ENVIRONMENTAL ASSESSMENT
(Final)

Managing Damage and Threats of Damage Caused by Birds in Georgia

Prepared by

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

In Cooperation with:

Tennessee Valley Authority

October 2023

EXECUTIVE SUMMARY

Wildlife are an important public resource that can provide economic, recreational, emotional, and esthetic benefits to many people. However, wildlife can cause damage to agricultural resources, natural resources, property, and threaten human safety. When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other federal, tribal, or state natural resources agencies or private conservation organizations. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife. Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from WS. In Georgia, WS has and continues to receive requests for assistance to reduce and prevent damage associated with several bird species, including requests for assistance to manage bird damage from the Tennessee Valley Authority (TVA) on property they own or manage in Georgia.

The National Environmental Policy Act (NEPA) requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. Therefore, if WS provided assistance by conducting activities to manage damage caused by bird species, those activities would be a federal action requiring compliance with the NEPA. The NEPA requires federal agencies to have available and fully consider detailed information regarding environmental effects of federal actions and to make information regarding environmental effects available to interested persons and agencies. To comply with the NEPA, WS, in cooperation with the TVA, prepared this Environmental Assessment (EA) to determine whether the potential environmental effects caused by several alternative approaches to managing bird damage might be significant, requiring the preparation of an Environmental Impact Statement (EIS). WS developed this EA under the 1978 NEPA regulations and existing APHIS NEPA implementing procedures because WS initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020.

Chapter 1 discusses the need for action and the scope of analysis associated with requests for assistance that WS receives involving several bird species in Georgia, including requests for assistance that WS could receive from the TVA to manage bird damage on property they own or manage. Chapter 2 identifies and discusses the issues (*i.e.*, concerns regarding potential effects that might occur from proposed activities) that WS and the TVA identified during the scoping process for this EA and through consultation with state and federal agencies. Federal agencies must consider such issues during the decision-making process required by the NEPA. Chapter 2 also discusses the alternative approaches that WS and the TVA developed to meet the need for action and to address the issues identified during the scoping process.

Issues of concern addressed in detail include: 1) effects on target bird populations, 2) effects on non-target species, including threatened and endangered species, 3) effects of management methods on human health and safety, and 4) humaneness and animal welfare concerns of methods. Alternative approaches evaluated to meet the need for action and to address the issues include: 1) continuing the current integrated methods approach to managing damage, 2) using an integrated methods approach using only non-lethal methods, 3) addressing requests for assistance through technical assistance only, and 4) no involvement by WS. Depending on the alternative approach, several methods would be available to manage damage caused by birds in the state. Appendix B discusses the methods that WS could consider when responding to a request for assistance and the methods the TVA could allow WS to use on property they own or manage.

Chapter 3 provides information needed for making informed decisions by comparing the environmental consequences of the four alternative approaches to determine the extent of actual or potential impacts on each of the issues. WS and the TVA will use the analyses in this EA to help inform agency decision-makers of the significance of the environmental effects, which will aid decision-makers in determining the need to prepare an EIS or concluding the EA process with a Finding of No Significant Impact.

TABLE OF CONTENTS

CHAPTER 2: ISSUES AND ALTERNATIVE APPROACHES

CHAPTER 3: ENVIRONMENTAL EFFECTS

CHAPTER 4: LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

LIST OF APPENDICES

ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
CBC	Christmas Bird Count
CFR	Code of Federal Regulations
DNC	4,4'-dinitrocarbanilide
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Federal Fiscal Year
GDNR	Georgia Department of Natural Resources
HDP	2-hydroxy-4,6-dimethylpyrimidine
LD	Median Lethal Dose
MBTA	Migratory Bird Treaty Act
NEPA	National Environmental Policy Act
TVA	Tennessee Valley Authority
UAV	Unmanned Aerial Vehicle
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WS	Wildlife Services

CHAPTER 1: NEED FOR ACTION AND SCOPE OF ANALYSIS

1.1 INTRODUCTION

Wildlife are an important public resource greatly valued by people. In general, people regard wildlife as providing economic, recreational, emotional, and esthetic benefits. Knowing that wildlife exist in the natural environment provides a positive benefit to many people. Wildlife can also be important to the culture and beliefs of Native American Tribes. However, the behavior of animals may result in damage to agricultural resources, natural resources, and property, and threaten human safety. Therefore, wildlife can have either positive or negative values depending on the perspectives and circumstances of individual people.

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 (Berryman 1991, Reidinger and Miller 2013, The Wildlife Society 2017) and the North American Model of Wildlife Conservation (Organ et al. 2010, Organ et al. 2012). Resolving damage caused by wildlife 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. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988).

Sociological carrying capacities are especially important because they define the sensitivity of a person or community to a wildlife species. There may be 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 or already met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety. Therefore, the wildlife acceptance capacity helps define the range of wildlife population levels and associated damage acceptable to individuals or groups (Decker and Purdy 1988, Decker and Brown 2001).

Animals have no intent to do harm. They utilize habitats (*e.g.*, for feeding, shelter, and reproduction) where they can find a niche. If their activities result in lost value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or pose a threat to human safety, people often seek assistance. The threshold triggering a person to seek assistance with alleviating damage or threats of damage is often unique to the individual person requesting assistance and many factors (*e.g.*, economic, social, esthetics) can influence when people seek assistance. What one person considers damage another person may not consider as damage. However, the term "*damage*" is consistently used to describe situations in which the individual person has determined the losses associated with an animal or animals 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 esthetic value of property and other situations in which the behavior of wildlife was no longer tolerable to an individual person. The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management could occur from specific threats to resources.

When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife (USDA 2019*a*) (see WS Directive 1.201)[1]. The primary statutory authority for the WS program is 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). WS directives define program objectives and guide WS activities when managing wildlife damage (see WS Directive 1.201, WS Directive 1.205, WS Directive 1.210). Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from WS.

1.2 NEED FOR ACTION

As discussed in Section 1.1, when people seek assistance with managing bird damage, they may seek assistance from WS. In Georgia, WS continues to receive requests for assistance to reduce and prevent damage associated with several bird species. The need for action to manage damage and threats associated with birds in Georgia arises from requests for assistance[2] that WS could receive to reduce and prevent damage from occurring. Birds can cause damage to agricultural resources, natural resources, and property, and pose threats to human safety.

WS has identified bird species most likely to be responsible for causing damage in Georgia based on previous requests for assistance and assessments of the threat of bird strike hazards at airports in the state. Those bird species include Canada geese (*Branta canadensis*), feral/free-ranging domestic fowl[3], mallards (*Anas platyrhynchos*), wild turkeys (*Meleagris gallopavo*), rock pigeons (*Columba livia*), Eurasian collared-doves (*Streptopelia decaocto*), mourning doves (*Zenaida macroura*), killdeer (*Charadrius vociferus*), ring-billed gulls (*Larus delawarensis*), double-crested cormorants (*Nannopterum auritum*), great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), cattle egrets (*Bubulcus ibis*), black-crowned night-heron (*Nycticorax nycticorax*), yellow-crowned night-heron (*Nyctanassa violacea*), white ibis (*Eudocimus albus*), black vultures (*Coragyps atratus*), turkey vultures (*Cathartes aura*), osprey (*Pandion haliaetus*), American crows (*Corvus brachyrhynchos*), barn swallows (*Hirundo rustica*), cliff swallows (*Petrochelidon pyrrhonota*), European starlings (*Sturnus vulgaris*), American robins (*Turdus migratorius*), 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*). Table 1.1 shows the primary resource types those bird species damage in Georgia.

In addition to species identified in Table 1.1, WS could receive requests for assistance to manage damage and threats of damage associated with several other bird species, but WS expects requests for assistance associated with those species would occur infrequently and/or requests would involve a small number of individual birds of a species. Damage and threats of damage 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. Table E-1 in Appendix E shows the primary resource types those bird species damage in Georgia.

Most requests for assistance that WS receives are associated with reducing the risk of aircraft striking birds at airports and military facilities in the state. For example, all of those bird species shown in Table

[1]At the time of preparation, WS Directives occurred at the following web address: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_WS_Program_Directives.

[2]WS would only conduct bird damage management after receiving a request for assistance. Before initiating bird damage activities, WS and the cooperating entity must sign a work initiation document or another comparable document that lists all the methods the property owner or manager would allow WS to use on property they own and/or manage.

[3]Free-ranging or feral domestic fowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, swans, peafowl, chickens, and other fowl. 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.

1.1 and Appendix E could pose a threat to aircraft when those bird species occur at or near air facilities. WS also receives requests for assistance to manage damage to many other resources, including threats to human health and safety. In addition, WS could receive requests for assistance to manage damage and threats of damage on properties owned or managed by the Tennessee Valley Authority (TVA)[4].

Table 1.1 – Bird species that WS could address and the resource types threatened

Species	Resource*				Species	Resource			
	A	N	P	H		A	N	P	H
Canada Goose	X	X	X	X	**White Ibis**			X	X
Feral Fowl	X	X	X	X	**Black Vulture**	X		X	X
Mallard			X	X	**Turkey Vulture**	X		X	X
Wild Turkey	X		X	X	**Osprey**	X		X	X
Rock Pigeon	X	X	X	X	**American Crow**	X	X	X	X
Eurasian Collared-Dove			X	X	**Barn Swallow**	X		X	X
Mourning Dove			X	X	**Cliff Swallow**			X	X
Killdeer			X	X	**European Starling**	X	X	X	X
Ring-billed Gull	X	X	X	X	**American Robin**			X	X
Double-crested Cormorant	X	X	X	X	**House Sparrow**	X	X	X	X
Great Blue Heron	X		X	X	**Eastern Meadowlark**			X	X
Great Egret			X	X	**Red-winged Blackbird**	X		X	X
Snowy Egret			X	X	**Brown-headed Cowbird**	X		X	X
Cattle Egret			X	X	**Common Grackle**	X		X	X
Black-crowned Night-Heron	X		X	X	**Boat-tailed Grackle**	X		X	X
Yellow-crowned Night-Heron	X		X	X					

*A=Agriculture, N =Natural Resources, P=Property, H=Human Safety (includes aviation safety and potential disease transmission to humans)

Some of the bird species 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 occur in large flocks, such as migration periods and when the cold of winter months limits food sources. For some bird species, high concentrations of birds occur during the breeding season where suitable nesting habitat exists, such as swallows. The flocking behavior of many bird species during migration periods and during the breeding season can pose increased risks of damage and threats to human health and safety. The following subsections of this Environmental Assessment (EA) provide additional information regarding the need to manage bird damage.

1.2.1 Need for Bird Damage Management on TVA Properties and Facilities

The TVA operates hydroelectric dams, coal-fired power plants, nuclear power plants, solar facilities, and combustion turbine sites throughout the Tennessee River Valley, as well as more than 80 public recreation areas throughout the Tennessee Valley region, including campgrounds, day-use areas, and boat launching ramps. In addition, the TVA maintains 16,200 miles of transmission lines and 500 substations that provide electrical power to 10 million people across 80,000 square miles in the Tennessee Valley region. The TVA is also responsible for the management of 293,000 acres of public land and 11,000 miles of public shoreline along the Tennessee River system. All of the land, facilities, and other infrastructure support TVA's goals of power generation and transmission, public recreational use, flood control, and economic development of the Tennessee River Valley. In Georgia, TVA operates two hydroelectric dams, 22 substations and switchyards, and 469 miles of transmission line. In addition, the

[4] See Section 1.7 for the role and authorities of the TVA.

TVA manages recreational, natural, and cultural resources on 1,700 acres of public land and 250 miles of public shoreline.

Bird damage and threats of damage occurring at facilities and properties owned or managed by the TVA have occurred primarily to property, human safety, and the operational reliability of the electrical system. Birds roosting at TVA facilities can cause considerable economic damage due to the excessive amount of droppings on buildings, equipment, and facilities resulting in constant cleaning. The droppings can occur in work areas, which can be esthetically displeasing to employees. Additionally, birds can pose a threat to people from the potential transmission of zoonotic diseases when employees contact fecal matter or surfaces contaminated with fecal matter. The fecal droppings make work areas slippery, which can create safety concerns from employees slipping and falling.

For example, fecal droppings can accumulate under areas where vultures roost and loaf. Fecal droppings can be corrosive to the metal support towers of transmission lines. Accumulation of fecal droppings on and around the structures can present a safety concern for workers that conduct maintenance on the towers. Large accumulations of feces threaten human safety by creating slick surfaces where employees work at extreme heights and increases the risk of zoonotic disease transmission from contact with contaminated surfaces as workers conduct maintenance. The odor and presence of fecal material on equipment is also esthetically displeasing to employees. Vultures can also pose a risk of large power outages if the birds/fecal material short out the power supply.

Birds can also roost on or enter electrical substations and power generation facilities and threaten the interruption of power. Osprey nests are often a threat to the safe operation of electrical equipment due to the risk of outages caused when debris from the nests or nesting material carried by osprey comes into contact with transmission equipment. Nests are often constructed of large sticks and twigs that can cause disruptions in the electrical power supply when those nests are located on utility structures and can inhibit access to utility structures for maintenance by creating obstacles to workers. Osprey will utilize the same nest year after year, adding more material and increasing the size of the nest each year, which can grow up to 6 feet in diameter (Bierregaard et al. 2020). In 2001, the United States Geological Survey (2005) reported that 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites. In 2010, 91% of osprey nests observed in Pennsylvania were located on man-made structures (Gross 2012). The average osprey nest size in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (United States Geological Survey 2005).

All of these damage issues and others occur throughout TVA owned and managed properties. The TVA has requested assistance from WS to address these in the past and may request assistance with additional bird damage issues in the future.

1.2.2 Need to Resolve Bird Damage to Agricultural Resources

During 2017, nearly 10 million acres were devoted to agricultural production in Georgia (USDA 2019*b*). The total market value of agricultural products sold in the state was nearly $9.6 billion in 2017. The value of crops sold in the state was nearly $3.3 billion in 2017. The value of livestock, poultry, and their products sold in the state during 2017 was over $6.3 billion (USDA 2019*b*). As of January 2021, the cattle and calf inventory for Georgia was nearly 1.1 million head with 66,000 goats, 38,000 swine, and 1.3 billion chickens (USDA 2022*a*).

As shown in Table 1.1 and Table E-1 in Appendix E, many of the bird species that WS could address can cause damage to or pose threats to agricultural resources in Georgia. Damage and threats of damage to agricultural resources are often associated with bird species that exhibit flocking behaviors (*e.g.*, European starlings) or colonial nesting behavior (*e.g.*, rock pigeons). Damage occurs through direct consumption of agricultural resources, the contamination of resources from fecal droppings, or the potential for disease transmission to livestock from contact with fecal matter.

Damage to Aquaculture Resources

The National Agricultural Statistics Service defines aquaculture as the farming of fish, crustaceans, mollusks, and other aquaculture products (USDA 2019*b*). In 2017, there were 90 aquaculture operations in Georgia with sales of over $26.6 million (USDA 2019*b*). The principal species propagated in Georgia are catfish, trout, other food fish, baitfish, crustaceans, ornamental fish, mollusks, sport/game fish, and other aquaculture products (USDA 2019*b*).

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 suffered when birds attempt to prey upon aquatic organisms. Threats of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites can also be a concern for aquaculture producers. 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.

In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities, including grebes, pelicans, herons, egrets, waterfowl, hawks, harriers, gulls, crows, mergansers, common grackles, and brown-headed cowbirds (Parkhurst et al. 1987). In the southeastern United States, double-crested cormorants (Dorr et al. 2012, Craig et al. 2016, Dorr et al. 2016), American white pelicans (King 1997, King 2005, King 2019), and great blue herons (Stickley et al. 1995, Glahn et al. 2002, Hoy 2017) are the primary bird species associated with damage to aquaculture. Although generally not considered a fish-eating bird species, lesser scaup do consume farm raised fish (Clements et al. 2020, Engle et al. 2020). Engle et al. (2020) estimated that fish losses to lesser scaup in Arkansas averaged nearly $1.1 million per year and that lesser scaup cause an average of $5.5 million in total direct negative economic effects to the baitfish industry in Arkansas per year. Predation at aquaculture facilities can also occur from other bird species, such as crows (Parkhurst et al. 1987, Parkhurst et al. 1992), common grackles (Beeton and Wells 1957, Darden 1974, Zottoli 1976, Whoriskey and Fitzgerald 1985, Parkhurst et al. 1992), mallards (Parkhurst et al. 1987, Parkhurst et al. 1992), and osprey (Parkhurst et al. 1987).

From federal fiscal year (FY) 2017 through FY 2021, WS received requests for assistance to alleviate damage to aquaculture resources associated with double-crested cormorants, great egrets, great blue herons, anhingas, green herons, and belted kingfishers. Damage or threats of damage from those bird species occurred to baitfish, striped bass, catfish, carp, and trout. Requests for assistance that WS received in Georgia were primarily related to predation of aquaculture stock.

Also of concern to aquaculture facilities is the transmission of diseases by birds between impoundments and from facility to facility. Aquaculture farms often confine aquatic organisms inside water impoundments or similar structures, and they often maintain aquatic organisms at high densities within those structures. Therefore, the introduction of a disease could result in substantial economic losses because pathogens can spread quickly and would likely infect nearly all the aquatic organisms confined in the structure. 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 matter and possibly through other mechanical means such as on feathers, feet, and regurgitation. For example, *Aeromonas hydrophila* is a bacterium that can cause disease in fish. Cunningham et al. (2018) found that double-crested cormorants and American white pelicans could shed a highly virulent strain of *Aeromonas hydrophila* bacteria in their feces when fed catfish infected with the bacteria, which demonstrated that those two bird species could transfer the bacteria from an aquaculture pond with infected fish to ponds with uninfected fish.

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, Goodwin 2002). 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 virus occurs on the beaks of herons. 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 can occur within the intestines and rectal areas of great blue herons, great egrets, snowy egrets, and double-crested cormorants (Taylor 1992). However, because Enteric Septicemia of Catfish is endemic to parts of the United States, 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 associated with aquaculture ponds 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, Hoy 2017). Birds are very mobile and have the ability to move from one impoundment or facility to another. Therefore, 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 Georgia. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual or small groups of birds can cause economic damage to livestock producers, such as a vulture or a group of vultures killing a newborn calf, most damage occurs from bird species that congregate in large flocks at livestock operations. Birds defecate while feeding increasing the possibility of disease transmission to livestock through direct contact or consumption of contaminated feed or water. Fecal droppings can also accelerate corrosion of metal components of fences, shade canopies, and other structures and can be esthetically 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 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 pigeons, house sparrows, and swallows. Of primary concern to livestock feedlots and dairies in Georgia are European starlings, house sparrows, rock pigeons, red-winged blackbirds, common grackles, brown-headed cowbirds, and to a lesser extent, American crows, fish crows, and gulls. The flocking behavior of those species associated with roosting and/or nesting can lead to economic losses to agricultural producers from the consumption of livestock feed and increased risks associated with the transmission of diseases from fecal matter deposited by birds 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. 2005). Diet rations for cattle contain all 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, to increase milk production. 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 and red-winged blackbirds may reduce milk yields and weight gains, which can be economically critical (Feare 1984, Carlson et al. 2018*a*, Carlson et al. 2018*b*). 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.

Besser et al. (1968) found the value of losses in feedlots to starlings 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 at a Kansas feedlot. In Washington, dairy operators reported annual feed losses of $55 per cow due to birds, which resulted in annual losses totaling $14.7 million in the state (Elser et al. 2019*a*).

Damage and threats to livestock operations can also occur from the risk of or actual transmission of diseases from birds to livestock. The confining and concentrating of domestic animals in livestock operations can attract a large number of birds because of the availability of food sources and/or roosting/nesting locations (*e.g.*, barns). Many bird species, especially those encountered at livestock operations, can carry pathogens that can cause infectious diseases and they can excrete those disease pathogens in their fecal droppings. Large concentrations of birds feeding, roosting, or loafing in livestock areas can increase the possibility of and the concern over the transmission of diseases from birds to livestock (Daniels et al. 2003, Fraser and Fraser 2010, Miller et al. 2013). Birds feeding alongside livestock in open feeding areas or feeding on stored livestock feed can leave fecal deposits, which livestock can consume. Birds can also deposit fecal matter into sources of water for livestock, which can increase the likelihood of disease transmission. Birds can also contaminate other surface areas where livestock can encounter fecal matter. Large concentrations of birds not only pose a potential risk to individual livestock operations, but they can be a source of transmission to other livestock operations as birds move from one area to another.

Several pathogens that affect livestock have been associated with rock pigeons, European starlings, and house sparrows, such as erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981, Carlson et al. 2010, Carlson et al. 2011*a*). Weber (1979) reported pigeons, starlings, and house sparrows as carriers of several viral, fungal, protozoal, and rickettsial diseases, which can 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 *Escherichia coli* between dairy farms. Carlson et al. (2010) 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 relate directly to the number of European starlings that are present (Carlson et al. 2010, Carlson et al. 2011*b*, Carlson et al. 2012). Poultry operations can be highly susceptible to pathogens, such as *Salmonella* spp., campylobacter, and clostridium, which are sometimes isolated in wild birds, such as European starlings and house sparrows (Craven et al. 2000).

Contamination of livestock facilities through fecal accumulation by various bird species can be an important concern to those facilities. Numerous pathogens can spread through feces, with *Salmonella* spp. and *Escherichia coli* being two pathogens of concern. *Salmonella* spp. bacteria cause salmonellosis and numerous bird species may be reservoirs for *Salmonella* spp. (Friend and Franson 1999, Tizard 2004). *Escherichia coli* is a fecal coliform bacterium associated with the fecal material of warm-blooded animals. Multiple studies document birds can be an important vector of *Escherichia coli* contamination of both land and water sources (Fallacara et al. 2001, Kullas et al. 2002, Hansen et al. 2009, Silva et al. 2009, Franklin et al. 2020). Multiple species of birds can carry dangerous strains of *Escherichia coli*, including gulls, geese, pigeons, and starlings (Pedersen and Clark 2007, Franklin et al. 2020). European starlings may also harbor various strains of *Escherichia coli* (Gaukler et al. 2009), including O157:H7, a strain that can cause human mortalities (LeJeune et al. 2008, Cernicchiaro et al. 2012).

