibited under FAC 68A-27.003 and FAC 68A-27.0011 unless allowed by a specific federal or state permit or authorization. However, under FAC 68A-9.012, the lethal take of wildlife, including those species listed as endangered or threatened designated by the state in FAC 68A-27.003, can occur on properties of airports to alleviate aircraft strike risks when meeting the provisions within FAC 68A-9.012.

Table E-2: Bird species designated by the State of Florida as threatened or endangered that WS could address infrequently or in limited numbers†*

Species	Scientific Name	State Designation‡
American Oystercatcher	*Haematopus palliates*	ST
Florida Sandhill Crane	*Antigone canadensis pratensis*	ST
Least Tern	*Sternula antillarum*	ST
Little Blue Heron	*Egretta caerulea*	ST
Roseate Spoonbill	*Platalea ajaja*	ST
Tricolored Heron	*Egretta tricolor*	ST

†Table E-2 is not a complete list of species designated by the State of Florida as threatened or endangered (see Appendix D). Table E-2 only includes those bird species that WS could address infrequently or in limited numbers. Chapter 4 identifies other bird species the FWC has designated as threatened or endangered that WS could address to alleviate damage or threats of damage.

*The USFWS has not designated any of the species as federally threatened or endangered in Florida pursuant to the ESA

‡SE=State-designated endangered; ST=State-designated threatened

Provisions under FAC 68A-9.012 include the use of non-lethal harassment methods and the reporting of any lethal take to the FWC within five days of take occurring. The permitting of the take by the USFWS and the FWC ensures the take of each species occurs within population management objectives for those species and is conducted pursuant to federal and state laws and regulations.