Transmission of *Salmonella* spp. from 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* spp. 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 *Escherichia coli* and *Salmonella enterica* among cattle at feedlots and dairies and between livestock operations. Migratory birds are capable of spreading pathogens over a larger area, and domestic livestock 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 esthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through direct contact with fecal droppings or when droppings create 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 *Escherichia coli* or *Salmonella* spp. to a livestock operation or the transmission of these pathogens between sites by wild birds can be high (Pedersen and Clark 2007).

Starlings, gulls, and other species can transfer pathogens that are specific to some livestock, 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 contact a pathogen and transfer it to another farm or to healthy animals at the same farm. 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 because the fecal droppings of waterfowl can carry pathogens that can cause diseases in livestock. Fraser and Fraser (2010) provide a literature review that highlights several bacterial, viral, and fungal diseases of concern to livestock associated with Canada geese and other waterfowl. However, Fraser and Fraser (2010) pointed out that due to a lack of data, they could not perform an evidence-based risk assessment on the health risks to humans or livestock from free ranging waterfowl. Livestock producers may have concerns that waterfowl droppings in and around ponds that provide drinking water for livestock could affect water quality and could be a source of several different types of pathogens. For example, *Salmonella* spp. can cause shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, salmonellosis can kill cattle and calves. In addition, the contamination of feed by waterfowl through droppings in pastures, crops, or harvested grasses is also a possible method of pathogen transmission to livestock (*e.g.*, see Fraser and Fraser 2010).

Another disease often associated with waterfowl is avian influenza, which is a disease caused by various strains of influenza viruses. Avian influenza viruses occur naturally among many bird species throughout the world. Wild and domestic waterfowl, as well as a variety of other bird species, can be reservoirs for a variety of those viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Brown et al. 2006, Keawcharoen et al. 2008, Pedersen et al. 2010, United States Geological Survey 2018). Scientists often categorize the different types of avian influenza viruses as either a low pathogenic or a highly pathogenic, which refers to the ability of the virus to produce disease (United States Geological Survey 2018, Centers for Disease Control and Prevention 2022).

Most of the avian influenza viruses that circulate naturally in wild birds are low pathogenic. Typically, the low pathogenic avian influenza viruses circulate among wild birds without clinical signs and are not an important mortality factor in wild birds (Davidson and Nettles 1997, Clark and Hall 2006, United States Geological Survey 2018, Centers for Disease Control and Prevention 2022). However, highly pathogenic avian influenza viruses can cause severe disease and high mortality in birds, especially in domestic poultry and domestic waterfowl (Nettles et al. 1985, Clark 2003, Gauthier-Clerc et al. 2007, Pedersen et al. 2010, United States Geological Survey 2018, Centers for Disease Control and Prevention 2022). The potential for avian influenza virus to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Hahn and Clark 2002, Clark and Hall 2006, Gauthier-Clerc et al. 2007). The potential impacts of a severe outbreak of highly pathogenic avian influenza in domestic poultry could cripple the industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

In December 2014, a highly pathogenic avian influenza virus was isolated from a northern pintail (*Anas acuta*) in Washington State making it the first detection of highly pathogenic avian influenza virus in wild birds in North America (United States Geological Survey 2015). The detection in North America coincided with the detection of the virus in poultry across the western and central United States (USDA 2015*a*). Another major outbreak of highly pathogenic avian influenza occurred in the United States during 2022. Beginning in January 2022, a highly pathogenic avian influenza variant was detected in wild aquatic birds, commercial poultry, and backyard and hobbyist poultry flocks in the United States and as of July 12, 2023, the highly pathogenic avian influenza virus had affected nearly 59 million poultry in the United States (Centers for Disease Control and Prevention 2023). In addition, the federal, state, and tribal entities had detected highly pathogenic avian influenza virus in 7,144 wild birds. WS has been one of several agencies and organizations conducting surveillance and monitoring of avian influenza in migratory birds.

Another viral disease that is often associated with wild birds and can be a concern to the poultry industry is Newcastle disease. More than 230 species of birds may be susceptible to natural or experimental infections with the viruses that cause Newcastle disease, 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 viruses that causes Newcastle disease. 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, such as pigeons, may carry avian paramyxoviruses, which may pose a risk of transmission because of their close association with livestock (Kommers et al. 2001).

Certain bird species may also prey upon livestock, resulting in economic losses to livestock producers. Direct damage to livestock occurs primarily from vultures but can also include raptors (Avery and Lowney 2016, Washburn 2016). Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process (Avery and Lowney 2016). In Georgia, 8.1% of cattle deaths due to predators were associated with birds, such as vultures, during 2015 (USDA 2017). While both turkey vultures and black vultures have been documented harassing expectant cattle, livestock predation is generally restricted to black vultures. Vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported black vultures killed pigs (mainly newborn and very young piglets) by pulling eyes out followed by attacks to the rectal area or by directly attacking the rectal area. During a difficult birth, vultures can harass the mother and peck at the calf as its being born. This predation behavior often results in serious injury to livestock, which can cause livestock to die from those injuries or require the producers to euthanize livestock due to the extent of the injuries.

Milleson et al. (2006) surveyed Florida ranchers as to the extent and severity of cattle losses associated with vultures. Respondents to the survey reported that 82.4% of all livestock loss 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 loss estimated at $2,595 (Milleson et al. 2006). Predation associated with vultures occurred primarily from November through March but could occur throughout the year (Milleson et al. 2006). From FY 2017 through FY 2021, most requests for assistance that WS received in Georgia involving livestock involved predation and harassment by turkey vultures and black vultures.

Direct damage can also result from raptors preying on domestic fowl, such as chickens and waterfowl (Washburn 2016) and other types of livestock, like domestic rabbits. Free-ranging fowl or fowl allowed to range outside of confinement for a period are particularly vulnerable to predation by raptors. From FY 2017 through FY 2021, WS received requests for assistance in Georgia to manage damage to domestic fowl from Canada geese (disease threat), bald eagles, red-tailed hawks, mallards (disease threat), and black vultures.

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 2017, agricultural crops accounted for over 34% of the total market value of agricultural commodities (livestock and crops) in Georgia. Some of the crop commodities harvested in 2020 include cotton, peanuts, corn, pecans, hay, melons, blueberries, soybeans, peaches, tobacco, beans, wheat, oats, cabbage, peppers, squash, and cucumbers (USDA 2022*a*). Table 1.1 and Appendix E identify several bird species that can cause damage to agricultural resources, including agricultural crops.

Birds can also cause damage to fruit, berry, and nut crops by consuming them or by causing damage that makes them unmarketable. Fruit growers are often concerned about the damage that birds can cause and often employ several methods to alleviate bird damage (Elser et al. 2019*b*). In 2017, there were 4,107 orchard farms consisting of 182,259 acres in Georgia, producing a variety of fruits and nuts, including apples, peaches, citrus fruit, almonds, pecans, walnuts, and grapes (USDA 2019*b*). In addition, there were 1,281 farms producing berries in Georgia during 2017 on 19,427 acres (USDA 2019*b*).

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, 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, Canada, Avery et al. (1991) 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. 1991); however, respondents identified several additional bird species as causing damage to blueberries (Avery et al. 1991). Avery et al. (1991) 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).

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 house sparrows can also have a detrimental effect 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 (Homan et al. 2017) 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 (Homan et al. 2017). House sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits, and localized damage can be considerable because house sparrows often feed in large flocks on a small area (Fitzwater 1994).

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, Bodenchuk and Bergman 2020). Damage to sprouting corn occurs primarily from grackles and crows, but red-winged blackbirds can also cause damage to sprouting corn (Stone and Mott 1973). Additionally, starlings may pull sprouting grains and feed on planted seed (Homan et al.

2017). 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.

As resident Canada goose populations have increased across the United States, including the resident population in Georgia, the number of requests for assistance to manage damage associated with geese has also increased. Agricultural impacts include losses to corn, soybeans, and winter wheat, as well as overgrazing of pastures and a degradation of water quality (Gabig 2000, USFWS 2005, Atlantic Flyway Council 2011, Mississippi Flyway Council Technical Section 2017). From FY 2017 through FY 2021, most requests for assistance that WS received in Georgia involving agricultural crops were associated with damage to sod and other cultivated grasses caused by Canada geese.

1.2.3 Need to Resolve Threats that Birds Pose to Human Health and Safety

Several bird species listed in Table 1.1 and Table E-1 in Appendix E can be closely associated with people and often exhibit gregarious roosting or flocking behavior, such as vultures, gulls, pigeons, sparrows, starlings, waterfowl, crows, swallows, grackles, cowbirds, and blackbirds. 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 aircraft strike birds. In addition, excessive droppings can be esthetically 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 animals can transmit to people) (Conover 2002). However, few studies are available on the occurrence of zoonotic diseases in wild birds or the risks to people or domestic animals from transmission of those diseases (Clark and McLean 2003). Complicating the study of disease threats is the fact that people can contract some disease-causing agents associated with birds 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 likely to be low. 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. WS could receive requests to assist with identifying the cause or source of a disease by collecting samples from birds for testing.

Elevated contaminant levels associated with breeding and/or roosting concentrations of birds and their potential effects on water supplies can be a concern. Fecal droppings often accumulate in areas where birds congregate for long periods of time (*e.g*., roosts, nesting areas). Accumulations of fecal droppings can pose a threat to human health and safety in areas where people may encounter those accumulations. For example, starlings may roost inside barns at night and fecal droppings may accumulate in areas of the barn used by people. Accumulations of bird droppings in public areas are esthetically displeasing and are often in areas where people may come in direct contact with the droppings. Fecal droppings in and around water resources can affect water quality and be a source of a number of different types of pathogens and contaminants. Because the fecal droppings of birds can contain coliform bacteria, streptococcus bacteria, *Salmonella* spp., toxic chemicals, and nutrients, fecal droppings that enter water could compromise water quality, depending on the number of birds, the amount of excrement, and the size of the water body.

Birds can play a role in the transmission of diseases to people. For example, birds may serve as a reservoir for pathogens that mosquitoes can transmit from birds to people, such as the West Nile virus and the virus that causes encephalitis. Birds may also play a direct and indirect role in transmission of *Escherichia coli* and *Salmonella enterica* to people through contact with infected cattle feces, watering troughs, and agricultural 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). 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 Georgia, crows, blackbirds, and starlings can form large communal roosts, which could facilitate the growth of disease organisms, such as *Histoplasma capsulatum* (Weeks and Stickley 1984). The disturbance of soil or fecal droppings at bird roosts where fecal droppings have accumulated can cause *Histoplasma capsulatum* to become airborne. Once airborne, people in the area can inhale the fungus. For example, two siblings contracted pneumonia in Arkansas during 2011, and additional family members suffered from respiratory disease, after burning bamboo from a grove that red-winged blackbirds roosted in (Haselow et al. 2014). *Histoplasma capsulatum* can remain in the soil and can become airborne several years after blackbirds abandon a roost (Clark and McLean 2003).

People may contract salmonellosis (caused by *Salmonella* spp.) when handling materials contaminated with bird feces (Stroud and Friend 1987). Wild birds can carry several types of the Salmonella bacteria. *Salmonella* spp. have been isolated from the gastrointestinal tract of starlings (Carlson et al. 2010). Friend and Franson (1999) reported relative rates of detection of *Salmonella* spp. in free ranging birds. *Salmonella* spp. isolates were frequent in some songbirds, common in doves and pigeons, occasional in starlings, blackbirds and cowbirds, and infrequent in crows. Infection by *Salmonella* spp. can cause gastrointestinal illness, including diarrhea in people. Public health concerns related to *Salmonella* spp. 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 can also potentially contaminate vegetable crops and livestock feed while feeding on them.

Escherichia coli is a fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *Escherichia coli* with the majority of serological types not causing serious illness in people (Sterritt and Lester 1988). The serological type of *Escherichia coli* that is best known for causing serious illness is *Escherichia coli* O157:H7 and is usually associated with cattle (Gallien and Hartung 1994). Many communities monitor water quality at swimming beaches and lakes but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, governmental entities may temporarily close beaches to the public even though the strain of *Escherichia coli* may be unknown. Linking the elevated bacterial counts to the frequency of waterfowl use and attributing the elevated levels to human health threats can be problematic. However, advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific vertebrate 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 implicated 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 pathogens 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.

Various species of bacteria, such as *Bacillus* spp., *Clostridium* spp., *Campylobacter* spp., *Escherichia coli*, *Listeria* spp., and *Salmonella* spp., can occur in gulls (MacDonald and Brown 1974, Fenlon 1981, Butterfield et al. 1983, Monaghan et al. 1985, Norton 1986, Quessey and Messier 1992, Franklin et al. 2020). 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 fecal contamination in cases of human salmonellosis. Gulls can threaten the safety of municipal drinking water sources by contaminating water with fecal matter and potentially causing dangerously high levels of coliform bacteria. Gulls have been implicated in contamination of public water supplies in several cases (*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.

As discussed in Section 1.2.1, birds can be a reservoir for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2010). While most avian influenza viruses are restricted to birds, on extremely rare occasion, a few, including a highly pathogenic H5N1 strain, can be transmitted to people, and have sometimes resulted in death (Gauthier-Clerc et al. 2007, Peiris et al. 2007, Majumdar et al. 2011, 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, USDA 2016).

While transmission of pathogens or parasites from birds to people is uncommon, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blankespoor and Reimink 1991, Hatch 1996, Graczyk et al. 1997, Saltoun et al. 2000, Kassa et al. 2001). Infections may even be life threatening for people with suppressed or compromised immune systems (Roffe 1987, Graczyk et al. 1998). Human exposure to bird fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings increases the likelihood of disease transmission. Several of the bird species addressed in this EA often exhibit gregarious roosting and nesting behavior, which can lead to accumulations of fecal droppings in areas associated with people. Accumulations of bird droppings in public areas are not only esthetically displeasing but 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 transmission of pathogens from birds to people have occurred but entities want to reduce the risk of disease transmission. However, the risk of disease transmission is 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 Birds at Airports and Military Bases

In addition to potentially transmitting zoonotic pathogens, birds also pose a threat to human safety related to aircraft. Bird strikes can cause catastrophic failure of aircraft systems (*e.g.*, ingesting birds into engines), which can cause the plane to become uncontrollable leading to a crash. 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, DeVault et al. 2017). Species found in Table 1.1 and in Appendix E can all represent a threat to aviation safety.

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 died in the crash of an airliner that collided with a flock of European starlings (Terres 1980, Dolbeer and Wright 2008). In 1995, 24 individuals died when a military aircraft struck a flock of Canada geese at Elmendorf, Alaska and crashed (Smith et al. 1999). The threat that Canada Geese pose to aircraft safety was dramatically demonstrated in January 2009 when United States Airways Flight 1549 made an emergency landing in the Hudson River after ingesting multiple Canada geese into both engines shortly after takeoff from New York's LaGuardia Airport (Dolbeer et al. 2009, Wright 2010). Though the aircraft was destroyed after sinking in the river, all 150 passengers and 5 crewmembers survived (Wright 2010).

In Oklahoma, an aircraft struck American white pelicans (*Pelecanus erythrorhynchos*) causing the plane to crash, which killed all five people aboard (Dove et al. 2009). From 1990 through 2021, 40 human fatalities have occurred after civil aircraft struck birds in the United States (Dolbeer et al. 2022). Human fatalities have occurred after aircraft struck red-tailed hawks, American white pelicans, bald eagles, snow geese, Canada geese, rock pigeons, black vultures, turkey vultures, and unidentified bird species (Dolbeer et al. 2022). From 1988 through 2021, wildlife strikes have killed more than 301 people and destroyed over 298 aircraft globally (Dolbeer et al. 2022).

Injuries can also occur to aircraft crewmembers and passengers from bird strikes. From 1990 through 2021, injuries to crewmembers and passengers have occurred from aircraft strikes involving vultures, waterfowl, hawks, eagles, gulls, cormorants, kestrels, pigeons, doves, grebes, and unknown bird species in the United States[5]. For example, from 1990 through 2021, 51 aircraft strikes involving unknown bird species caused 67 human injuries and 19 strikes involving turkey vultures resulted in 23 injuries (Dolbeer et al. 2022).

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, may lead to a reduction of fear that 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. 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. Raptors can aggressively defend their nests, nesting areas, and young, and may swoop and strike at pets, children, and adults (Morrison et al. 2006).

In addition to raptors, waterfowl can aggressively defend their nests and nestlings during the nesting season. Feral waterfowl often nest in high densities in areas used by people for recreational purposes, such as industrial areas, parks, beaches, and sports fields (VerCauteren and Marks 2004). If people or their pets unknowingly approach waterfowl or their nests at those locations, injuries can occur if waterfowl react aggressively to the presence of those people or pets (Conover 2002). During the nesting season, geese aggressively defend the area around their nests and goslings from other animals and people (Mississippi Flyway Council Technical Section 1996, Gabig 2000, Atlantic Flyway Council 2011). Additionally, the buildup of feces from birds on docks, walkways, and other foot traffic areas can create slipping hazards. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

[5]Includes aircraft strikes in foreign countries involving aircraft registered in the United States.

1.2.4 Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.1 and in Appendix E, all of the bird species addressed in this EA have the potential to cause damage to property in Georgia but not all incidents result in damage, such as the threat of aircraft striking birds at airports. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property occurs through direct damage to structures, roosting behavior, and their nesting activities. One example of direct damage to property occurs when vultures tear roofing shingles or pull latex caulking out around windows (Avery and Lowney 2016). Accumulations of fecal droppings can cause damage to buildings and statues. Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, often scratching adjacent paint and siding (Miller 2018).

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, DeVault et al. 2017). 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 likely to exceed $1.2 billion worldwide (Allan 2002). Wildlife strikes result in millions of dollars in direct and indirect damages annually. 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 through 2021, Federal Aviation Administration records indicate total reported losses from bird strikes cost the civil aviation industry over $871 million in monetary losses and nearly 841,000 hours of aircraft downtime (Dolbeer et al. 2022). Because reporting rates of aircraft strikes have been historically low, these figures likely underestimate total damage caused by bird strikes. Historically, wildlife strike reporting rates may have been as low as 20% (Linnell et al. 1999, Wright and Dolbeer 2005). However, reporting rates for civil aviation in the United States appear to be increasing (Dolbeer et al. 2022). Not all reports provide notation as to whether or not there was damage and some strike reports to the Federal Aviation Administration 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. Thus, actual monetary losses from bird strikes are likely much higher than estimated losses.

Target bird species 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 take-off. From 1990 through 2021, approximately 71% 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 92% occurred at less than 3,500 feet above ground level (Dolbeer et al.

2022). Thus, management of the area immediately surrounding taxiways, runways, and approaches is important to reducing the strike hazard and threat to human safety.

Gulls, raptors, waterfowl, shorebirds, and doves/pigeons are the bird groups most frequently struck by aircraft in the United States with waterfowl, gulls, and raptors causing the most damage. From 1990 through 2021, aircraft strikes involving waterfowl caused more than $300 million in damages to civil aircraft in the United States and strikes involving hawks, eagles, and vultures caused nearly $181 million in damages (Dolbeer et al. 2022). DeVault et al. (2011) concluded that ducks, turkey vultures, herring gulls, great egrets, great blue herons, great-horned owls, red-tailed hawks, and wild turkeys were among the 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 of the bird (DeVault et al. 2011).

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, flocking behavior (which increases the likelihood of multiple bird strikes), attraction to airports for grazing, and year-round presence in urban environments near airports (Seubert and Dolbeer 2004).

Vultures and raptors can present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures and raptors are two of the most hazardous birds for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused (Dolbeer et al. 2000, DeVault et al. 2011, Dolbeer et al. 2022). When in large flocks or flight lines entering or exiting a winter roost at or near airports, starlings and blackbirds 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 picking up grit on airport turf and runways further increase the risks of bird-aircraft collisions.

From January 1990 through July 2023, the Federal Aviation Administration (2023) has received at least 5,123 reports of aircraft striking birds in Georgia. In Georgia, nearly 93% of the reported aircraft strikes from January 1990 through July 2023 involved birds (Federal Aviation Administration 2023). Aircraft in Georgia have struck at approximately 150 species of birds (Federal Aviation Administration 2023). From January 1990 through July 2023, 2,112 aircraft strike reports in Georgia indicated the aircraft struck an "*unknown bird*" species. In addition, some reports provide limited identification information, such as aircraft striking "*gulls*" or "*hawks*" (Federal Aviation Administration 2023). Therefore, additional species were likely involved in airstrikes in Georgia during this period.

The open grassland habitats of airports and military facilities can provide ideal habitat for many grassland bird species, such as barn swallows and meadowlarks. Barn swallows will often forage in large groups. The open habitats associated with airports can provide ideal locations for swallows to forage and the presence of those swallows can increase the risks of an aircraft strike. From 1990 through 2021, 14,544 reported civil aircraft strikes have occurred in the United States involving swallows resulting in 1,410 hours of aircraft downtime and over $2.2 million in damages to aircraft (Dolbeer et al. 2022). From January 1990 through mid-January 2022, 394 reported aircraft strikes involving swallows occurred in Georgia, including barn swallows, bank swallow, tree swallows, northern rough-winged swallows, and cliff swallows. Of the bird species identified most frequently as being struck by civil aircraft in the United States, barn swallows ranked third from 1990 through 2021 and third in 2021 only (Dolbeer et al. 2022).

The open areas found at airports also make ideal habitat for meadowlarks to forage and nest while providing ample perching areas. Most requests for assistance to reduce threats associated with eastern meadowlarks occur at airports in Georgia. Meadowlarks found on and adjacent to airport property can pose a strike hazard, causing damage to the aircraft and threatening passenger safety. From 1990 through 2021, there have been 6,499 reported civil aircraft strikes involving meadowlarks in the United States causing nearly $1.2 million in damages (Dolbeer et al. 2022). From January 1990 through July 2023, 120 reported civil aircraft strikes involving meadowlarks have occurred in Georgia (Federal Aviation Administration 2023).

Similar to meadowlarks, airports often have ideal habitat for killdeer. From 1990 through 2021, there have been 8,469 reported civil aircraft strikes involving killdeer in the United States causing over $4.6 million in damages (Dolbeer et al. 2022). From January 1990 through July 2023, 325 reported civil aircraft strikes involving killdeer have occurred in Georgia (Federal Aviation Administration 2023).

In addition to the open grassland habitats found at airports, other habitat types can attract bird species, such as wetlands, water retention ponds, and agricultural practices (DeVault and Washburn 2013). Wetlands and water retention ponds can attract waterfowl and waterbirds, such geese, gulls, herons, and egrets. Agricultural practices on airfields can attract geese, blackbirds, doves, and cranes. Abundant food sources found on airport property can attract certain bird species, such as waste grains from agricultural practices, a high density of small mammals, or the presence of earthworms on runways and taxiways after a rainfall (DeVault and Washburn 2013).

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, 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 esthetically displeasing and can cause damage to property (Dolbeer and Linz 2016, Homan et al. 2017). The reoccurring presence of fecal droppings under bird roosts can lead to constant cleaning costs for property owners.

Property damage most often involves fecal matter that contaminates landscaping and walkways, often at golf courses and waterfront property. Fecal droppings and the overgrazing of vegetation can be esthetically displeasing (*e.g*., see Fitzwater 1994, Gorenzel and Salmon 1994*a*, Gorenzel and Salmon 1994*b*, Johnson 1994, Williams and Corrigan 1994, Cummings 2016, Homan et al. 2017). 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 (Homan et al. 2017).

The accumulation of fecal matter from birds can also negatively affect landscaping and walkways, often at golf courses and waterfront property (Conover and Chasko 1985). Businesses may be concerned about the negative esthetic 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 esthetic value of flowers, gardens, and lawns consumed by birds, 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.

For example, in the fall and winter, American crows often form large roosting flocks in urban areas. American crows typically roost in trees, and they tend to concentrate in areas where abundant food and roosting sites are available. Adaptation to human industrialization and agricultural expansion has allowed the American crow to expand its home range since the 1800s (Emlen 1940, Marzluff et al. 1994). The socialization of corvids, such as American crows, has further increased the prevalence of crows across urban sprawls by attracting populations to metropolitan epicenters and residential neighborhoods (Hogrefe et al. 1998). In the United States, some crow roosts may reach a half-million birds (Verbeek and Caffrey 2021). These large flocks disperse to different feeding areas during the day. Crows can fly six 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.

In addition to damage caused by the accumulation of droppings, damage can occur in other ways. Damage from vultures can include tearing and consuming latex window caulking or rubber gaskets that seal windowpanes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and other equipment (Avery and Lowney 2016, Kluever et al. 2020). Similarly, nesting colonies of gulls frequently cause damage to structures when they nest on rooftops and peck at spray-on-foam roofing and rubber roofing material, including caulking. 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 (Miller 2018). Waterfowl can cause damage to landscaping, when they consume or trample turf, flowers, gardens, and lawns (Conover 1991, Cummings 2016). Gulls pick up refuse at landfills and carry it off the property to feed, resulting in garbage being deposited on buildings, equipment, and vehicles in neighboring areas. 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).

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. These materials 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, Lowney et al. 2018). Nesting material and feathers can also clog ventilation systems or fall onto or into equipment or goods (Gorenzel and Salmon 1994*b*, Homan et al. 2017). Electrical utility companies frequently have problems with bird nests causing power outages when they short out transformers and substations (United States Geological Survey 2005, Pruett-Jones et al. 2007). Nesting material can also be esthetically displeasing, or in the case of some species can cause a fire hazard (Fitzwater 1994). Additionally, because the active nests of most species are protected under the Migratory Bird Treaty Act (MBTA), problems arise when birds nest in areas where new construction or maintenance is scheduled to occur (Coates et al. 2012).

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, Belant et al. 1998, Gabrey 1997, Bruleigh et al. 1998, Lowney et al. 2018). Landfills may be 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 pathogens to landfill employees. 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 pathogens to neighboring residences.

Damage and the threat of damage associated with increasing populations of resident Canada geese are well documented (*e.g.*, see Mississippi Flyway Council Technical Section 1996, Gabig 2000, Atlantic Flyway Council 2011, Mississippi Flyway Council Technical Section 2017). Those potential impacts include damage to property. Damage to property can occur when geese congregate on lawns or mowed areas, including athletic fields, golf courses, lawns, parks, beaches, and marinas, depositing their droppings and feathers (Mississippi Flyway Council Technical Section 1996, Gabig 2000, Atlantic Flyway Council 2011).

Cliff swallows, as their name implies, often nest on rock ledges and cliffs throughout much of the mountains in western North America. Today, cliff swallows also nest on buildings, under bridges, and in culverts with the construction of those structures likely contributing to the range expansion of the cliff swallow into eastern North America (Brown et al. 2020). Cliff swallows are colonial nesters and are one of the most social landbirds in North America. Nesting colonies of cliff swallows may contain up to 6,000 active nests (Brown et al. 2020), which can equate to 12,000 breeding adults at a single nesting site.

Active swallow nests on bridges can hinder maintenance or replacement. The destruction of active nests would be a violation of the MBTA without the necessary permits from the USFWS. For example, the destruction of active nests, including the loss of eggs or young, caused by any activities associated with maintaining or replacing a bridge or any activities that cause the abandonment of active nests would violate the MBTA. Delaying the maintenance or replacement of bridges can put the driving public at risk. Delays can also result in additional costs if contractors are unable to meet deadlines due to the presence of swallow nests.

1.2.5 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 of natural resources. In addition, WS could receive requests for assistance to prevent birds from using areas where chemical spills or other hazards have occurred.

Protecting Habitats

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 esthetically displeasing. Degradation of habitat can occur from the continuous accumulation of fecal droppings under nesting colonies of birds or under areas where birds consistently roost. Over time, the accumulation of fecal droppings can lead to vegetation loss from ammonium nitrogen found in the droppings. A study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979). 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. Double-crested cormorants can have a negative effect on wetland habitats (Jarvie et al. 1997, Shieldcastle and Martin 1997) and wildlife, including threatened and endangered species (Korfanty et al. 1997). Nesting colonies of double-crested cormorants can also have an impact on vegetation and change soil characteristics (Rush et al. 2011, Dorr et al. 2016, Lafferty et al. 2016, Veum et al. 2019).

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, these effects can be so severe on islands that all woody vegetation is eliminated (Cuthbert et al. 2002) and some islands can be completely denuded of vegetation. 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 (Bedard et al. 1999, Dorr et al. 2021).

For example, double-crested cormorants began nesting relatively recently at Lake Guntersville, Alabama. Double-crested cormorants often nest on islands to avoid predators (Dorr et al. 2021), which is where double-crested cormorants are primarily nesting on Lake Guntersville. The number of double-crested cormorants nesting at Lake Guntersville has led to concerns about the potential impacts double-crested cormorants are having on fish, vegetation, soil quality, and water quality in the area where they nest (Barras 2004). The loss of vegetation on islands from nesting and roosting cormorants has led to shoreline erosion and the dead trees that have fallen into the water have created navigational hazards (Barras 2004).

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 1997) and wildlife, including state and federally listed threatened and endangered species (Korfanty et al. 1997). 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, Bedard et al. 1995, Weseloh and Collier 1995, Korfanty et al. 1997, Hebert et al. 2005, Weseloh et al. 2020).

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).

Protecting Birds from Competition

Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites. For example, European starlings and house sparrows can be aggressive and often out-compete native species, destroying their eggs, and killing nestlings (Cabe 2020, Lowther and Cink 2020). Miller (1975) and Barnes (1991) reported European starlings were responsible for a severe depletion of the eastern bluebird (*Sialis sialis*) population due to nest competition. Nest competition by European starlings has been known to displace American kestrels (von Jarchow 1943, Nickell 1967, Wilmers 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 (*Progne subis*) (Allen and Nice 1952), and wood ducks (*Aix sponsa*) (Shake 1967, McGilvery and Uhler 1971, Grabill 1977, Heusmann et al. 1977). Weitzel (1988) reported nine native species of birds in Nevada had been displaced by starling nest competition, and Mason et al. (1972) reported European starlings evicting bats from nest holes.

Double-crested cormorants are known to displace other colonial nesting waterbird species, such as herons, egrets, and terns through competition for nest sites (USFWS 2020*a*). Cuthbert et al. (2002) examined potential impacts of cormorants on great blue herons and black-crowned night-herons in the Great Lakes and found that cormorants have not negatively influenced breeding distribution or productivity of either species at a regional scale but did contribute to declines in heron presence and increases in site abandonment in certain site-specific circumstances.

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 2020). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 different species of birds (Lowther 2020). 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 host species (Lowther 2020). Due to this, brown-headed cowbirds can have adverse effects on the reproductive success of other species (Lowther 2020) and can threaten the viability and the survival of a host species (Trail and Baptista 1993).

Protecting Fisheries from Bird Predation

As the population of double-crested cormorants has increased, so has concern for sport fishery populations. Cormorants can have a negative effect on recreational fishing on a localized level (USFWS 2020*a*). 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 et al. 2009).

Protecting Other Natural Resources from Predation

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 species, and species of conservation concern. Some species listed as threatened or endangered under the Endangered Species Act (ESA) are preyed upon or otherwise could be adversely affected by certain bird species. For example, crows and gulls will consume a variety of food items, including the eggs and chicks of other birds (Pollet et al. 2020, Weseloh et al. 2020, Verbeek and Caffrey 2021). These species in particular are among the most frequently reported avian predator of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). Impacts on the productivity and survivorship of rare or threatened colonial waterbirds can be severe when nesting colonies become targets of avian predators. Fish eating birds, such as cormorants, egrets, herons, and osprey, also have the potential to impact fish and amphibian populations, especially those listed as threatened and endangered species.

Concentrations of gulls often affect the productivity and survivorship of rare or endangered colonial species such as terns and prey upon the chicks of colonial waterbirds (Hunter et al. 2006). 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).

Protecting Other Natural Resources from Disease Threats

As discussed in Section 1.2.2 and Section 1.2.3, birds can carry a wide range of bacterial, viral, fungal, and protozoan pathogens that can affect other bird species, as well as mammals. Birds carry various pathogens that can affect other species (*e.g.*, see Friend and Franson 1999, Forrester and Spalding 2003, Thomas et al. 2007). There is a risk that birds will transmit pathogens to a single individual or a local population, new areas, or other species including birds, mammals, reptiles, amphibians, and fish species. Birds may also act as a vector, reservoir, or intermediate host of various pathogens and parasites.

Diseases like avian botulism, avian cholera, and Newcastle disease can result in 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).

Protecting Birds from Chemical Spills and Other Hazards

WS could also receive requests for assistance with recovering birds from areas affected by oil spills or other chemical spills. In addition, WS could receive requests to conduct activities to exclude, harass, and/or disperse birds from areas where oil or other toxic spills have occurred to prevent birds from contacting those chemicals. Exposure to oil, both chronic and acute, such as that from an oil spill, can adversely affect bird species (Szaro 1977, Flickinger 1981, Albers 1984, Albers 1991, Rocke 1999). Petroleum in all of its forms can affect birds through external oiling of feathers (which causes loss of buoyancy and waterproofing properties), ingestion, oiling of eggs, and habitat alteration (Rocke 1999). Death of individual birds often occurs from exposure or drowning, or sometimes indirectly from disease, malnutrition, and predation that results from ingesting chemical spills.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT AND DECISION-MAKING

The National Environmental Policy Act (NEPA) requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes (Public Law 9-190, 42 USC 4321 et seq.). Therefore, if WS provided assistance by conducting activities to manage damage caused by bird species, those activities would be a federal action requiring compliance with the NEPA. The NEPA requires federal agencies to have available and fully consider detailed information regarding environmental effects of federal actions and to make information regarding environmental effects available to interested persons and agencies.

As part of the decision-making process associated with the NEPA, WS follows the Council on Environmental Quality regulations implementing the NEPA (40 CFR 1500 et seq.)[6] along with the implementing procedures of the USDA (7 CFR 1b) and the APHIS (7 CFR 372). The NEPA sets forth the requirement that federal agencies evaluate their actions in terms of their potential to significantly affect the quality of the human environment to avoid or, where possible, to mitigate and minimize adverse impacts, make informed decisions, and include governmental agencies and the public in their planning to support informed decision-making.

1.3.1 Complying with the National Environmental Policy Act

To comply with the NEPA and Council on Environmental Quality regulations, WS is preparing this EA to evaluate alternative approaches of achieving the objectives of WS and to determine whether the potential environmental effects caused by the alternative approaches might be significant, requiring the preparation of an Environmental Impact Statement (EIS). As described by the Council on Environmental Quality (2007), the intent of an EA is to provide brief but sufficient evidence and analysis to determine whether to prepare an EIS, aid in complying with the NEPA when an EIS is not necessary, and to facilitate preparation of an EIS when one is necessary. The Council on Environmental Quality (2007) further

[6]WS developed this EA under the 1978 NEPA regulations and the associated APHIS NEPA implementing procedures because WS, in cooperation with the TVA, initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020. Therefore, WS and the TVA followed the Council on Environmental Quality regulations implementing the NEPA at 40 CFR 1500 et seq. that were in effect prior to the NEPA revisions that became effective on September 14, 2020.

stated, "*The EA process concludes with either a Finding of No Significant Impact…or a determination to proceed to preparation of an EIS*". WS and the TVA developed this EA under the 1978 NEPA regulations and existing APHIS NEPA implementing procedures because WS initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020.

1.3.2 Rationale for Preparing an EA Rather Than an EIS

One comment that WS often receives during the public involvement process associated with the development of an EA is that WS should have prepared an EIS instead of an EA or that proposed activities require the development of an EIS. As discussed in Section 1.3.1, the primary purpose for developing an EA is to determine if the alternative approaches developed to meet the need for action could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS. WS prepared this EA so that WS can make an informed decision on whether or not an EIS would be necessary if WS implemented the alternative approaches to meeting the need for action.

WS is preparing this EA to facilitate planning, promote interagency coordination, streamline program management, clearly communicate to the public the analysis of individual and cumulative impacts of proposed activities, and to evaluate and determine if there would be any potentially significant or cumulative effects from the alternative approaches developed to meet the need for action. The analyses contained in this EA are based on information derived from WS Management Information System, available documents (see Appendix A), interagency consultations, and public involvement.

If WS makes a determination that implementation of a selected alternative approach would have a significant impact on the quality of the human environment based on this EA, WS would publish a Notice of Intent to prepare an EIS. This EA would be the foundation for developing that EIS.

1.3.3 Using this EA to Inform Decisions and the Decisions to be Made

Although WS only provides assistance when requested, WS is required to comply with the NEPA before making final decisions about actions that could have environmental effects. WS will use the analyses in this EA to help inform agency decision-makers, including a decision on whether the alternative approaches of meeting the need for action requires the preparation of an EIS or the EA process concludes with a Finding of No Significant Impact.

Another major purpose of the NEPA is to include other agencies and the public during the planning process to support informed decision-making. Prior to making and publishing the decision[7] to conclude this EA process, WS will make this EA available to the public, agencies, tribes, and other interested or affected entities for review and comment. Making the EA available to the public, agencies, tribes, and other interested or affected entities during the planning process will assist with understanding applicable issues and reasonable alternative means to meeting the need for action (see Section 1.2) and to ensure that the analyses are complete for informed decision-making.

Based on agency relationships, Memorandums of Understanding, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Section 1.5 discusses the roles and responsibilities of agencies related to activities discussed in this EA. As discussed in Section 1.2, WS receives requests for assistance associated with many bird species in Georgia, including properties owned or managed by the TVA. The United States Fish and Wildlife

---

[7] As discussed in Section 1.3, the EA process concludes with either a Finding of No Significant Impact or the publication of a Notice of Intent to prepare an EIS.

Service (USFWS) and the Georgia Department of Natural Resources (GDNR) have regulatory authority over many of those bird species and WS activities involving the take of certain bird species would require authorization from the USFWS and/or the GDNR prior to WS conducting activities. In addition, WS would be subject to any conditions associated with the authorizations given by the USFWS and/or the GDNR. Therefore, the take of many bird species to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS and/or the GDNR.

Based on the scope of this EA, a decision to be made is: Should WS conduct activities to alleviate bird damage and threats of damage in Georgia? If so, how can WS best respond to the need to reduce damage in Georgia, and would activities conducted in response to that need result in effects to the human environment requiring the preparation of an EIS? The decisions of the TVA would be to determine when WS' assistance was needed, the types of activities the TVA would allow WS to conduct on properties owned or managed by the TVA, and to ensure WS' activities were consistence with the TVA Natural Resources Plan and the TVA Environmental Impact Statement Assessing the Natural Resources Plan (see Section 1.6 for further discussion on the TVA natural Resources Plan and the TVA Environmental Impact Statement Assessing the Natural Resources Plan).

1.3.4 Public Involvement

Public outreach and notification methods for this EA will include posting a notice on the national WS program webpage and on the www.regulations.gov webpage. In addition, WS will send out direct mailings to local known stakeholders and an electronic notification to stakeholders registered through the APHIS Stakeholder Registry. WS will also publish a notice in the legal section of the *Atlanta Journal-Constitution* newspaper. WS and the TVA will provide for a minimum of a 30-day comment period for the public and interested parties to review the EA and provide their comments. WS will inform the public of the decision using the same venues.

WS and the TVA will coordinate the preparation of this EA with consulting partner agencies and tribes to facilitate planning, promote interagency and tribal coordination, and incorporate agency and tribal expertise, which includes the GDNR and the USFWS. WS and the TVA have asked each consulting agency to review the draft EA and provide input and direction to WS to ensure proposed activities would comply with applicable federal and state regulations and policies, federal land management plans, and Memorandums of Understanding.

1.3.5 Period for which this EA is Valid

If WS and the TVA determine that the analyses in this EA indicate that an EIS is not warranted, this EA remains valid until WS and the TVA determine that new or additional needs for action, changed conditions, new issues, and/or new alternative approaches having different environmental impacts need to be analyzed to keep the information and analyses current. At that time, this analysis and document would be reviewed and, if appropriate, supplemented, or a new EA prepared pursuant to the NEPA.

If WS provides assistance with managing damage caused by birds, WS would monitor activities conducted by its personnel to ensure those activities and their impacts remain consistent with the activities and impacts analyzed in this EA and selected as part of the decision. Monitoring activities would ensure that WS activities and the effects associated with those activities occurred within the limits of evaluated/anticipated activities. Monitoring involves review of the EA for all of the issues evaluated in Chapter 3 to ensure that the activities and associated impacts have not changed substantially over time.

1.4 SCOPE OF ANALYSIS

WS and the TVA have decided that one EA analyzing potential effects of implementing the alternative approaches of meeting the need for action for the entire State of Georgia provides a more comprehensive and less redundant analysis than multiple EAs covering smaller regions. This approach also provides a broader scope for the effective analysis of potential cumulative impacts and for using data and reports from state and federal wildlife management agencies, which are typically on a statewide basis.

Many of the bird species discussed in Section 1.2 and Appendix E occur statewide and may occur throughout the year in Georgia. Birds are dynamic and mobile; therefore, damage and threats of damage caused by birds can occur wherever those bird species occur in the state. Birds could occur in and around commercial, industrial, public, and private buildings, facilities, and properties where birds may roost, loaf, feed, nest, or otherwise occur. Examples of areas where birds occur include, but are not necessarily limited to, residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, and schools. Activities could also occur in and around agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, military bases, or at any other sites where birds may roost, loaf, or nest. Target bird species could occur in and around 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, target bird species could occur at airports and surrounding properties where birds represent a threat to aviation safety. Birds may occur in areas owned or managed by the TVA, which may include areas associated with power-generating equipment, power transmission structures, dams, locks, and other facilities, and may include islands and other natural areas along lakes, rivers, and waterways.

Responding to requests for assistance falls within the category of actions in which the exact timing or location of individual requests for assistance can be difficult to predict with sufficient notice to describe accurately the locations or times in which WS could reasonably expect to be acting. Although WS could predict some of the possible locations or types of situations and sites where some requests for assistance could occur, WS cannot predict the specific locations or times at which affected resource owners would determine that damage had become intolerable to the point that they request assistance from WS. WS must be ready to provide assistance on short notice anywhere in Georgia when receiving a request for assistance. Therefore, the geographic scope of the actions and analyses in this EA is statewide and this EA analyzes actions that could occur on federal, tribal, state, county, city, and private lands, when requested. However, WS would only provide assistance when the appropriate property owner or manager requested such assistance and only on properties where WS and the appropriate property owner or manager has signed a work initiation document.

The analyses in this EA would apply to any actions that WS may conduct to alleviate damage caused by bird species in any locale and at any time within Georgia when WS receives a request for such assistance from the appropriate property owner or property manager. 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 2 for a description of the WS 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. If WS and the TVA determine that the analyses in this EA do not warrant the preparation of an EIS, the decisions made by WS personnel using the model would be consistent with the alternative approach that WS selects to meet the need for action. In addition, decisions made using the model would be in accordance with WS directives as well as relevant laws and regulations.

As discussed previously, the property owner or property manager would determine when assistance from WS was appropriate. WS would only conduct activities after receiving a request from the appropriate property owner or property manager. In addition, WS would only conduct activities after the appropriate property owner or manager signed a work initiation document allowing WS to conduct activities on the property they own or manage. Therefore, this EA meets the intent of the NEPA with regard to site-specific analysis, informed decision-making, and providing the necessary timely assistance to those people requesting assistance from WS.

1.5 GOVERNMENTAL AGENCIES AND THEIR ROLES AND AUTHORITIES

If WS provides assistance to meet the need for action, several governmental agencies would have roles and authorities that would relate to WS conducting activities. Below are brief discussions of the roles and authorities of other governmental agencies, as those authorities relate to conducting wildlife damage management.

1.5.1 Tennessee Valley Authority

The TVA is a federal corporation created by an Act of Congress on May 18, 1933 [48 Stat. 58-59, 16 USC Sec. 831, as amended]. The TVA provides electricity for select directly served customers and local public power companies, serving 10 million people, businesses, and industries, and manages 293,000 acres of public land and 11,000 miles of reservoir shoreline in the 7-state Tennessee Valley region (Tennessee, Alabama, Mississippi, Kentucky, Georgia, North Carolina, and Virginia), which is an area of 80,000 square miles. The electricity generating assets of the TVA includes 29 hydroelectric dams, six coal-fired power plants, three nuclear plants, 18 natural gas-fired power facilities, and a pump-storage plant as well as solar, wind, and other renewable energy production sites that can produce about 34,000 megawatts of electricity, delivered through approximately 16,000 miles of high-voltage power lines. The TVA also provides flood control, navigation, land management, and recreation for the Tennessee River system and works with local utilities and state and local governments to promote economic development across the region. The TVA often requests assistance from WS with managing wildlife damage on its land and at its facilities.

1.5.2 United States Fish and Wildlife Service

The USFWS is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats. The USFWS shares responsibility with other federal, tribal, state, and local entities. However, the USFWS has specific responsibilities for the protection of threatened and endangered 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 mission of the USFWS is "*…working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people*" (USFWS 2023).

1.5.3 United States Environmental Protection Agency

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

1.5.4 Georgia Department of Natural Resources, Wildlife Resources Division

The Georgia Department of Natural Resources' authority in wildlife management is given under Title 27, Chapters 1 - 5 of the Official Code of Georgia Annotated. The mission of the Wildlife Resources Division is to manage, protect, conserve, and enhance the wildlife and aquatic resources of Georgia for the sustainable benefit of the people of Georgia. The mission of the Wildlife Resources Division is to "*Conserve and promote fishing, hunting and wildlife resources through management, education and scientific research*" (GDNR 2022*a*).

The GDNR currently has a Memorandum of Understanding with WS that establishes a cooperative relationship between WS and the GDNR. Responsibilities include planning, coordinating, and implementing policies to address wildlife damage management and facilitating exchange of information.

1.5.5 Georgia Department of Agriculture

The mission of the Georgia Department of Agriculture is to provide timely, fair and expert regulatory control over product, business entities, movement, and application of goods and services for which applicable State and Federal laws exist and strives to protect and provide service to Georgia consumers. Department personnel actively work to initiate and support economic development activities and promote domestic and international consumption of Georgia products. It is the Department's goal to be recognized for its employee's integrity and professional performance. The Pesticide Division enforces state laws pertaining to the use and application of pesticides.

1.6 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, including activities that could occur on properties owned and/or managed by the TVA. The relationship of those documents to this EA occurs below for each of those documents.

1.6.1 TVA Natural Resource Plan

The TVA developed an extensive plan in 2011 to strategically evaluate both renewable and nonrenewable resources and fulfill the responsibilities associated with good stewardship of TVA lands and resources. In February 2020, TVA adopted changes to the Natural Resource Plan (TVA 2020*a*) in an effort to support a more strategic, flexible, and comprehensive management approach to TVA's natural and cultural resource programs. This updated plan includes ten focus areas, with three of these being added with the update, that encompass TVA's work in resource stewardship. The newest focus areas added to the plan include Section 26a Permitting and Land Use Agreements, Nuisance and Invasive Species Management, and Ecotourism. The updated plan outlines more clearly defined strategies including objectives and programs for each focus area as well as a flexible approach for long-term planning to help prioritize funding and support the overall mission.

1.6.2 TVA Environmental Impact Statement Assessing the Natural Resource Plan

The TVA also prepared an EIS to assess the impacts of the Natural Resource Plan and its reasonable alternatives on the environment. It specifically describes the stewardship programs that are ongoing, the programs the TVA is evaluating for future implementation as part of the Natural Resource Plan, and assesses the potential environmental impacts associated with implementing the various alternatives. With the release of an updated Natural Resource Plan, a supplemental EIS (TVA 2020*b*) was completed to assess and analyze potential impacts associated with the proposed changes in the updated Natural

Resource Plan.

1.6.3 Resident Canada Goose Management Final Environmental Impact Statement

The USFWS has issued a Final Environmental Impact Statement (FEIS) addressing the need for and potential environmental impacts associated with managing damage caused by the resident Canada goose population (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 for the FEIS on August 10, 2006 (71 FR 45964-45993). On June 27, 2007, WS, as a cooperating agency, issued a Record of Decision and adopted the FEIS (72 FR 35217).

1.6.4 Light Goose Management Final Environmental Impact Statement

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*a*). The "*light*" geese referred to in the FEIS include the snow goose (*Anser caerulescens*) and Ross's goose (*Anser rossii*) that nest in Arctic and sub-Arctic regions of Canada and Alaska and migrate and winter throughout the contiguous United States. The USFWS published a Record of Decision and issued a final rule that went into effect on December 5, 2008.

1.6.5 Double-crested Cormorant Management Final Environmental Impact Statement

On November 20, 2020, the USFWS issued a FEIS that reviews regulatory options for managing damage from double-crested cormorants in the contiguous United States. The USFWS preferred action in the FEIS is to create a special state/tribal permit that would allow states and tribes to manage damage caused by double-crested cormorants to resources, such as state or tribal managed fisheries. The USFWS would continue to issue standard depredation permits to protect other resources, such as commercial aquaculture. The USFWS issued a Record of Decision for the FEIS selecting the preferred alternative on December 22, 2020. The USFWS has also issued a final rule associated with implementation of the selected alternative that went into effect on February 12, 2021.

1.6.6 Eagle Rule Revision Final Programmatic Environmental Impact Statement

Developed by the USFWS, this FEIS 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 FEIS 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). The USFWS issued a Record of Decision for the preferred alternative in the FEIS. The USFWS published a Final Rule on December 16, 2016 (81 FR 91551-91553).

1.6.7 National Bald Eagle Management Guidelines

The USFWS developed national bald eagle management guidelines to advise people of when and under what circumstances the protective provisions of the Bald and Golden Eagle Protection Act may apply to their activities (USFWS 2007*b*). A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The USFWS developed the bald eagle management guidelines to help people minimize their impacts on bald eagles, particularly where their activities may cause "*disturbance*".

1.6.8 WS Environmental Assessments

WS has previously developed an EA that analyzed the need for action to manage damage associated with rock pigeons, European starlings and house sparrows, an EA that analyzed the need to manage damage caused by waterfowl, and an EA that addressed the need to manage damage associated with other bird species. Those EAs identified the issues associated with managing damage associated with birds in the state and analyzed alternative approaches to meet the specific need identified in those EAs while addressing the identified issues. Changes in the need for action and the affected environment have prompted WS to initiate this new analysis to address damage management activities 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 new EA will re-evaluate activities conducted under the previous EAs to address the new need for action and the associated affected environment, the outcome of the Decision issued based on the analyses in this EA will supersede the previous EAs that addressed birds.

1.6.9 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 and 2 pelagic Bird Conservation Regions[8] (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.

1.6.10 Atlantic and Mississippi Flyways Double-crested Cormorant Management Plan

The Atlantic Flyway Council and the Mississippi Flyway Council developed a joint management plan that "*…provides the basic principles and strategies to help guide management of* [double-crested cormorants] *in the Atlantic and Mississippi Flyways* (Atlantic Flyway Council and Mississippi Flyway Council 2010). The main goal of the Atlantic and Mississippi Flyways Double-crested Cormorant Management Plan is to minimize "*…negative ecological impacts to habitats, other species, or personal property and other socioeconomic interests*" associated with double-crested cormorants while maintaining "*…the double-crested cormorant as a natural part of the waterbird biodiversity of the Atlantic and Mississippi Flyway…*" (Atlantic Flyway Council and Mississippi Flyway Council 2010).

1.6.11 Atlantic Flyway Resident Canada Goose Management Plan

In response to increasing populations of resident Canada geese along the Atlantic Flyway, the Atlantic Flyway Council composed the Atlantic Flyway Resident Canada Goose Management Plan to describe the status of resident geese and set population goals and management strategies for the flyway. To relieve damage and manage conflicts, the management recommended a variety of options including the adoption of a federal depredation order or conservation order to allow states to manage resident goose populations

---

[8]Bird Conservation Regions are areas in North America characterized by distinct ecological habitats that have similar bird communities and resource management issues. The State of Georgia lies within the Southeastern Coastal Plain (Bird Conservation Region 27), the Appalachian Mountains (Bird Conservation Region 28), and the Piedmont (Bird Conservation Region 29).

while maximizing the opportunities for the use and appreciation of resident Canada geese. The plan also called for management, which is compatible with management criteria already established for migratory Canada geese. Finally, the management plan called for annual monitoring of resident Canada geese populations, harvest and conflict levels so that the effectiveness of the plan could be assessed (Atlantic Flyway Council 1999). This plan was updated in 2011 with revised population goals (Atlantic Flyway Council 2011).

1.6.12 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. The Plan was further updated in 2018 (USFWS 2018).

1.6.13 Georgia State Wildlife Action Plan

The goal of the Georgia Wildlife Action plan "*…is to provide an informational and strategic framework that will support the conservation of Georgia's biological diversity over the next 5 to 10 years*" and "*… to outline objectives and partnerships for wildlife conservation in Georgia*" (GDNR 2015).

1.7 FEDERAL AND STATE REGULATIONS THAT COULD APPLY TO WS ACTIVITIES

In addition to the NEPA, several regulations and executive orders would be relevant to activities that WS could conduct when providing assistance. This section discusses several regulations and executive orders that would be highly relevant to WS activities when providing assistance. All management actions conducted and/or recommended by WS would comply with appropriate federal, state, and local laws in accordance with WS Directive 2.210.

1.7.1 Federal regulations that could apply to WS activities

If WS provides assistance to manage bird damage or threat of damage, several federal regulations could apply to the activities that WS conducts. The following are the primary federal regulations that could apply to WS activities.

Endangered Species Act

Under the ESA, all federal agencies will seek to conserve threatened and endangered species and will utilize their authorities in furtherance of the purposes of the ESA (Section 2(c)). Evaluation of the alternative approaches in regard to the ESA will occur in Section 3.1.2 of this EA.

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 occurs in the Code of Federal Regulations (CFR) at 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 authorized by the USFWS. Under permitting guidelines in the MBTA, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the MBTA. In addition, the USFWS may establish depredation/control orders for migratory birds that allow people to take bird species without the need for a depredation permit when those species cause damage. Information regarding migratory bird permits and depredation/control orders occurs in 50 CFR 13 and 50 CFR 21, respectively. The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the GDNR has the authority to manage wildlife populations in the State of Georgia. Section 2.1.1, Section 2.2.5, and Section 2.2.6 further discuss the permitting and authorization of take by the USFWS and other entities.

Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies

Pursuant to the MBTA under 50 CFR 21.150, a depredation permit is not required to take certain species of blackbirds, cowbirds, grackles, crows, and magpies when those species cause serious injuries to agricultural crops, horticultural crops, or livestock feed. In addition, a depredation permit is not required when those species cause a health hazard or structural property damage. A depredation permit is also not required to protect species designated as endangered, threatened, or a candidate species by a federal, state, and/or tribal government. Those species that WS could lethally remove pursuant to the blackbird depredation order that are addressed in this EA include American crows, fish crows, red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, and brown-headed cowbirds.

Control Order for Muscovy Ducks

Muscovy ducks are native to South America, Central America, and Mexico with a small naturally occurring population in southern Texas. People have domesticated Muscovy ducks and they have sold and kept Muscovy ducks for food and as pets in the United States. In many states, people have released Muscovy ducks or Muscovy ducks have escaped captivity and have formed feral non-migratory populations, especially in urban areas. The USFWS has issued a Final Rule on the status of the Muscovy duck in the United States (see 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 in the list of bird species afforded protection under the MBTA at 50 CFR 10.13 (see 75 FR 9316-9322). To address damage and threats of damage associated with Muscovy ducks, the USFWS has also established a control order for Muscovy ducks under 50 CFR 21.174 (see 75 FR 9316-9322). Under 50 CFR 21.174, 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 (see 75 FR 9316-9322).

Depredation/Control Orders for Canada Geese

As discussed previously, the USFWS developed a FEIS to evaluate alternative approaches to address increasing resident goose populations across the United States and to reduce associated damage (USFWS 2005). Canada geese are "*resident*" when they nest within the contiguous United States and the District of Columbia or when they reside within the contiguous United States and the District of Columbia in the months of April, May, June, July, or August (see 50 CFR 20.11, 50 CFR 21.6) (Rusch et al. 1995, Ankney 1996). The USFWS selected an approach that established several depredation/control orders to manage damage associated with resident Canada Geese. When certain criteria are occurring, the depredation/control orders allow people to take resident Canada geese without the need for a depredation permit from the USFWS.

Under 50 CFR 21.159, airport authorities or their agents can lethally take resident Canada Geese at airports and military airfields without the need for a depredation permit when resident Canada geese are causing damage or posing a threat of damage to aircraft operations. The USFWS also established a Canada goose nest and egg depredation order that allows people to destroy the nests and eggs of those resident Canada geese causing or posing a threat to people, property, agricultural crops, and other interests without the need for a depredation permit once the participant has registered with the USFWS (see 50 CFR 21.162). The USFWS established a similar depredation order to manage damage to agricultural resources associated with Canada geese. Under 50 CFR 21.165, designated people can lethally remove resident Canada geese without a permit from the USFWS in those states identified, including Georgia, when resident Canada geese are causing damage to agricultural resources. Pursuant to 50 CFR 21.168, state agencies, tribes, and the District of Columbia can address resident Canada geese using lethal and non-lethal methods when those geese pose a direct threat to human health.

Bald and Golden Eagle Protection Act (16 USC 668-668c), as amended

The Bald and Golden Eagle Protection Act and the MBTA protect the bald eagle and the golden eagle from a variety of harmful actions and impacts. Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of bald eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "*take*" includes actions that can "*molest*" or "*disturb*" eagles. For the purposes of the Act, under 50 CFR 22.6, 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*."

Federal Insecticide, Fungicide, and Rodenticide Act

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All pesticides used by WS in Georgia, including the use or recommendation of repellents, would be registered with and regulated by the EPA and the Georgia Department of Agriculture, and used or recommended by WS in compliance with labeling procedures and requirements.

National Historic Preservation Act

The National Historic Preservation Act and its implementing regulations (see 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.

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

The Native American Graves Protection and Repatriation Act of 1990

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

Consultation and Coordination with Indian Tribal Governments – Executive Order 13175

Executive Order 13175 directs federal agencies to provide federally recognized tribes the opportunity for government-to-government consultation and coordination in policy development and program activities that may have direct and substantial effects on their tribe. Its purpose is to ensure that tribal perspectives on the social, cultural, economic, and ecological aspects of agriculture, as well as tribal food and natural resource priorities and goals, are heard and fully considered in the decision-making processes of all parts of the federal government.

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 Memorandum of Understanding with the USFWS that promotes the conservation of migratory bird populations. The APHIS has developed a Memorandum of Understanding with the USFWS as required by this Executive Order.

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 alternative approaches 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 their physical and mental development. 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.

Invasive Species - Executive Order 13112 and Executive Order 13751

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 damage, 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. Executive Order 13751 amended Executive Order 13112 by clarifying the operations of the National Invasive Species Council and by expanding its membership. In addition, Executive Order 13751 incorporated additional considerations into federal efforts to address invasive species and to strengthen coordinated, cost efficient federal actions.

Advancing Racial Equity and Support for Underserved Communities Through the Federal Government - Executive Order 13985

Executive Order 13985 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. Advancing Racial Equity 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 13985 requires federal agencies to make Advancing Racial Equity part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minorities and low-income persons or populations. APHIS implements Executive Order 13985 principally through its compliance with the NEPA.

Protecting Health and the Environmental and Restoring Science to Tackle the Climate Crisis – Executive Order 13990

Executive Order 13990 directs federal agencies to ensure access to clean air and water, limit exposure to dangerous chemicals and pesticides, reduce greenhouse gas emissions, bolster resilience to the impacts of climate change, restore and expand our national treasures and monuments, and prioritize both environmental justice and employment.

Tackling the Climate Crisis at Home and Abroad - Executive Order 14008

Executive Order 14008 makes climate considerations an essential element of United States foreign policy and national security. Executive Order 14008 establishes a policy to meet the challenges of climate change through a coordinated government-wide approach and engagement with stakeholders, including state, local, and tribal governments.

1.7.2 State regulations that could apply to WS activities

Georgia Compiled Rules and Regulations, Department 391, Chapter 391-4, Subject 391-4-9 establishes procedures for issuing scientific collecting permits to authorize an entity "*….to take, possess, capture, kill, ship or transport any of the wildlife of this State, or the plumage, skin or body thereof, or the nest of eggs of the same for scientific purposes according to the rules and regulations promulgated by the Board of Natural Resources…*". Georgia Compiled Rules and Regulations, Department 391, Chapter 391-4, Subject 391-4-10 defines protected species of plants and animals in Georgia and states any activities intended to harass, capture, kill, or otherwise directly cause death of any protected animal species, except as specifically authorized by law or by regulation as adopted by the Board of Natural Resources is unlawful.

CHAPTER 2: ISSUES AND ALTERNATIVE APPROACHES

WS and the TVA have identified several issues associated with the activities that WS could implement to meet the need for action to manage damage caused by birds in Georgia. Issues are concerns regarding potential effects that might occur from proposed activities. Federal agencies must consider such issues during the decision-making process required by the NEPA. Section 2.1 of this EA discusses the issues that WS and the TVA identified, which could occur from implementation of the alternative approaches to meet the need for action. Section 3.2 discusses additional issues that WS and the TVA identified; however, the EA does not analyze those issues in detail for the reasons provided in Section 3.2.

WS and the TVA developed four alternative approaches to meet the need for action that Section 1.2 of this EA identifies and to address the identified issues discussed in Section 2.1. Section 2.4.1 discusses the four alternative approaches that WS could implement to meet the need for action. Section 2.4.2 discusses the alternative approaches considered but not analyzed in detail and provides the rationale for not considering those alternative approaches in detail within this EA. In addition, WS directives would provide guidance to WS personnel conducting official activities (see WS Directive 1.101).

2.1 ISSUES USED TO DEVELOP THE ALTERNATIVE APPROACHES

This section describes the issues that WS and the TVA identified during the scoping process for this EA. Section 3.1 analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues. WS evaluated, in detail, the following four issues.

2.1.1 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 populations of target species. Methods available to alleviate bird damage or threats of damage are either non-lethal or lethal methods. Non-lethal methods available can capture, exclude, disperse, or otherwise make an area unattractive to target species causing damage, which can reduce the presence of those species at the site and potentially the immediate area around the site where people use those non-lethal methods. Lethal methods could also be available to remove a bird or those birds responsible for causing damage or posing threats to human safety. Therefore, if WS personnel used lethal methods, the removal of a bird or birds could result in local population reductions in the area where damage or threats were occurring.

In addition, people can harvest some of the bird species addressed in this EA during annual hunting seasons in the state, such as waterfowl species. 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. Therefore, any activities conducted by WS under the alternative approaches 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.

Section 3.1.1 analyzes the effects on the populations of target bird species in the state from implementation of the alternative approaches. Information on bird populations and population trend data can be available from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population database, available literature, and harvest data. Further information on those sources of information occurs below.

Breeding Bird Survey

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. 2019). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. During the BBS, observers count birds at established survey points along roadways for a set duration along a pre-determined route. Survey routes are 24.5 miles long with the observer stopping every 0.5 mile along the route to conduct the survey. The observer records the species and number of birds heard and seen within 0.25 mile of each survey point during a 3-minute sampling period. A survey along the route occurs once per year. The first surveys occurred in 1966 and occur each year in late May or June in Georgia, which is the period of time when the majority of bird species breed in the state. The BBS occurs annually in the United States and Canada, across a large geographical area, and uses standardized survey protocols. Scientists monitor bird populations by using trend data derived from bird observations collected during the BBS. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. Hierarchical model analysis is the basis for the current population trends derived from BBS data (Link and Sauer 2002, Sauer and Link 2011) and are dependent upon a variety of assumptions (Link and Sauer 1998).

Christmas Bird Count

Thousands of volunteers conduct the CBC annually in December and early January under the guidance of the National Audubon Society. The CBC reflects the number of birds frequenting a location during the winter months. Survey data consists of the number of birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but the data can be an indicator of trends in a population over time (Meehan et al. 2020).

Partners in Flight Landbird Population Estimate

The BBS monitors the status of trends of North American bird populations, but it is also possible to use BBS data to develop a general estimate of the size of bird populations (Will et al. 2020). Using relative abundances derived from the BBS conducted from 2006 through 2015, Partners in Flight (2020) extrapolated population estimates for many bird species in North America as part of the Partners in Flight Landbird Population Estimate database (see Will et al. 2020). 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 the Partners in Flight (2020) makes assumptions on the detectability of birds, which can vary for each species (Stanton et al. 2019, Will et al. 2020). 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. Therefore, the Partners in Flight Landbird Population Estimate database uses information on the detectability of a species 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, Will et al. 2020).

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. The USFWS establishes frameworks for the migratory bird hunting seasons that the GDNR implements in the state.

2.1.2 Issue 2 - Effects on the Populations of Non-target Wildlife Species, Including Threatened and Endangered Species

The potential for effects on non-target species and threatened and endangered species arises from the use of non-lethal and lethal methods identified in the alternative approaches. The use of non-lethal and lethal methods has the potential to inadvertently exclude, disperse, capture, or kill non-target wildlife. A non-target animal would be an animal that WS personnel exclude, disperse, capture, or kill unintentionally while targeting a specific bird or group of birds. Appendix B describes the methods available for use under the alternative approaches. As part of the scoping process for this EA, WS consulted with the USFWS pursuant to Section 7 of the ESA during the development of this EA, which Section 3.1.2 discusses in further detail.

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

An additional issue often raised is the potential risks to human health and safety associated with employing methods to manage damage caused by target species. WS employees would use and recommend only those methods that are legally available, selective for target species, and 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 analyzes the potential for proposed methods to pose a risk to members of the public and employees of WS. Section 3.1.3 further evaluates the risks to human safety as this issue relates to the alternative approaches.

2.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

Several non-lethal and lethal methods would be available to alleviate damage associated with bird species. The use of non-lethal and lethal methods has the potential to disperse, exclude, capture, or kill target bird species. Section 3.1.4 discusses concerns regarding the humaneness of available methods and animal welfare concerns.

2.2 COMMON ACTIONS ASSOCIATED WITH DAMAGE MANAGEMENT ACTIVITIES

The following subsections discuss those actions WS and the TVA identified that would continue to occur if WS implemented any of the alternative approaches identified in Section 2.4 that involve WS providing assistance.

2.2.1 WS Co-managerial Approach to Making Decisions

Entities experiencing damage associated with birds could conduct activities on their own, contact a private business for assistance, seek assistance from another governmental agency, seek assistance from WS, if available, or take no action. However, in all cases, the person and/or entity experiencing damage or threats of damage would determine the appropriate level of involvement of other people and/or entities in the decision-making process.

If a person and/or entity requested assistance from WS and WS was able to provide assistance, WS would follow the "*co-managerial approach*" to alleviate damage or threats of damage as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of target bird species and effective, practical, and reasonable methods available to a local decision-maker(s) to reduce damage or threats. 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 presentations by WS at public meetings to allow for involvement of the community. Requests for assistance to manage damage caused by 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) would be 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 would allow WS to recommend and implement activities based on local input.

The decision-maker for a local community would be elected officials or representatives of the communities. Elected officials or representatives oversee the interests and business of the local community, 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. In the case of private property owners, the decision-maker would be the individual who owns or manages the affected property. 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. If WS implemented Alternative 4, WS would not provide any assistance with managing the damage that birds can cause in the state; therefore, the co-managerial approach would not be applicable.

2.2.2 Availability of Methods to Manage Damage Caused by Birds

Appendix B discusses several methods available to alleviate damage or threats of damage associated with birds. The methods discussed in Appendix B would be available to any entity for use when managing damage or threats of damage caused by birds in the state, except the use of the avicide DRC-1339, which is currently only available for use by WS. Therefore, despite the level of involvement by WS, most methods discussed in Appendix B would be available to other entities to manage damage or threats of damage associated with birds, including the public, private businesses, tribal entities, and other state or federal agencies.

2.2.3 Effectiveness of Methods to Address Damage and Threats of Damage

Defining the effectiveness of damage management activities often occurs in terms of losses or risks potentially reduced or prevented. Effectiveness can be dependent upon how accurately practitioners diagnose the problem, the species responsible for the damage, and how people implement actions to correct or mitigate risk or damage. 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. Efficacy is based on the types of methods employed, application of the method(s), restrictions on the use of method(s), skill of people using the method(s), and, for WS personnel, guidance provided by WS directives and policies. For any management method(s) employed, proper timing is essential in effectively dispersing birds causing damage. Employing methods soon after damage begins or soon after identifying damage threats increases the likelihood that 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.

WS is considering several methods (see Appendix B) that WS personnel could incorporate into alternative approaches (see Section 2.4) to meet the need for action. If WS provides assistance and depending on the alternative approach selected to meet the need for action (see Section 2.4), WS could consider the use of an individual method or consider the use of several methods in combination to address damage and threats of damage. When WS provides assistance, WS personnel would use the WS Decision Model (see WS Directive 2.201) to identify methods (see WS Directive 2.101) appropriate to reducing damage and reducing the threat of damage. In general, when providing assistance, WS personnel would consider an adaptive approach that would integrate a combination of methods to resolve damage and reduce threats of damage (see WS Directive 2.105).

The use of non-lethal methods in an integrated approach may effectively disperse birds. For example, Avery et al. (2002) and Seamans (2004) found that the use of vulture effigies was 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 continued use of non-lethal methods often leads to the habituation of birds to those methods, which can decrease the effectiveness of those methods (Conover 2002, Avery et al. 2008*a*, Chipman et al. 2008, Seamans and Gosser 2016). The intent of lethal methods is to reduce the number of birds present at a location. A reduction in the number of birds at a location leads to a reduction in damage, which is applicable whether using lethal or non-lethal methods. The use of lethal methods can successfully reduce bird damage (Boyd and Hall 1987, Blanton et al. 1991, Gorenzel et al. 2000). The intent of non-lethal methods is to haze, exclude, or otherwise make an area unattractive to birds, which disperses those birds to other areas and leads to a reduction in damage. Similarly, the intent of using lethal methods is to reduce the number of birds in the area where damage is occurring, which can lead to a reduction in the damage occurring at that location.

If WS implements Alternative 1, WS personnel could consider the use of an avicide known as DRC-1339, which could be applied as part of an integrated methods approach to managing damage or threats of damage. Like other methods, including non-lethal methods, the intent in using DRC-1339 is to reduce the number of birds present at a location where damage or threats of damage are occurring. Reducing the number of birds at a location where damage or threats of damage are occurring either using non-lethal methods or lethal methods can lead to a reduction in damage. The dispersal of birds using non-lethal methods can reduce the number of birds using a location, which can correlate to a reduction in damage at a location (Avery et al. 2008*a*, Chipman et al. 2008). Similarly, the use of lethal methods reduces the number of birds at a location by removing those birds identified as causing damage or posing a threat of damage. The use of DRC-1339 can also reduce the number of birds using a location. 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. Blanton et al. (1991) reported that DRC-1339 appeared to be a very effective, selective, and safe means of urban pigeon population reduction. DRC-1339 can also be effect at addressing blackbird/starling problems at feedlots (Glahn 1981, Glahn et al. 1987).

Often of concern with the use of lethal methods is that birds that are lethally taken would only be replaced by other birds either after the application of those methods (from other birds that immigrate into the area) or by birds the following year (increase in reproduction that could result from less competition). WS does not use lethal methods to manage a species population. The intent of lethal methods, including the use of DRC-1339, is to reduce the number of birds present at a location where damage is occurring by targeting those birds causing damage or posing threats. Because the intent of lethal methods is to manage those birds causing damage and not to manage entire bird populations, WS considers those methods effective even if birds return the following year.

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) had to re-use non-lethal methods every year during a six-year project evaluating the use of only non-lethal methods. At some roost locations, Chipman et al. (2008) found the number of crows that returned each year to roosts over a six-year period actually increased despite the use of non-lethal methods each year. Chipman et al. (2008) determined the use of non-lethal methods could be effective at dispersing urban crow roosts in New York despite needing to reapply non-lethal methods annually. 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. This suggests 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 is to reduce the number of birds present at a site where damage is occurring at the time those methods are employed.

If WS provides assistance, WS personnel would evaluate the request for assistance and would consider the effectiveness of the methods available for that request based on effectiveness of a method or methods used during previous requests for assistance. When using methods, WS personnel would continue to evaluate effectiveness. Therefore, WS personnel would consider method effectiveness as part of the decision-making process during their use of the WS Decision Model for each damage management request based on continual evaluation of methods and results.

In meeting the need for action, the objective would be to reduce damage, risks, and conflicts with birds as requested and not to reduce/eliminate a species population. If WS excludes, removes, and/or disperses birds from an area where they were causing damage or posing a threat of damage, those birds would no longer be present at that location to cause damage or pose a threat. The removal and/or dispersal of birds could be short-term because new individuals may immigrate to an area, especially during migration periods. Therefore, the return of birds to an area after removal and/or dispersal activities does not mean individual management actions or methods were unsuccessful, but that periodic management may be necessary.

Similar to the effectiveness of methods to reduce damage or reduce threats of damage is the cost effectiveness of methods. The cost of methods and/or the cost of implementing methods may sometimes be a secondary consideration because of overriding environmental, legal, human health and safety, humaneness, animal welfare, or other concerns. Therefore, the cost effectiveness of methods and/or a cost benefit analysis is not essential to making a reasoned choice among the alternative approaches that WS is considering. In addition, the Council on Environmental Quality does not require a formal, monetized cost benefit analysis to comply with the NEPA.

2.2.4 Research Methods and Information on the Life History of Birds

Under any of the alternative approaches, WS would continue to research and develop methods to address bird damage through the National Wildlife Research Center. The National Wildlife Research Center functions as the research unit of WS by providing scientific information and developing methods to address damage caused by animals. Research biologists with the National Wildlife Research Center work closely with WS personnel, wildlife managers, researchers, and others to develop and evaluate methods and techniques. For example, one research area that is a focus of the National Wildlife Research Center is aviation safety and reducing risks of aircraft striking birds at airports and military facilities. In addition, the National Wildlife Research Center could conduct research to understand the life history of bird species, such as migration routes and feeding habits.

2.2.5 Authorization of Migratory Bird Take by the USFWS

As noted in Section 1.7.1, 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). Most target bird species addressed in this EA are a migratory bird species protected by the MBTA (see 50 CFR 10.13), except native resident bird species (*e.g*., wild turkeys) and non-native species (*e.g*., domestic waterfowl, house sparrows, European starlings). Pursuant to 50 CFR 21.100, "…*a depredation permit is required before any person may take, possess, or transport migratory birds for depredation control purposes. No permit is required merely to scare or herd depredating migratory birds other than endangered or threatened species or bald or golden eagles*". Therefore, prior to the use of lethal methods to alleviate damage or threats of damage associated with a migratory bird species, any entity, including WS, must apply for and receive a depredation permit from the USFWS. In general, the dispersal (*i.e*., scaring) of birds from an area using non-lethal methods would not require an entity to apply for and receive a depredation permit. A depredation permit is also not required to destroy inactive nests (*i.e*., nests without eggs or nestlings). Under the permitting application process for a depredation permit, the USFWS requires applicants to describe prior non-lethal damage management techniques that they have used.

The USFWS can also authorize the take of migratory birds by establishing depredation orders, control orders, and other permitting processes. The USFWS has created depredation and control orders that allow the take of specific species of migratory birds for specific purposes without the need for a depredation permit. For example, the USFWS has established a depredation order that allows people to take specific species of blackbirds, cowbirds, grackles, and crows for specific purposes without the need for a depredation permit from the USFWS (see 50 CFR 21.150). Section 1.7.1 discusses the depredation and control orders that could apply to WS activities.

2.2.6 Authorization of Take by the GDNR

For native resident bird species, the GDNR may also require authorization before conducting activities that could result in the take of a resident bird species. For example, WS may need authorization from the GDNR to live-capture and translocate wild turkeys to alleviate damage or threats of damage.

2.2.7 Influence of Global Climate Change on Bird Populations

The 2021 State of the Climate report indicates that global temperatures continue to increase (Blunden and Boyer 2022). 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). Sheikh et al. (2007) stated, "*Wildlife species can be affected by several climatic variables such as increasing temperatures, changes in precipitation, and extreme weather events*". Sheikh et al. (2007) further stated that changes in climate could benefit some species of wildlife.

The impact of climate change on wildlife and their habitats is of increasing concern to land managers, biologists, and members of the public. 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 to a species' range and abundance. Climate change may also affect other factors, such as agricultural practices and the timing of water freeze up, which can influence the timing and movement pattern of bird migrations. Over time, climate change would likely lead to changes in the scope and nature of human-wildlife conflicts in the state. Because these types of changes are an ongoing process, WS has developed adaptive management strategies that allow WS and other agencies to monitor for and adjust to impacts of ongoing changes in the affected environment.

If WS selected an alternative approach to meet the need for action that allows WS to provide assistance (see Section 2.4), WS would monitor activities, in context of the issues analyzed in detail, to determine if the need for action and the associated impacts remain within the parameters established and analyzed in this EA. If WS determines that a new need for action, changed conditions, new issues, or new alternative approaches having different environmental impacts warrant a new or additional analysis, WS would supplement this analysis or conduct a separate evaluation pursuant to the NEPA. Through monitoring, WS can evaluate and adjust activities as changes occur over time.

In addition, most target bird species addressed in this EA are migratory bird species protected by the MBTA (see 50 CFR 10.13), except native resident bird species (*e.g.*, wild turkey) and non-native species (*e.g.*, domestic waterfowl, house sparrows, European starlings). Activities that involve the take of migratory bird species protected by the MBTA require authorization (*e.g.*, depredation permit, depredation order, control order) from the USFWS. The take of resident bird species may require authorization from the GDNR. Therefore, WS activities would only occur when authorized by the USFWS and/or the GDNR, when required, and take would not exceed the levels authorized. WS would submit activity reports to the USFWS and/or the GDNR, when required, so the USFWS and/or the GDNR have the opportunity to evaluate WS activities and the cumulative take occurring for bird species. Conducting activities only when authorized and providing activities reports would ensure the USFWS and/or the GDNR have the opportunity to incorporate any activities WS conducts into population objectives established for wildlife populations in the state.

WS monitoring would also include reviewing the list of species the USFWS and the National Marine Fisheries Service considers 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 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. If deemed necessary through the monitoring process, WS could adjust activities to assure that WS actions do not significantly contribute to changes in the environmental status quo that occur because of climate change.

2.2.8 Impacts of Avian Influenza on Bird Populations

A virus in the Orthomyxovirus group causes avian influenza. Viruses in this group vary in the intensity of illness (*i.e.*, virulence) they may cause. Wild birds, in particular waterfowl and shorebirds, can be natural reservoirs for the avian influenza virus (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2012). Most strains of the avian influenza virus rarely cause severe illness or death in birds, although some 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 and high pathogenic avian influenza. The low and high refer to the potential of the viruses to kill domestic poultry (Centers for Disease Control and Prevention 2022). In wild birds, low pathogenic avian influenza rarely causes signs of illness and is not an important mortality factor (Davidson and Nettles 1997, Clark and Hall 2006). In contrast, high pathogenic avian influenza can cause clinical signs and lead to death in wild birds. Prior to 2014, high pathogenic strains were not known to occur in wild waterfowl species in North America (Brown et al. 2006, Keawcharoen et al. 2008, Centers for Disease Control and Prevention 2015).

WS has been one of several agencies and organizations conducting surveillance and monitoring of avian influenza in migratory birds. Between December 20, 2014 and February 1, 2015, Bevins et al. (2016) reported 63 cases of highly pathogenic avian influenza virus in wild birds across the United States. All 63 cases involved detection of the virus in waterfowl that people harvested during the annual hunting season (Bevins et al. 2016). Most strains of avian influenza do not cause severe illnesses or death in wild bird populations; however, from 2021 into 2022, a highly pathogenic avian influenza virus spread into North America causing mass death events in some wild birds (World Health Organization 2022, World Health Organization 2023).

The impacts of avian influenza on the populations of wild bird species would continue to occur if WS implements any of the alternative approaches. As discussed in Section 2.2.7, monitoring of WS' activities would be a major component of activities if WS implemented Alternative 1 and Alternative 2. Therefore, as discussed in Section 2.2.7, if deemed necessary through the monitoring process, WS could adjust activities to assure that WS actions do not significantly contribute to changes in the environmental status quo that occur because of impacts to a species' population associated with avian influenza. In addition, most of the birds that WS could address are migratory birds protected by the MBTA and many activities that involve managing damage associated with those species require authorization from the USFWS.

2.3 WS DIRECTIVES AND STANDARD PROCEDURES WHEN PROVIDING ASSISTANCE

WS directives define program objectives and guide WS activities when managing wildlife damage (see WS Directive 1.201, WS Directive 1.205, WS Directive 1.210). WS personnel would adhere to applicable WS directives when responding to and providing assistance. WS directives improve the safety, selectivity, and efficacy of activities that WS personnel could conduct to alleviate or prevent bird damage. For example, WS Directive 2.615 establishes guidelines for the use of firearms by WS employees and prescribes standard training requirements. WS Directive 2.401 establishes guidelines for the safe and effective storage, disposal, recordkeeping, and use of pesticides. In addition, WS personnel would follow the standard conditions and requirements of appropriate permits and depredation/control orders issued by the USFWS or the GDNR, including any requirements to report WS activities.

2.4 ALTERNATIVE APPROACHES THAT WS AND THE TVA CONSIDERED

This section discusses those alternative approaches that WS and the TVA identified during the initial scoping process for this EA and provides a description of how WS would implement those approaches. WS and the TVA developed the alternative approaches based on the need for action. The need for action identified by WS and the TVA is associated with requests for assistance that WS receives to manage damage and threats of damage caused by birds in Georgia, including requests for assistance that WS could receive from the TVA (see Section 1.2). WS and the TVA also developed the alternative approaches to address those issues identified in Section 2.1.

2.4.1 Alternative Approaches Considered in Detail within this EA

As discussed in Section 1.2, people experiencing damage or threats of damage associated with wildlife often seek assistance from other entities to alleviate that damage or to prevent damage from occurring. WS is the lead federal agency responsible for managing conflicts between people and wildlife (see Section 1.2); therefore, people could request assistance from WS. This EA considers in detail the following four alternative approaches to meeting the need for action identified in Section 1.2 and those issues identified in Section 2.1.

Alternative 1 – WS would continue the current integrated methods approach to managing damage caused by birds in Georgia (Proposed Action/No Action)

If WS implements Alternative 1, WS would be available to provide assistance when people experience damage or threats of damage associated with those target bird species addressed in this EA and, consequently, request assistance from WS. When responding to a request for assistance, WS personnel would use the WS Decision Model (Slate et al. 1992; see WS Directive 2.201) to formulate a management strategy to address each request for assistance.

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, extent, and 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 (see Appendix B). The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, humaneness, 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, human safety, humaneness, non-target animal risks, 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). All management actions conducted and/or recommended by WS would comply with appropriate federal, state, and local laws in accordance with WS Directive 2.210.
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.

Therefore, if WS implements Alternative 1, 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 damage caused by birds, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. WS would provide technical assistance to those entities requesting assistance as described for Alternative 3. 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 would not effectively alleviate the damage or the threat of damage and when WS and the entity requesting assistance have signed a work initiation document. Funding for WS activities could occur from state appropriations, federal appropriations, and/or from cooperative service agreements with an entity requesting WS assistance.

Appendix B discusses those methods that WS employees would consider when evaluating management methods to alleviate damage or threats of damage associated with birds. Non-lethal methods from Section I in Appendix B that WS could use and/or recommend include repellents, exclusion methods (*e.g.*, fencing, netting, overhead wires), auditory deterrents (*e.g.*, propane cannons, pyrotechnics, electronic distress calls), visual deterrents (*e.g.*, scarecrows, lasers, lights), trained dogs, nest destruction, translocation, live traps (*e.g.*, cage traps, modified padded foothold traps), and nets (*e.g.*, cannon nets, mist nets). In addition, WS could recommend minor habitat modifications (*e.g.*, pruning trees to discourage roosting) and changes in cultural practices (*e.g.*, changes in flight patterns at an air facility or using bird proof livestock feeders). Lethal methods would include the use of a firearm, euthanasia after live-capture, egg destruction (*i.e.*, puncturing, breaking, oiling, or shaking an egg), Avitrol (pigeons, crows, blackbirds, grackles, cowbirds, starlings, house sparrows only), and the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, gulls only). Section II in Appendix B describes those lethal methods that would be available to manage damage and threats of damage associated with birds.

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. When evaluating management methods and formulating a management strategy, WS personnel would give preference to non-lethal methods when they determine those methods to be practical and effective (see WS Directive 2.101). For those migratory bird species protected by the MBTA, WS would only use lethal methods, including egg destruction, after the USFWS authorized the lethal removal of the target migratory bird species and would only use those methods allowed in an authorization. The use of methods that live-capture migratory birds protected by the MBTA also require authorization from the USFWS; therefore, WS would only use live-capture methods after the USFWS had issued the appropriate permit or authorization allowing capture of the target bird species (see Section 1.7.1). Similarly, the GDNR may also require authorization before conducting activities that lethally remove or capture a target bird species, including their nests and eggs (see Section 1.7.2). Many non-native species, such as rock pigeons, European starlings, and house sparrows, do not require authorization from the USFWS or the GDNR to use lethal methods or live-capture methods. WS activities to manage damage associated with birds in Georgia would comply with WS Directive 2.301.

In general, the most effective approach to resolving damage would be to integrate the use of several methods simultaneously or sequentially while continuing to evaluate the effectiveness of the method or methods. Alternative 1 would be an adaptive approach to managing damage that 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 while minimizing the potentially harmful effects on people, target and non-target species, and the environment. WS personnel would not necessarily use every method from Appendix B to address every request for assistance but would use the WS Decision Model to determine the most appropriate approach to address each request for assistance, which could include using additional methods from Appendix B if initial efforts were unsuccessful at reducing damage or threats of damage adequately.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia using only non-lethal methods

Under this alternative, WS would implement an adaptive integrated methods approach as described under Alternative 1, including the use of the WS Decision Model; however, WS would only consider non-lethal methods when formulating approaches to resolve damage associated with bird species. WS could provide technical assistance and/or direct operational assistance similar to Alternative 1. WS would provide technical assistance to those entities requesting assistance as described for Alternative 3. The only methods that WS could recommend and/or use would be non-lethal methods. Non-lethal methods that WS could use and/or recommend include human presence, exclusion methods (*e.g*., netting, overhead wires, fencing, surface coverings), auditory deterrents (*e.g*., propane cannons, pyrotechnics, electronic distress calls), visual deterrents (*e.g*., scarecrows, lasers, lights), and chemical repellents. In addition, WS could use and/or recommend destruction of inactive nests, live capture (*e.g*., nets, live traps), limited habitat alteration/modification (*e.g*., pruning trees), supplemental feeding, lure crops, and the reproductive inhibitor nicarbazin (rock pigeons, starlings, blackbirds, grackles, cowbirds only). WS could also use aircraft and Unmanned Aerial Vehicles (UAVs) (*e.g*., drones) to conduct surveillance and monitoring of bird populations and bird damage in the state. In addition, WS could occasionally haze birds with UAVs, primarily vultures. Section I of Appendix B describes those non-lethal methods in more detail.

WS would refer requests for information regarding lethal methods to the USFWS, the GDNR, and/or private entities. Although WS would not recommend or use lethal methods under this alternative, other entities, including private entities, could continue to use many of the lethal methods discussed in Section II of Appendix B to resolve damage or threats of damage. The USFWS could continue to authorize the lethal take of migratory birds protected by the MBTA and the GDNR could authorize the lethal take of resident bird species, such as wild turkeys.

Alternative 3 – WS would recommend an integrated methods approach to managing bird damage in Georgia through technical assistance only

If WS implements Alternative 3, WS would continue to use the WS Decision Model to respond to requests for assistance; however, WS would only provide those cooperators requesting assistance with technical assistance. Technical assistance would provide those cooperators experiencing damage or threats of damage associated with birds with information, demonstrations, and recommendations on the 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 Alternative 1 and Alternative 2, a key component of assistance provided by WS would be providing information to the requester about birds and how to manage damage associated with target bird species.

Education would be an important component of technical assistance 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. WS would provide property owners or managers requesting assistance 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 could provide lectures, courses, and demonstrations to agricultural producers, homeowners, governmental entities, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, WS personnel may present technical papers at professional meetings and conferences so that other wildlife professionals and the public receive updates on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Technical assistance would include collecting information, such as the number of birds involved, the extent of the damage, and previous methods that the cooperator had used to alleviate the problem. WS personnel would then provide information on appropriate methods that the cooperator could consider to alleviate the damage themselves. Types of technical assistance projects may include a site visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

Generally, WS personnel would describe several management strategies 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. WS personnel would recommend and loan only those methods legally available for use by the appropriate individual. Those methods described in Appendix B would be available to those people experiencing damage or threats associated with birds in the state, except for DRC-1339, which is 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 addition, WS personnel would also advise the property owner or manager of the potential need to seek authorization from the USFWS and/or the GDNR to take target bird species, such as the need to apply for a depredation permit from the USFWS to take migratory birds and the need to receive authorization from the GDNR. Similarly, WS would advise the property owner or manager of the potential need to seek authorization from the USFWS and/or the GDNR to remove nests and eggs.

When conducting technical assistance, WS personnel could assist people experiencing damage caused by birds with the process for applying for their own depredation permit from the USFWS and/or seeking authorization from the GDNR. In accordance with WS Directive 2.301, WS personnel will assist people seeking assistance with applying for a depredation permit from the USFWS by completing a USFWS Migratory Bird Permit Application or Review form (WS Form 37). The USFWS Migratory Bird Permit Application or Review form provides the USFWS with the basic information required as part of the application process for a depredation permit, which includes information on the extent of the damage or risk, the number of birds involved, and recommended methods to alleviate damage (see 50 CFR 21.100 for required information). Following review by the USFWS of a complete application for a depredation permit from a property owner or manager and the USFWS Migratory Bird Permit Application or Review form, the USFWS could issue a depredation permit authorizing the lethal take of a specified number of birds and bird species.

Alternative 4 – WS would not provide any assistance with managing damage caused by birds in Georgia

This alternative would preclude any activities by WS to alleviate damage or threats of damage associated with those bird species addressed in the EA. WS would refer all requests for assistance associated with target bird species to the USFWS, to the GDNR, and/or to private entities. This alternative would not prevent other governmental agencies (*e.g*., federal, tribal, state, and local agencies) and/or 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 those bird species addressed in this EA 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 governmental agencies and private entities to manage damage and threats associated with birds. The only method discussed in Appendix B that is restricted to use by WS personnel and by persons under their supervision and would not be available for other entities to use would be the avicide DRC-1339. The avicide DRC-1339 is only available to alleviate damage associated with European starlings, red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, American crows, fish crows, rock pigeons, Eurasian collared-doves, and certain gull species.

2.4.2 Alternative Approaches and Strategies that WS and the TVA Did Not Consider in Detail

In addition to those alternative approaches discussed in Section 2.4.1, WS and the TVA identified several additional alternative approaches to meeting the need for action that did not receive detailed analysis in this EA for the reasons provided for each alternative approach. Those alternative approaches considered but not analyzed in detail include the following.

Implementation of Alternative 1 but WS must use all of the non-lethal methods identified in Appendix B before using lethal methods

Implementation of this alternative would be an adaptive integrated method approach similar to Alternative 1. However, 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 associated with target bird species in the state. If the use of non-lethal methods failed to alleviate the damage situation or reduce threats to human safety at each damage situation, WS personnel would use lethal methods to alleviate the damage or threat occurring. WS personnel would apply non-lethal methods to every request for assistance regardless of severity or intensity of the damage or threat until the employee deemed those non-lethal methods inadequate to resolve the damage or threat. This alternative would not prevent the use of lethal methods by other entities to alleviate damage or threats of damage.

WS did not carry this alternative forward for further analysis in Chapter 3 because people experiencing damage often employ non-lethal methods to reduce damage or threats prior to contacting WS. For example, Stickley and Andrews (1989) conducted a survey of catfish farms in Mississippi to determine the methods and costs associated with dispersing fish-eating birds from ponds where the farms were raising catfish. Of the 281 catfish farms that replied to the survey, 87% of the farmers felt the economic losses associated with fish-eating birds were sufficient to warrant hazing fish-eating birds from the ponds (Stickley and Andrews 1989). Stickley and Andrews (1989) found that catfish farms in Mississippi spent an average of 2.6 hours per day hazing waterbirds from aquaculture ponds. Of those aquaculture facilities that used propane cannons, 9% indicated their use was "*very effective*", 51% indicated they were "*somewhat effective*" and 40% indicated they were "*not effective*" (Stickley and Andrews 1989). Similarly, of the aquaculture facilities using pyrotechnics, 24% considered their use to be "*very effective*", 57% considered them to be "*somewhat effective*" and 19% determined the use of pyrotechnics was "*not effective*" (Stickley and Andrews 1989).

For example, aquaculture producers in Mississippi reported spending an average of $7,400 per farmer, or a total of more than $2.1 million, to haze birds from their ponds during 1988 (Stickley and Andrews 1989). In Arkansas, Engle et al. (2020) estimated the overall cost of dispersing birds from facilities raising baitfish and sportfish was $622 per hectare with the cost of dispersing birds comprised of manpower (56%), truck usage (32%), levee upkeep for vehicle access to disperse birds (9%), firearms and ammunition (2%), and pyrotechnics (1%). Elser et al. (2019*b*) found that fruit producers used several non-lethal methods to reduce bird damage to wine grapes, sweet cherries, and apples. Elser et al. (2019*a*) found that dairy farmers in Washington used non-lethal methods to reduce bird damage. In addition, the USFWS requires the use of non-lethal methods prior to authorizing the take of those bird species protected from take by the MBTA. Therefore, people often use non-lethal methods prior to contacting WS for assistance.

If WS implemented this alternative, WS would be required to implement non-lethal methods that the entity requesting assistance had already used or would have to establish criteria to measure the efforts of the requesting entity to determine if the requesting entity applied non-lethal methods appropriately. For example, 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. Therefore, continuing to use methods already proven ineffective at alleviating the damage could prolong the amount of time damage occurs, which could increase the economic losses. Because many people that request assistance use non-lethal methods but continue to experience damage or threats of damage and because there is no standard that exists for the use of non-lethal methods, WS did not carry this alternative forward for further analysis in Chapter 3. In addition, implementation of Alternative 1 would be similar to a non-lethal before lethal alternative because WS personnel would consider the use of non-lethal methods before considering the use of lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not add additional information to the analyses in this EA.

WS would implement Alternative 1 but would only use lethal methods

This alternative would be similar to Alternative 1 but WS would use only those methods that lethally remove birds. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. The USFWS also requires the use of non-lethal methods prior to issuing a depredation permit to take migratory birds. 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, Seamans 2004, Avery et al. 2008*a*, Chipman et al. 2008). In those situations where damage could be alleviated using non-lethal methods, WS personnel could use those methods and/or recommend those methods as determined by the WS Decision Model. Therefore, WS did not consider this alternative in detail.

WS would develop a program that compensates people for damage

This 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 require large expenditures of money and labor to investigate and validate damage claims and to determine and administer appropriate compensation. Compensation would most likely be below full market value. Compensation for damage would give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies and would not be practical for reducing threats to human health and safety. For the above listed reasons, WS did not carry this alternative forward for further analysis in Chapter 3.

WS would implement Alternative 1 but would establish a loss threshold before allowing lethal methods

There is also a concern that 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 3.

WS would require cooperators completely fund activities (no taxpayer money)

This alternative would be similar to Alternative 1 or Alternative 2 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 3.

WS would implement Alternative 1 but would require cooperators fund the use of lethal methods

This alternative would be identical to Alternative 1 except WS would require people requesting assistance to pay for all the costs associated with using lethal methods to resolve their request for assistance. If WS used lethal methods to alleviate or prevent damage, the person requesting assistance would be responsible for paying for the costs associated with those activities. WS could then use existing federal and/or state funding to pay for the costs associated with using non-lethal methods to manage bird damage. WS did not carry this alternative forward for further analysis because the environmental consequences associated with the use of this method would be identical to Alternative 1.

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 any of the alternative approaches. 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.

WS would trap and translocate birds only

Under this alternative approach, WS would address all requests for assistance by the use or recommendation of live-capture methods. Birds could be live-captured using 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, WS personnel would identify a release site or sites and obtain approval from the appropriate property owner and/or manager to release birds on their property or properties. In addition, the translocation of most bird species requires prior authorization from the USFWS and/or the GDNR. For example, WS would need prior approval from the GDNR to live-capture and translocate wild turkeys within the state. WS could translocate birds if WS implemented Alternative 1 or Alternative 2. Other entities could translocate birds to alleviate damage if WS implemented Alternative 3 or Alternative 4.

Translocation may not be appropriate for all bird species. For example, it may be inappropriate to translocate and release non-native bird species in the state. In addition, 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, the same species of birds generally already occupy habitats in other areas, and translocation would most likely result in bird damage problems at the new location. In addition, WS would need to capture and translocate hundreds or thousands of birds 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, Massei et al. 2010, Mengak 2018). Therefore, WS did not consider this alternative in detail.

WS would reduce damage by managing bird populations through the use of reproductive inhibitors

Under this alternative, the only method available to alleviate requests for assistance would be the recommendation and use of reproductive inhibitors to reduce or prevent reproduction in birds responsible for causing damage. Reproductive inhibitors can be effective where wildlife populations are overabundant and where traditional hunting or lethal control programs are not publicly acceptable (Muller et al. 1997). 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 can limit the use and effectiveness of reproductive control as a population management tool.

Reproductive control for wildlife consists of sterilization (permanent) or contraception (reversible). Sterilization can occur 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, WS did not evaluate this alternative in detail.

If a reproductive inhibitor becomes available to manage a large number of bird populations and is proven effective in reducing localized bird populations, WS could evaluate the use of the inhibitor as a method available under the alternative approaches. WS would review and supplement this EA to the degree necessary to evaluate the use of the reproductive inhibitor. Currently, the only reproductive inhibitor registered with the EPA is nicarbazin. In Georgia, a formulation of nicarbazin is available under the trade name of OvoControl® P (Innolytics, LLC, La Quinta, California), which is available to manage localized populations of urban rock pigeons and resident populations of European starlings, red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, and brown-headed cowbirds. Reproductive inhibitors for the other bird species addressed in this EA do not currently exist.

CHAPTER 3: ENVIRONMENTAL EFFECTS

Chapter 3 provides information needed for making informed decisions by comparing the environmental consequences of the four alternative approaches. To determine if the real or potential effects are greater, lesser, or the same as the environmental baseline, Section 3.1 compares the environmental consequences associated with each of the four alternative approaches. A discussion occurs on the cumulative and unavoidable impacts, including direct and indirect effects, in relation to the issues for each of the alternative approaches. Impacts caused by implementation of an alternative approach and occur at the same time and place are direct effects. In contrast, impacts caused by implementing an alternative approach that occurs later in time or farther removed in distance, and are still reasonably foreseeable, are indirect effects. The analyses discuss the cumulative effects in relationship to each of the alternative approaches analyzed, with emphasis on potential cumulative effects from similar activities, and include summary analyses of potential cumulative impacts to target and non-target species, including threatened or endangered species, threats to human health and safety, and the humaneness of methods.

3.1 ISSUES CONSIDERED IN DETAIL AND THEIR IMPACTS BY ALTERNATIVE APPROACH

WS developed the alternative approaches (see Section 2.4) to meet the need for action identified in Section 1.2 and to address the issues identified in Section 2.1. This section analyzes the environmental consequences of each alternative approach in comparison to determine the extent of actual or potential impacts on each of the issues. Therefore, Alternative 1 serves as the baseline for the analysis and the comparison of expected impacts among the alternative approaches. The analysis also takes into consideration mandates, directives, and the procedures of WS, the USFWS, the GDNR, and the Georgia Department of Agriculture.

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

Maintaining viable populations of native species is a concern of the public and state, tribal, and federal agencies, including WS. If WS implemented Alternative 1, Alternative 2, or Alternative 3, WS could conduct and/or recommend that others conduct activities that could disperse, exclude, capture, or lethally remove birds depending on the alternative approach WS selected and implemented. Appendix B identifies and discusses the methods that WS could consider when formulating strategies to resolve damage caused by birds in Georgia when someone requests such assistance. If WS implemented Alternative 4, WS would not conduct any activities in Georgia involving those target bird species addressed in this EA. This section evaluates the magnitude of cumulative effects on the populations of target bird species that could occur if WS implemented one of the four alternative approaches.

As discussed in Section 1.5, the USFWS and/or the GDNR are the federal and state entities responsible for managing those bird species addressed in this EA. As discussed in Section 2.2.5, in most cases, the use of non-lethal methods to haze bird species does not require prior authorization from the USFWS. However, any activities that result in the take of most bird species (*e.g.*, live-capture, lethal removal), requires prior authorization from the USFWS and may require authorization from the GDNR.

- **Management of Bird Populations by the USFWS and the GDNR**

With management authority over bird populations, the USFWS and/or the GDNR could adjust take levels, including the take by WS, to achieve population objectives for bird species. Consultation and reporting of take by WS would ensure the USFWS and/or the GDNR had the opportunity to consider the activities conducted by WS.

Because take of most bird species can only legally occur when authorized by the USFWS and/or the GDNR, the USFWS and the GDNR can consider take when determining population objectives for those bird species. Therefore, the USFWS and/or GDNR could adjust the number of birds that people harvest during the regulated hunting season and the number of birds that people can take for damage management purposes to achieve the population objectives. For most species, take by WS and the authorized take allowed would occur at the discretion of the USFWS and/or the GDNR. 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 GDNR.

- **Population Impact Analyses of the Alternative Approaches - Direct, Indirect, and Cumulative Effects**

Implementation of the alternative approaches could have direct, indirect, and cumulative effects on the populations of birds targeted during damage management activities. Direct effects are impacts the action causes and occur at the same time and place. Indirect effects occur because of the action but are later in time or farther removed in distance. Indirect effects may include impacts related to actions that induced changes in population density, ecosystems, and land use changes. Cumulative impacts 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. The potential cumulative impacts analyzed below would occur from either WS activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities.

WS actions would be occurring simultaneously 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. WS employees use the WS Decision Model to evaluate damage occurring (including other affected elements and the dynamics of the damaging species) and to determine appropriate strategies to minimize effects on environmental elements. After WS personnel apply damage management actions, they subsequently monitor and adjust/cease 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, to avoid cumulative adverse impacts on target species. Discussion on the potential direct, indirect, and cumulative effects of the alternative approaches on the populations of target bird species occurs below for each of the alternative approaches identified in Section 2.4.1.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia (Proposed Action/No Action)

If WS implements Alternative 1, WS would be available to provide both technical assistance and direct operational assistance to those persons requesting assistance with managing damage and threats caused by birds in the state. The effects on the populations of target bird species associated with WS providing technical assistance during the implementation of Alternative 1 would be similar to those effects discussed for Alternative 3. Therefore, to reduce redundancy, the effects associated with WS providing technical assistance that would occur if WS implements Alternative 1 occur in the discussion for Alternative 3.

When providing direct operational assistance, WS could employ those methods described in Appendix B in an adaptive approach that would integrate methods to reduce damage and threats associated with birds effectively. WS personnel would use the WS Decision Model (see WS Directive 2.201) to identify the most appropriate damage management strategies and their impacts. If WS implemented Alternative 1, WS personnel could choose to use any of the methods discussed in Appendix B when using the WS Decision Model to formulate strategies. Therefore, implementation of Alternative 1 would allow WS personnel to consider the widest range of methods available when formulating strategies to resolve requests for assistance associated with birds. WS personnel would employ methods in an adaptive approach that would integrate methods to reduce damage and threats of damage associated with birds in the state. WS would only use methods after WS and the appropriate entity requesting assistance have signed a work initiation document allowing WS to use those methods on property they own or manage. When practical and effective, WS personnel would give preference to non-lethal methods pursuant to WS Directive 2.101.

DIRECT, INDIRECT, AND CUMULATIVE POPULATION EFFECTS: NON-LETHAL METHODS

If WS implemented Alternative 1, the potential effects on the populations of target bird species associated with WS use of non-lethal methods would be similar to those potential effects discussed for Alternative 2 because the same non-lethal methods would be available for use by WS personnel. To limit redundancy, a discussion on the potential effects associated with the use of non-lethal methods does not occur for Alternative 1 because those potential effects would be similar to those discussed for Alternative 2; however, those potential effects could possibly occur if WS implemented Alternative 1. In general, the use of non-lethal methods to disperse, exclude, or capture birds from areas where they are causing damage or posing a threat of damage would have minimal effects on the overall population of a target bird species because those methods generally do not harm birds (see discussion for Alternative 2).

DIRECT, INDIRECT, AND CUMULATIVE POPULATION EFFECTS: LETHAL METHODS

The evaluation of potential effects on the populations of target bird species for Alternative 1 will primarily focus on WS use of lethal methods because the use of lethal methods could result in local population reductions in the area where damage or threats were occurring because those methods would remove birds from a population. WS often uses lethal methods to reinforce non-lethal methods and to remove birds that WS personnel identify as causing damage or posing a threat of damage with the intent of managing those birds causing damage and not to manage entire bird populations.

The number of individuals from a target species that WS could remove from a population using lethal methods under the alternative approaches would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, the efficacy of methods employed, and the take permitted by the USFWS and/or the GDNR. The analysis includes WS anticipated annual take level for each species, which WS based on previous requests for assistance associated with the species and in anticipation of future requests for assistance. WS anticipated annual take level for each species is not a prescribed take level but is a maximum take level that WS anticipates could occur annually to alleviate damage.

WS could also destroy active and inactive nests of target bird species that nest in Georgia. For those species protected from take by the MBTA, the destruction of active nests (those nests containing eggs or nestlings) can only occur when the USFWS 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 authorization from the USFWS with the exception of bald eagle and golden eagle nests. In addition, a person may need authorization from the GDNR to take the nests or eggs of protected birds. WS could take active nests of those bird species identified in Section 1.2 and in Appendix E that nest in Georgia unless otherwise noted for an individual species below or in Appendix E.

WS would use nest destruction to alleviate damage associated with the nesting activities and/or to discourage nesting in an area where damage occurs or could occur. Many bird species can identify areas with regular human disturbance and low reproductive success and they will relocate to nest elsewhere when confronted with repeated nest failure. After the initial removal of active or inactive nests, WS personnel or the cooperating entity would attempt to monitor the site for additional nesting activity. If new nesting activity occurred, WS personnel would continue to destroy the inactive nests by hand. After repeated nesting failures, birds often seek other nesting locations. Monitoring a site for nesting activity by WS personnel would reduce or alleviate the need to destroy eggs and euthanize any nestlings.

Impacts due to nest and egg destruction should have little adverse effect on a species' population in Georgia. Although there may be reduced fecundity for the individuals affected by nest destruction, this activity would not have long-term effects on breeding adult birds because of the limited number of nests removed and the ability of many bird species to re-nest after a nest failure. 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. WS personnel would not destroy active nests over large geographical areas. Therefore, WS does not anticipate the destruction of active nests would occur at an intensity level that would cause an adverse impact to a species' population. For example, 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).

If WS personnel encounter eggs and/or nestlings in an active nest, WS could destroy the eggs by puncturing, oiling, shaking, 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 or relinquish control to an appropriate wildlife rehabilitator. For the purposes of the analysis, WS will consider nestlings euthanized as part of the cumulative take of a target bird species. WS would only destroy active nests when authorized by the USFWS and/or the GDNR, when required, and only at levels authorized. Therefore, the USFWS and/or the GDNR would determine the allowable levels of take to authorize.

The basis for the analysis to determine the magnitude of impacts on the populations of those target bird species addressed in this EA from the use of lethal methods would be 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 may rely on population estimates, allowable removal levels, and actual removal data. Qualitative determinations may rely on population trend data, when available. Information on bird populations and trends are often derived from several sources including the BBS, the CBC, the Partners in Flight Landbird Population database, available literature, and harvest data, which WS used to evaluate the magnitude of impact on the population of a species. The potential impacts on the populations of target bird species from the implementation of Alternative 1 occurs below.

CANADA GOOSE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Canada geese are the most widely distributed goose species in North America (Mowbray et al. 2020*a*). Canada geese occur in a broad range of habitats including prairie, arctic plains, mountain meadows, agricultural areas, reservoirs, sewage lagoons, parks, golf courses, lawn-rich suburban areas, or other similar areas not far from permanent sources of water (Mowbray et al. 2020*a*). Their diet consists of grasses, sedges, berries, and seeds, including agricultural grain (Mowbray et al. 2020*a*). Canada geese are highly social birds that often gather and feed in flocks, with some flocks exceeding 1,000 birds (Mowbray et al. 2020*a*).

In the past, most authorities recognized one species of the Canada goose with 11 subspecies, which differed primarily in body size and color (Mowbray et al. 2020*a*). Today, there are generally two recognized, distinct species of geese instead of just a single species. Those two distinct species are the smaller cackling goose and the larger Canada goose (Willcox and Giuliano 2012, Mowbray et al. 2020*a*, Mowbray et al. 2020*b*). There are four recognized subspecies of cackling geese, which generally occur within western and northwestern North America (Mowbray et al. 2020*b*). In North America, there are seven subspecies of Canada geese recognized (Willcox and Giuliano 2012, Mowbray et al. 2020*a*).

Historically, the breeding range of Canada geese occurred along the northern portion of the United States and across most of Canada and they migrated south to spend the winter in more temperate climates (Mowbray et al. 2020*a*). Overharvest and habitat loss nearly extirpated the native breeding populations of Canada geese in the United States following settlement in the 19th century (Mississippi Flyway Council Technical Section 1996, Mowbray et al. 2020*a*). In the mid-1900s, state and federal agencies began efforts to restore historic breeding populations and to establish breeding populations of Canada geese in new locations.

Canada geese did not historically breed in many of the states in the southern United States. However, due to restoration and pioneering efforts, Canada geese now breed and reside throughout the year in the continental United States, including Georgia (Mowbray et al. 2020*a*). Today, many of the breeding populations of Canada geese that state and federal agencies established do not migrate and generally occur in the same area throughout the year (Mowbray et al. 2020*a*). Canada geese are also present in the state during the fall and spring migration periods and during the winter (Mowbray et al. 2020*a*). Canada geese that breed elsewhere augment the breeding population of Canada geese in the state during the migration periods and during the winter.

Canada geese that occur in the state during the migration periods and during the winter are primarily from the Atlantic Flyway Resident Population (*i.e.*, Canada geese that nest in within the Atlantic Flyway) and the Southern Hudson Bay Population (USFWS 2022). The Southern Hudson Bay Population of Canada geese nest in the Hudson Bay Lowlands, on Akimiski Island, and along the eastern and southern portions of the Hudson and James Bay in Canada and then migrate southward into the southern United States during the fall to spend the winter before returning in the spring (USFWS 2022).

Therefore, there are two behaviorally distinct types of Canada goose populations present in the state depending on the time of year. People generally label the two distinct types of geese that could be present in the state as "*resident*" and "*migratory*" geese. Discussion on resident and migratory geese that could be present in the state occurs below.

➢ *Resident Canada Geese*

Canada geese are "*resident*" (also sometimes referred to as "*temperate breeding*") when they nest within the lower 48 states and the District of Columbia or that reside within the contiguous United States in the months of April, May, June, July, or August (see 50 CFR 20.11, 50 CFR 21.6) (Rusch et al. 1995, Ankney 1996). Resident Canada geese can have a relatively high nesting success compared to migratory Canada geese (Mowbray et al. 2020*a*). Resident Canada geese nest in traditional sites (*e.g*., along shorelines, on islands and peninsulas, small ponds, lakes, and reservoirs), as well as on rooftops, adjacent to roadways, swimming pools, and in parking lots, playgrounds, planters, and abandoned property (*e.g*., tires, automobiles).

During much of the year, the majority of Canada geese present in Georgia would be resident geese, not migratory. However, when migrant populations are present in the state, distinguishing a resident Canada goose from a migratory Canada goose by appearance can be difficult. In general, migratory Canada geese begin arriving in Georgia from September through November with the majority of migratory Canada geese arriving during October and November (Mowbray et al. 2020*a*). During the spring migration period, migratory Canada geese in Georgia generally begin their northward movements in March and April (Mowbray et al. 2020*a*).

Most requests for assistance received by WS to address damage caused by Canada geese occur during those months when geese present in the state are resident geese. Table 3.1 shows the number of Canada geese that WS addressed in Georgia using lethal and non-lethal methods from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS employed several different non-lethal techniques to disperse Canada geese including boats, vehicle presence, pyrotechnics, and the noise associated with the discharge of a firearm. In addition, WS relocated Canada geese after live capture using drive traps. WS also lethally removed Canada geese using firearms and euthanized Canada geese after live capture using drive traps, net guns, hand nets, and after hand capture.

Table 3.1 – Canada geese addressed by WS in Georgia, FY 2017 - FY 2021

		Non-lethal Methods	
Fiscal Year	**Lethal Take**	**Dispersed**	**Relocated**
2017	514	0	592
2018	510	109	1,083
2019	368	63	565
2020	549	20	311
2021	555	11	592

In Georgia, adult resident Canada geese molt their primary flight feathers from mid-June through mid-July each year. Molting is the process whereby geese annually replace their primary and secondary flight (wing) feathers (Welty 1982). When adult Canada geese lose their primary flight feathers, they are unable to fly until their new flight feathers grow back. Portions of a flock of geese can be flightless from about one week before until two weeks after the primary molt period because individual birds molt at slightly different times. When Canada geese are flightless, WS personnel are able to live-capture target geese by slowly guiding them into drive traps. Once live-captured, WS could euthanize the Canada geese and/or translocate those Canada geese to other areas.

Based on the number of requests that WS has previously received for assistance and in anticipation of additional efforts to manage damage, WS could lethally remove up to 4,000 Canada geese annually in the state to alleviate damage and/or threats of damage. WS would continue to use an integrated method approach when addressing requests for assistance. WS would continue to consider the use of non-lethal methods before considering the use of lethal methods. As discussed previously, WS has employed several non-lethal methods to address requests for assistance associated with Canada geese. However, WS may employ lethal methods when personnel deem those methods to be appropriate using the WS Decision Model.

As stated previously, distinguishing between resident and migratory Canada geese can be difficult, especially using visual identification. Similarly, distinguishing Canada geese from the different breeding populations that may be present in Georgia during the migration periods and during the winter months is difficult. To evaluate a worst-case scenario, the analysis will evaluate the anticipated take of up to 4,000 Canada geese by WS annually as though all of those Canada geese were resident Canada geese that are part of the Atlantic Flyway Resident Population.

In the spring of 2021 and 2022, the USFWS (2022) estimated the Atlantic Flyway Resident Population at one million Canada geese. The 10-year trend for the Atlantic Flyway Resident Population has shown a 1% increase per year (USFWS 2022). The Atlantic Flyway Council (2011) indicated the population in Georgia was approximately 186,000 Canada geese with a statewide population objective of 30,000 nesting Canada geese. Therefore, the population exceeded the statewide population objective by approximately 156,000 Canada geese. From 1966 through 2019, the number of Canada geese observed along BBS routes in Georgia has shown an increasing trend estimated at 12.4% per year.

If WS takes up to 4,000 Canada geese per year and the population in Georgia remains at 186,000 Canada geese, the take of up to 4,000 Canada geese by WS would represent 2.2% of the estimated population in Georgia. All take of resident Canada geese by WS would occur pursuant to depredation permits issued by the USFWS or pursuant to depredation orders established by the USFWS for resident Canada geese. With management authority for migratory birds, the USFWS can adjust allowed take through the regulated harvest season and take under depredation permits and orders to meet population objectives. Therefore, the USFWS would have the opportunity to consider cumulative take as part of population objectives for resident Canada geese.

Under current frameworks, the USFWS allows states to implement an annual September harvest season to target resident Canada geese in addition to the harvest of Canada geese during the annual regular waterfowl season. The intent of the September hunting season for Canada geese is to target resident nesting geese before migratory Canada geese arrive in the state. Based on those frameworks, the GDNR currently allows people in the state to harvest geese during the September resident Canada goose season and the regular waterfowl harvest season. Although migratory Canada geese are likely present in the state during the regular waterfowl harvest season, the number of resident nesting Canada geese and the number of migratory geese that people harvest annually during the regular waterfowl harvest season is unknown. However, people likely harvest some resident nesting Canada geese in the state during the regular waterfowl harvest season. For example, during the regular waterfowl hunting seasons, Klimstra and Padding (2012) estimated that 62% of the geese harvested in the Atlantic Flyway were resident Canada geese.

During the September hunting season for Canada geese in 2020, people harvested 15,800 Canada geese in Georgia, which compared to 5,200 Canada geese harvested in Georgia during the 2019 September hunting season. In addition, people harvested 9,700 Canada geese during the regular hunting season for waterfowl in Georgia during 2020, which compared to 16,100 Canada geese harvested during the 2019 regular waterfowl harvest season (Raftovich et al. 2021). If up to 62% of the Canada geese harvested during the regular waterfowl season during 2019 and 2020 were resident Canada geese (Klimstra and Padding 2012), then hunters harvested 9,982 resident Canada geese during the 2019 regular hunting season for waterfowl in Georgia and 6,014 resident Canada geese during 2020.

However, the harvest estimates for Canada geese are likely biased high (Padding and Royle 2012). For example, using a harvest derivation analysis (Munro and Kimball 1982), McAlister et al. (2017) estimated the proportion of migrant and non-local resident Canada geese in the 2014 harvest estimate for Canada geese in North Carolina following methods described by Klimstra and Padding (2012). Before applying correction factors, the initial USFWS harvest estimate in 2014 for North Carolina was 37,267 Canada geese (Raftovich et al. 2015). Using band recoveries, McAlister et al. (2017) estimated that 1,192 Canada geese harvested in North Carolina during the 2014 hunting season were migratory Canada geese and nonlocal, temperate-nesting Canada geese. In addition, McAlister et al. (2017) calculated Raftovich et al. (2015) overestimated the 2014 harvest in North Carolina by 11,444 Canada geese. During the 2014 hunting season for Canada geese in North Carolina, McAlister et al. (2017) estimated that hunters harvested 24,631 resident Canada geese consisting of 7,923 hatch-year geese and 16,708 adult geese. Although the harvest estimate for Canada geese is likely biased high, the analysis will continue to use the harvest estimates for Canada geese because the estimates would represent a worst-case scenario (highest possible cumulative take); therefore, the magnitude of cumulative take on the resident Canada goose population would actually be lower than analyzed.

In addition to hunter harvest, other entities have reported the take of Canada geese to the USFWS. From 2016 through 2019, entities reported to the USFWS an average annual removal of approximately 39 Canada geese in Georgia with the highest reported take occurring in 2018 when other entities reported the take of 76 Canada geese. Therefore, if hunters harvest nearly 26,000 resident Canada geese per year, other entities lethally remove 76 Canada geese per year, and WS removes up to 4,000 Canada geese per year, the cumulative take would be nearly 30,100 Canada geese in the state. The cumulative take of 30,100 Canada geese per year would represent 16.2% of the estimated nesting population in Georgia. Despite the cumulative take of Canada geese that has occurred previously, the number of Canada geese observed along routes surveyed during the BBS in the state continues to show an increasing trend.

- *Migratory Canada Geese*

Migratory Canada geese nest across the arctic, subarctic, and boreal regions of Canada and Alaska and migrate south to winter in the United States and Mexico (Mowbray et al. 2020*a*). Canada goose migrations may encompass up to 3,000 miles, like that of the Richardson's Canada goose (*B. c. hutchinsii*), which nests as far north as Baffin Island, Nunavut, Canada and winters as far south as the eastern states of Mexico. Migratory Canada geese that could occur in the state during the migration periods and during the winter are primarily from two breeding populations, the Southern Hudson Bay population and the Atlantic Flyway Resident population (USFWS 2022).

The USFWS (2022) estimated the Southern Hudson Bay population at 120,000 Canada geese in 2021. and estimated the Atlantic Flyway Resident Population to be one million Canada geese in 2021 and 2022.

The number of Canada/cackling geese observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019 estimated at 11.8% per year (Meehan et al. 2020). The number of migratory Canada geese present in the state during the winter or during the spring and fall migration is unknown. In addition, both resident and migratory Canada geese are present in the state during those periods.

Based on increasing requests for assistance to manage geese, WS may receive requests to address geese during those months when migratory geese could be present in the state. Based on an increase in the number of requests received for the lethal take of geese during those periods of time when migratory geese may be present in the state, WS may take up to 200 geese annually during those periods when migratory geese could be present in the state.

Under frameworks for the harvest of waterfowl developed by the USFWS, the GDNR allows hunters to harvest geese during regulated seasons in the state. People harvested 9,700 Canada geese during the regular hunting season for waterfowl in Georgia during 2020, which compared to 16,100 Canada geese harvested during the 2019 regular waterfowl harvest season (Raftovich et al. 2021). However, as discussed previously, Klimstra and Padding (2012) estimated that only 38% of the geese harvested in the Atlantic Flyway during the regular waterfowl hunting seasons were migratory geese. Therefore, some of the geese harvested in Georgia are likely resident Canada geese that nest in the state.

Cumulative impacts of the proposed action on migratory geese would be based upon anticipated WS take, take by other entities under depredation permits, and hunter harvest. The number of migratory geese lethally removed annually in the state is unknown. As discussed previously, other entities lethally removed an average of 39 geese per year in the state to manage damage or threats of damage. The number of those geese that were migratory is unknown. During 2019, hunters harvested an estimated 16,100 Canada geese in the state during the regular waterfowl season. Hunters harvested an estimated 9,700 Canada geese during the 2020 regular waterfowl season in the state. If 38% of those geese harvested in the state during the 2019 and 2020 regular waterfowl hunting season were migratory geese, hunters harvested approximately 6,120 migratory geese during 2019 and approximately 3,700 migratory geese during 2020.

WS take of up to 200 geese that could be migratory would represent 3.3% of the 6,120 geese harvested during the 2019 regular waterfowl hunting season that could also be migratory and 5.4% of the 3,700 geese harvested during the 2020 regular waterfowl hunting season that could also be migratory. If all of the geese lethally removed by other entities were migratory and if 38% of the harvest of geese during the regular waterfowl season were migratory, the annual lethal removal of 200 geese by WS would represent 3.2% of the cumulative removal of geese during the 2019 regular waterfowl hunting season and 5.1% of the cumulative removal of geese during the 2020 regular waterfowl hunting season.

The number of migratory geese potentially removed by WS on an annual basis in Georgia is likely to be relatively low. The majority of WS lethal activities would occur when migratory geese were not present in the state (*i.e.*, from April through August). Most, if not all, of damage management activities that WS could conduct under this alternative would involve the resident Canada goose population. WS proposed take is of low magnitude when compared with the number of geese that people harvest annually in the state. WS limited proposed take would not reduce the ability of people to harvest geese in the state based on the limited portion of the overall take that could occur by WS and the locations where WS conducts activities. The take of migratory geese could only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA would ensure take by WS and by other entities occurred within allowable levels to achieve the desired population objectives for Canada geese.

FERAL FOWL AND OTHER FOWL POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Free-ranging or feral domestic fowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, swans, peafowl, and other fowl. 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 domesticated mallards, Muscovy ducks, and mallard-Muscovy hybrids. People have released many fowl of domestic or semi-wild genetic backgrounds into rural and urban environments, including numerous species of ducks, geese, swans, peafowl, and other fowl.

Domestic fowl have been purchased and released by property owners for their esthetic value or as a food source but may not always remain at the release sites; thereby, becoming feral. Feral fowl are domestic species of fowl that do not have a link to a specific ownership. Examples of areas where people have released domestic fowl are business parks, universities, wildlife management areas, recreational parks, military bases, residential communities, and housing developments. Many times, people release those birds with no regard or understanding of the consequences that releasing domestic fowl can have on the environment or the local community.

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 a 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).

Federal law does not protect domestic varieties of waterfowl (see 50 CFR 21), nor are domestic waterfowl specifically protected by state law in Georgia. Domestic and feral waterfowl 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). WS would address those types of hybrid waterfowl species in accordance with definitions and regulations provided in 50 CFR 10 and 50 CFR 21.

Feral domestic ducks, geese, swans, peafowl, and other fowl 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 those domestic fowl species could provide some benefit to other native bird species because they compete with native wildlife for resources. Domestic and feral waterfowl usually occur near water, such as ponds, lakes, retaining pools, and waterways. Domestic and feral waterfowl generally reside in the same area throughout the year with little to no migration occurring. Currently, there are no population estimates for domestic and feral fowl in Georgia. Federal and state laws do not protect domestic and feral fowl from take and neither the USFWS nor the GDNR consider domestic waterfowl for population goal requirements for wild waterfowl, 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. Because Muscovy ducks now occur naturally in southern Texas, the USFWS has added the species to the list of migratory birds provided protections under the MBTA; however, people have introduced the domesticated Muscovy duck into other parts of the United States where Muscovy ducks are not native, including the State of Georgia. 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 the United States, including Georgia. The USFWS has revised 50 CFR 21.48 (permit exceptions for captive-bred migratory waterfowl other than mallards), 50 CFR 21.88 (waterfowl sale and disposal permits), and has added 50 CFR 21.174, a control order to allow people to address Muscovy ducks, their nests, and eggs without the need for a depredation permit.

People introduced mute swans to North America in the 1800s for their esthetic value (Ciaranca et al. 2020). The bright, orange-red bill distinguishes the mute swan from the native trumpeter swans and tundra swans, both of which have black bills. This adaptable species can occur in a variety of aquatic habitats from municipal parks, coastal ponds, lakes, and slow-moving rivers (Ciaranca et al. 2020). There are some concerns regarding the effects on native ecosystems (*e.g.*, overgrazing of aquatic vegetation, displacing native waterfowl, and contamination of water supplies with fecal waste) from mute swans (Ciaranca et al. 2020). Due to the species' non-native status, the MBTA does not afford protection to the species and people can remove mute swans at any time without a depredation permit from the USFWS.

Table 3.2 shows the number of free-ranging or feral domestic fowl lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS relocated free-ranging or feral domestic fowl after they were captured in drive traps. In addition, WS lethally removed free-ranging or feral domestic fowl using a firearm and euthanized free-ranging or feral domestic fowl after they were live captured using drive traps or hand nets.

Table 3.2 – Free-ranging or feral domestic fowl addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Non-Lethal Methods	
		Dispersed	Freed/Relocated
2017	48	0	30
2018	2	0	1
2019	0	0	0
2020	1	0	0
2021	0	0	0

Based on previous efforts to alleviate the threat of damage associated with free-ranging or feral domestic fowl and in anticipation of an increase in the number of requests received by WS annually, WS could lethally remove up to 300 free-ranging or feral domestic fowl annually in the state. In addition, WS could destroy up to 500 feral fowl nests (including eggs) annually, when requested. The number of free-ranging or feral domestic fowl present in the state is currently unknown; however, because free-ranging or feral domestic fowl often compete with native wildlife species for resources, any reduction of the free-ranging or feral domestic fowl population in the state, even to the extent of complete eradication from the natural environment, could provide some benefit.

MALLARD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Found across most of North America, the mallard is the most abundant and one of the most recognizable waterfowl species (Drilling et al. 2020). In Georgia, mallards occur statewide throughout the year. Mallards are often associated with wetlands, streams, ponds, and lakes; however, mallards are flexible and adaptable and can occur in a variety of habitats (Drilling et al. 2020). An omnivorous and opportunistic duck, mallards will consume a wide variety of invertebrates, vegetation, seeds, and human provided food. With the exception of the mating season, mallards are highly social, congregating in flocks that can number in the thousands during the winter and during the spring and fall migrations (Drilling et al. 2020).

Mallards primarily occurring the state during the migration periods and during the winter, but mallards may be present in the state during the nesting season; however, those mallards present during the nesting season may be non-breeding mallards. From 1966 through 2019, the number of mallards observed along routes surveyed in Georgia during the BBS has shown an increasing trend estimated at 4.0% per year (Sauer et al. 2019). From 1970 through 2019, the number of mallards observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 1.0% per year (Meehan et al. 2020). The number of mallards present in the state throughout the year is unknown.

From FY 2017 through FY 2021, WS did not receive requests for direct operational assistance in Georgia involving mallards. However, WS anticipates receiving requests for assistance in the future. Based on the flocking behavior of mallards, WS could lethally remove up to 300 mallards per year in Georgia. In addition to take by WS, other entities could also be issued depredation permits to take mallards to alleviate damage and threats of damage. From 2016 through 2019, other entities only reported the take of two mallards, which occurred in 2018.

In 2022, the USFWS (2022) estimated the breeding population in the United States and Canada to be 7.2 million mallards. Like other waterfowl species, hunters can harvest mallards during annual hunting seasons in the state. People harvested an estimated 6,659 mallards in Georgia during the 2019 hunting season and 5,268 mallards during the 2020 hunting season (Raftovich et al. 2021).

Most requests for assistance that WS receives involving mallards occur in areas with restricted access and/or where hunting is prohibited (*e.g.*, airports, inside city limits). The lethal removal of mallards by WS would not reach a magnitude where the ability to harvest mallards in the state during the regulated seasons would be affected. WS based this determination on the areas where requests for assistance were likely to occur and on the low magnitude of take that would likely occur when compared to the annual harvest of mallards.

All lethal take by WS would occur pursuant to depredation permits issued by the USFWS, which would ensure the USFWS had the opportunity to evaluate the cumulative take of mallards from all known sources when establishing population objectives for mallards.

WILD TURKEY POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

A non-migratory bird, wild turkeys occur from the southern edge of Canada southward across most of the United States, and into the Mexico (McRoberts et al. 2020). There are five distinct subspecies of wild turkeys found in the United States: eastern wild turkey, Osceola wild turkey, Gould’s wild turkey, Merriam’s wild turkey, and the Rio Grande wild turkey (National Wild Turkey Federation 2022*a*). Subspecies can interbreed, creating hybrid species where distribution ranges overlap. The only wild turkey found in Georgia is the eastern subspecies. The eastern wild turkey subspecies is endemic to the eastern half of the United States and is the most abundant and most widely distributed subspecies (National Wild Turkey Federation 2022*a*). The eastern wild turkey can be found in 38 States and four Canadian provinces, ranging from southern Canada and New England to northern Florida, west to Texas, Missouri, Iowa, and Minnesota (National Wild Turkey Federation 2022*a*). In the eastern United States, wild turkeys inhabit hardwood, mixed, and pine forests foraging on a variety of acorns, fruits, seeds, and insects. There are an estimated 6 to 6.2 million wild turkeys in North America (National Wild Turkey Federation 2022*b*).

Like many eastern states, the wild turkey population in Georgia saw a decline in the early 1900s, but after successful restoration projects, the wild turkey population in the state has made a successful recovery (Thackston et al. 1991). Presently, wild turkeys occur statewide throughout the year. From 1966 through 2019, the number of wild turkeys observed along routes surveyed in Georgia during the BBS has shown an increasing trend estimated at 6.9% per year (Sauer et al 2020). Similarly, the number of wild turkeys observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019 estimated at 7.0% per year (Meehan et al. 2020). Despite the long-term increasing population trends, the current statewide population may be showing a declining trend. However, from 2009 through 2019, the number of wild turkeys observed in Georgia along routes surveyed during the BBS continue to show increasing trends estimated at 5.2% per year (Sauer et al. 2019). Similarly, trend data from 2009 through 2019 for areas in Georgia surveyed during the CBC has shown an increasing trend for wild turkeys estimated at 3.5% per year (Meehan et al. 2020). The current population of turkeys in Georgia is unknown.

From FY 2017 through FY 2021, WS only managed damage or threats of damage involving wild turkeys during FY 2018 and FY 2020. In FY 2018, WS intentionally lethally removed one wild turkey using a firearm to manage damage. During FY 2020, WS dispersed one wild turkey using pyrotechnics. In addition, two wild turkeys died during FY 2017 when WS unintentionally captured them in foothold traps that WS set to capture other animals. WS also captured a wild turkey unintentionally in a foothold trap set to capture another animal during FY 2018, but WS was able to release the wild turkey unharmed. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 300 wild turkeys annually in Georgia.

Because wild turkeys are non-migratory, they are permanent residents in states where they are present and the MBTA does not afford protection to non-migratory bird species; therefore, the lethal take of wild turkeys does not require a depredation permit from the USFWS. The overall management of the wild turkey population is the responsibility of the individual states where they occur. The GDNR manages and regulates wild turkeys as a game species in Georgia.

Currently, people in Georgia can harvest up to two male wild turkeys per season, which generally occurs from late March through mid-May each year (GDNR 2023). From 2017 through 2021, people harvested an average of 12,362 wild turkeys per year in Georgia with the highest annual harvest of wild turkeys occurring in 2020 when people harvested 14,412 wild turkeys (GDNR 2022*b*). The take of up to 300 wild turkeys by WS would represent 2.4% of the average annual harvest of wild turkeys in the state from 2017 through 2021 and 2.1% of the highest annual turkey harvest that occurred in 2020. Cumulatively, the annual harvest of 12,362 wild turkeys and the take of 300 wild turkeys by WS would only represent 4.2% of the statewide harvest of wild turkeys.

Most requests for assistance that WS receives involving wild turkeys occur in areas with restricted access and/or where hunting is prohibited (*e.g.*, airports, inside city limits). The lethal removal of wild turkeys by WS would not reach a magnitude where the ability to harvest turkeys in the state during the regulated seasons would be affected. WS based this determination on the areas where requests for assistance were likely to occur and on the low magnitude of take that would likely occur when compared to the annual harvest of turkeys. The annual take of wild turkeys by WS would not exceed the take levels that the GDNR authorizes WS to take.

ROCK PIGEON POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Rock pigeons are a non-indigenous species that European settlers first introduced into the United States as a domestic bird for sport, carrying messages, and as a source of food (Schorger 1952, Lowther and Johnston 2020). Many of those birds escaped and eventually formed the feral pigeon populations that now occur throughout the United States, southern Canada, and Mexico (Lowther and Johnston 2020). Rock pigeons are non-migratory and closely associated with people, where structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994, Lowther and Johnston 2020). Thus, pigeons commonly occur 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). Pigeons occur throughout the year in all 50 states, including Georgia (Lowther and Johnston 2020).

In Georgia, rock pigeons occur statewide throughout the year (Lowther and Johnston 2020). From 1966 through 2019, the number of rock pigeons observed along routes surveyed during the BBS in the state have shown a decreasing trend estimated at -2.6% annually (Sauer et al. 2019). Based on data from the BBS, Partners in Flight (2020) estimated the statewide population at 94,000 pigeons. The number of rock pigeons observed in areas surveyed during the CBC is showing a general increasing trend in the state since 1966; however, since the early 1990s, the number of rock pigeons observed has shown a general declining trend (National Audubon Society 2020).

Table 3.3 shows the number of rock pigeons lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. Since FY 2017, WS dispersed rock pigeons using pyrotechnics and the noise associated with the discharge of a firearm. In addition, WS freed or relocated rock pigeons after they were live captured using decoy traps and cannon/rocket nets. WS also lethally removed rock pigeons from FY 2017 through FY 2021 using firearms and from euthanasia after live-capture using rocket/cannon nets, cage traps, and decoy traps.

Table 3.3 – Rock pigeons addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Non-Lethal Methods	
		Dispersed	Freed/Relocated
2017	909	0	227
2018	786	0	0
2019	555	0	0
2020	286	0	0
2021	635	14	0

Based on the gregarious behavior of rock pigeons and in anticipation of additional efforts to address requests associated with rock pigeons, WS could take up to 5,000 rock pigeons per year in Georgia. Based on a breeding population estimated at 94,000 rock pigeons, take of up to 5,000 rock pigeons by WS would represent 5.3% of the estimated statewide breeding population.

Because rock pigeons are a non-native species in North America, the MBTA does not afford rock pigeons protection from take. A depredation permit from the USFWS is not required for people to take rock pigeons and there are no requirements to report the take of rock pigeons to the USFWS; therefore, the number of rock pigeons that other entities lethally remove in the state is unknown. Activities associated with rock pigeons would occur pursuant to Executive Order 13112 and Executive Order 13751, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and associated damage.

EURASIAN COLLARED-DOVE POPULATION – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The Eurasian collared-dove was first introduced to North America when several were released in the

Bahamas during the mid-1970s. Eurasian collared-doves have quickly expanded their range and now have established populations throughout North America and Central America. Eurasian collared-doves occur primarily in urban, suburban, and agricultural areas (Romagosa and Mlodinow 2022).

Eurasian collared-doves occur statewide throughout the year in Georgia (Romagosa and Mlodinow 2022). Since 1966, data from the BBS indicates the breeding population of Eurasian collared-doves in Georgia has increase at approximately 14.4% per year. However, from 2009 through 2019, the breeding population in Georgia has shown a declining trend estimated at -5.7% per year (Sauer et al. 2019). Partners in Flight (2020) estimated the breeding population at 120,000 Eurasian collared-doves in Georgia. The number of Eurasian collared-doves observed in areas of the state surveyed during the CBC has shown an increasing trend in the state from 1970 to 2019 estimated at 24.8% per year (Meehan et al. 2020).

From FY 2017 through FY 2021, WS lethally removed an average of four Eurasian collared-doves per year using a firearm to alleviate damage or threats of damage. The highest annual lethal take of Eurasian collared-doves by WS occurring in FY 2020 when WS lethally removed nine Eurasian collared-doves. Outside of the breeding season, Eurasian collared-doves tend to be gregarious and can mix with flocks of mourning doves (Romagosa and Mlodinow 2022). Based on the increasing population trends of Eurasian collared-doves observed on BBS routes and the CBC along with the gregarious behavior of Eurasian collared-doves, WS anticipates requests for assistance associated with Eurasian collared-doves to increase along with the number of Eurasian collared-doves encountered while addressing those requests for assistance. To address requests for assistance concerning Eurasian collared-doves, WS anticipates the need to take up to 500 Eurasian collared-doves per year to alleviate damage.

Because Eurasian collared-doves are a non-native species in North America, the MBTA does not afford Eurasian collared-doves protection from take. A depredation permit from the USFWS is not required for people to take Eurasian collared-doves and there are no requirements to report the take of Eurasian collared-doves to the USFWS; therefore, the number of Eurasian collared-doves that other entities lethally remove in the state is unknown.

In addition, Eurasian collared-doves are similar in appearance to mourning doves and people may harvest Eurasian collared-doves during the annual hunting season for mourning doves. People can harvest mourning doves under frameworks established by the USFWS and implemented by the GDNR. However, because Eurasian collared-doves are a non-native species, no frameworks for the harvest of Eurasian collared-doves exist. Therefore, the number of Eurasian collared-doves that people harvest annually in Georgia during the hunting season for mourning doves is currently unknown.

WS lethal removal of Eurasian collared-doves to reduce damage and threats would comply with Executive Order 13112 and Executive Order 13751. WS does not anticipate the annual take of up to 500 Eurasian collared-doves to have any cumulative effects on the statewide population. Trend information available indicates populations continue to increase within the state.

MOURNING DOVE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Mourning doves are 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. Mourning doves occur throughout the year in Georgia (Otis et al. 2020).

According to trend data provided by Sauer et al. (2020), the number of mourning doves observed along BBS routes in Georgia has shown a declining trend estimated at -0.2% annually from 1966 through 2019.

Based on BBS data, Partners in Flight (2020) estimated the statewide breeding population at 2.8 million mourning doves. The number of mourning doves observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 0.8% per year from 1970 through 2019 (Meehan et al. 2020). The USFWS publishes a report on the population status of mourning doves annually based upon survey data. Seamans (2021) estimated the absolute abundance of mourning doves in the Eastern Management Unit[9] ranged from 42.9 million to 85.5 million mourning doves over the past ten years. In 2020, Seamans (2021) estimated the absolute abundance of mourning doves in the Eastern Management Unit at 52.9 million doves, which was an increase in abundance from the estimated 42.9 million mourning doves in the Eastern Management Unit during 2019.

Table 3.4 shows the number of mourning doves lethally removed or dispersed in Georgia by WS to alleviate damage and threats of damage from FY 2017 through FY 2021. Since FY 2017, WS has employed pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm to disperse mourning doves in Georgia to address requests for assistance to manage damage. WS also used lethal methods to remove mourning doves that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, the lethal take of mourning doves in Georgia by WS occurred from euthanasia after live-capture in a cage trap and from the use of firearms.

Table 3.4 – Mourning doves addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	89	20
2018	80	0
2019	28	30
2020	16	21
2021	43	154

Based on the number of requests to manage damage associated with mourning doves received previously and based on the gregarious behavior of doves in the state during the migration periods, up to 2,000 mourning doves could be lethally removed by WS annually in the state to address damage or threats of damage. The lethal removal of up to 2,000 mourning doves in Georgia by WS would represent 0.07% of the statewide breeding population estimated at 2.8 million mourning doves.

From 2016 through 2019, other entities have reported to the USFWS the lethal take of an average of 52 mourning doves per year in Georgia with the highest reported take occurring in 2017 when other entities reported the take of 98 mourning doves. If other entities take 52 mourning doves per year and WS take reached 2,000 mourning doves, the cumulative take of 2,052 mourning doves would represent 0.07% of the nesting population in Georgia, which the Partners in Flight (2020) estimated at 2.8 million mourning doves. If lethal take by other entities reached 98 mourning doves per year and WS take reached 2,000 mourning doves, the cumulative take would represent 0.08% of the nesting population estimated at 2.8 million mourning doves.

Many states have regulated annual hunting seasons for mourning doves with generous bag limits. Hunters harvested nearly 10 million mourning doves in the United States during the 2019 hunting season and nearly 12 million doves during the 2020 hunting season (Raftovich et al. 2021, Seamans 2021). Hunters in Georgia harvested an estimated 713,600 mourning doves during the 2019 hunting season and an estimated 856,500 mourning doves in the state during the 2020 hunting season (Raftovich et al. 2021, Seamans 2021).

[9]The Eastern Management Unit consists of those states east of the Mississippi River and includes Georgia.

Migrating mourning doves likely augment local populations of mourning doves in the state during the migration periods and during the winter months. Therefore, the take of mourning doves by WS and other entities would likely represent a smaller percentage of the nesting population the state. Like other 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 at levels authorized by USFWS, which ensures the USFWS has the opportunity to consider WS take and take by all entities, including hunter harvest, to achieve the desired population management levels of doves in Georgia.

KILLDEER POPULATION – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Killdeer occur over much of North America from the Gulf of Alaska southward throughout the United States and extending from the Atlantic Coast to the Pacific Coast (Hayman et al. 1986, Jackson and Jackson 2020). Although killdeer are technically in the family of shorebirds, they are unusual shorebirds in that they often nest and live far from water. Killdeer commonly occur 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 they seldom occur in large flocks.

In Georgia, killdeer occur statewide during the nesting season and occur throughout the year over much of the state (Jackson and Jackson 2020). Since 1966, the number of killdeer observed during the breeding season in the state has shown an annual increasing trend estimated at 1.3% per year (Sauer et al. 2019). The number of killdeer observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019 estimated at 0.4% per year (Meehan et al. 2020). A breeding population estimate from Partners in Flight (2020) is not available for Georgia. Like other bird species, the actual population in the state likely fluctuates throughout the year.

BirdLife International (2016) indicated the killdeer population was declining across their entire range. 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). BirdLife International (2016) and Wetlands International (2022) estimated the population at 1 million killdeer. Andres et al. (2012) indicated a population estimated at 1 million killdeer in 2006 with a population estimated at 2 million killdeer in 2012.

Table 3.5 shows the number of killdeer lethally removed or dispersed by WS to alleviate damage and threats of damage from FY 2017 through FY 2021. Since FY 2017, WS dispersed killdeer using vehicle activity, pyrotechnics, and the noise associated with the discharge of a firearm. WS also used lethal methods to remove killdeer that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, WS lethally removed killdeer using firearms.

Table 3.5 – Killdeer addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	27	0
2018	23	2
2019	2	14
2020	62	71
2021	46	144

In anticipation of additional efforts to address requests associated with killdeer, WS could take up to 300 killdeer each year to alleviate damage or threats throughout Georgia. From 2016 through 2019, other entities reported removing an average of 32 killdeer per year in Georgia. The highest annual reported take of killdeer by other entities occurred in 2018 when other entities reported the take of 43 killdeer.

With a population estimated at one to two million killdeer in the United States, the take of up to 300 killdeer in Georgia by WS would represent 0.02% to 0.03% of the population. If other entities take 32 killdeer per year and WS take reached 300 killdeer, the cumulative take of 332 killdeer would represent 0.02% to 0.03% of the population. If lethal take by other entities reached 43 killdeer per year and WS take reached 300 killdeer, the cumulative take would represent 0.02% to 0.03% of the population estimated to range from 1 million to 2 million killdeer. The International Union for Conservation of Nature and Natural Resources ranks the killdeer as a species of "*least concern*" based on the "*species…extremely large range…*," "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2016). The United States Shorebird Conservation Plan Partnership (2016) indicated the killdeer was a species of "*moderate concern*".

The take of killdeer could only occur when authorized through the issuance of depredation permits by the USFWS. All take of killdeer would occur within the levels permitted by the USFWS pursuant to the MBTA. The permitting of take by the USFWS pursuant to the MBTA would ensure take by WS and other entities occurred within allowable take levels to achieve desired population objectives for killdeer.

RING-BILLED GULL POPULATION – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

In North America, the nesting range of ring-billed gulls extends across the northern United States and extends northward into southern Canada (Pollet et al. 2020). Ring-billed gulls winter in the southern and coastal areas of the United States and across most of Mexico. Ring-billed gulls are inland, colonial ground nesters that nest on sparsely vegetated islands in large lakes, with occasional colonies on mainland peninsulas and near-shore oceanic islands (Pollet et al. 2020). Ring-billed gulls commonly occur in large numbers at landfills, parking lots, and southern coastal beaches during the winter. Ring-billed gulls are opportunistic foragers that feed primarily on fish, insects, earthworms, rodents, and grains (Pollet et al. 2020).

In Georgia, ring-billed gulls are present statewide during the migration periods and winter months, primarily near large bodies of water (Pollet et al. 2020). Because ring-billed gulls primarily nest in the northern United States and southern Canada, data from the BBS is currently not available for ring-billed gulls in Georgia. From 1970 through 2019, the number of ring-billed gulls observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 7.0% per year (Meehan et al. 2020). The number of ring-billed gulls that migrate through and winter in Georgia annually is not currently available.

Wires et al. (2010) estimated the ring-billed gull population in North America at 1.7 million breeding individuals. Wetlands International (2022) estimated the population at nearly 2.6 million ring-billed gulls. BirdLife International (2018) considers the ring-billed gull to be a species of "*least concern*" with an increasing population trend. In the North American Waterbird Conservation Plan, Kushlan et al. (2002) ranked the ring-billed gull as a species "*not currently at risk.*"

From FY 2017 through FY 2021, WS only addressed ring-billed gulls during FY 2019 and FY 2020. During FY 2019, WS dispersed 40 ring-billed gulls using the noise associated with the discharge of a firearm. During FY 2020, WS lethally removed nine ring-billed gulls using a firearm and dispersed 25 ring-billed gulls using the noise associated with the discharge of a firearm to alleviate damage or threats of damage. Based on the number of requests received to alleviate damage or threats of damage associated with ring-billed gulls, the number of ring-billed gulls addressed previously to address those requests, and in anticipation of receiving additional requests for assistance, WS anticipates that personnel could lethally take up to 50 ring-billed gulls annually in Georgia to alleviate damage or threats of damage. Based on a population that ranges from 1.7 million to 2.6 million ring-billed gulls in North America, an annual take of up to 50 ring-billed gulls by WS would represent 0.002% to 0.003% of the estimated population.

Other entities have also reported to the USFWS the take of ring-billed gulls in Georgia. From 2016 through 2019, other entities have reported to the USFWS the lethal take of an average of 76 ring-billed gulls per year, with the highest reported take occurring in 2019 when other entities reported the take of 133 ring-billed gulls. If other entities take 76 ring-billed gulls per year and WS take reached 50 ring-billed gulls, the cumulative take of 126 ring-billed gulls would represent 0.007% of a population estimated at 1.7 million ring-billed gulls. If the lethal take of ring-billed gulls by other entities reached 133 ring-billed gulls per year and WS take reached 50 ring-billed gulls, the cumulative take would represent 0.01% of the population estimated at 1.7 million ring-billed gulls.

The take of ring-billed gulls can only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, the take of ring-billed gulls by WS would only occur when authorized by the USFWS. In addition, the take of ring-billed gulls by WS would only occur at levels authorized by the USFWS. The permitting of take by the USFWS would ensure the cumulative take of ring-billed gulls occurred within allowable take levels to achieve desired population objectives for the species.

DOUBLE-CRESTED CORMORANT POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Dorr et al. 2021). The diet of a double-crested cormorant consists almost entirely of fish, but they will also eat other aquatic animals. Therefore, double-crested cormorants generally occur in areas near bodies of water, such as coastal areas, rivers, ponds, lakes, estuaries, and artificial water impoundments (Dorr et al. 2021). Similarly, the double-crested cormorant nest near bodies of water with nests generally occurring on the ground on rocky or sandy islands, but they also will nest in trees close to water. Double-crested cormorants will also nest on bridges, docks, power line transmission towers, and other structures (Dorr et al. 2021). Double-crested cormorants are highly social birds that not only nest together but also feed, travel, and roost in flocks that can number more than 1,000 birds (Dorr et al. 2021).

Since the late 1970s, the double-crested cormorant population has increased in many regions of North America (Wires et al 2001). Jackson and Jackson (1995) and Wires et al. (2001) suggested that the current double-crested cormorant resurgence might be, at least in part, a population recovery following years of pesticide 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) found that the double-crested 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 double-crested 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 double-crested cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995). Breeding populations of double-crested cormorants in the southeastern United States are also showing increasing trends, with the total nesting population for this region estimated to be between 10,600 (Hunter et al. 2006) and over 13,604 nesting pairs (Tyson et al. 1999).

The recent increase in the double-crested cormorant population in North America and the subsequent range expansion of cormorants has been well-documented along with concerns of the negative impacts associated with the expanding population (*e.g.*, see Taylor and Dorr 2003, Hunter et al. 2006, Atlantic Flyway Council and Mississippi Flyway Council 2010, USFWS 2020). The Southeast United States

Regional Waterbird Conservation Plan ranks double-crested 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). Double-crested 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).

The Wetlands International (2022) estimated the continental population to be between 1,078,280 and 1,160,590 double-crested cormorants. In Northeast and Central North America, Wetlands International (2022) estimated the population to be between 947,000 and 1,020,000 double-crested cormorants. The USFWS (2020*a*) estimated the population to range from 871,001 to 1,031,575 double-crested cormorants with 254,045 to 293,860 double-crested cormorants occurring in the Atlantic Flyway[10].

Double-crested cormorants can occur throughout the year in Georgia, but they are more common and more widely distributed during the migration and wintering period (Atlantic Flyway Council and Mississippi Flyway Council 2010, Dorr et al. 2021). 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. 2021). 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. 2021).

Hunter et al. (2006) estimated the number of breeding double-crested cormorants in the state to be 50 breeding pairs. The USFWS (2020*a*) estimated the breeding population in the state at 10 to 100 breeding pairs. From 1966 through 2019, the number of double-crested cormorants observed along routes surveyed in the state during the BBS has shown an increasing trend estimated at 2.7% annually. Since 1970, the number of double-crested cormorants observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 10.0% per year (Meehan et al. 2020).

Table 3.6 shows the number of double-crested cormorants lethally removed or dispersed in Georgia by WS to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed double-crested cormorants in Georgia using vehicle activity and lethally removed double-crested cormorants using a firearm. Based on the number of requests received to alleviate damage or threats of damage associated with double-crested cormorants, the number of double-crested cormorants addressed previously to alleviate those requests, and in anticipation of receiving additional requests for assistance, WS could lethally take up to 100 double-crested cormorants annually in the state to alleviate damage or threats of damage. Based on a population of 254,045 double-crested cormorants in the Atlantic Flyway, an annual take of up to 100 double-crested cormorants by WS would represent 0.04% of the estimated population.

Table 3.6 – Double-crested cormorants addressed by WS in Georgia, FY 2017 – FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	14	0
2018	2	0
2019	5	0
2020	0	2
2021	1	0

[10]The population estimate for double-crested cormorants in the Atlantic Flyway does not include the Florida population (USFWS 2020*a*).

In addition to the take of double-crested cormorants by WS, other entities have also reported to the USFWS the take of double-crested cormorants in Georgia. From 2016 through 2019, entities other than WS reported to the USFWS an average lethal take of 135 double-crested cormorants per year in Georgia pursuant to depredation permits issued by the USFWS[11]. The take of double-crested cormorants can only occur when authorized by the USFWS pursuant to the MBTA. Therefore, the take of double-crested cormorants by WS would only occur when authorized by the USFWS. In addition, the take of double-crested cormorants by WS would only occur at levels authorized by the USFWS. The permitting of take by the USFWS would ensure the cumulative take of double-crested cormorants occurred within allowable take levels to achieve desired population objectives for the species. The USFWS is currently issuing permits to take double-crested cormorants pursuant to a Potential Take Limit model developed to maintain double-crested cormorant populations (see Appendix E in USFWS 2020).

Under the FEIS developed by the USFWS to evaluate the management of conflicts associated with double-crested cormorants, the USFWS would continue to authorize the take of double-crested cormorants within the allowable take levels predicted by the Potential Take Limit model (USFWS 2020*a*). The USFWS selected the preferred alternative in the FEIS, which created a special state/tribal permit that would allow states and tribes to manage damage caused by double-crested cormorants to state and tribal resources, such as state or tribal managed fisheries. The USFWS continues to issue standard depredation permits to protect other resources, such as commercial aquaculture.

The USFWS would authorize take within the allowable take limits predicted by the Potential Take Limit model. A Potential Take Limit model uses population abundance and demographic information to estimate annual take levels that meet a management objective to ensure the long-term sustainability of a population. Therefore, the level of take authorization that occurs within Georgia, including WS authorized take, would occur within allowable take predicted by the model and used by the USFWS to maintain the double-crested cormorant population. If WS implements Alternative 1, the activities conducted by WS to manage damage caused by double-crested cormorants in Georgia would be within the scope and management objectives of the Southeast United States Waterbird Conservation Plan (Hunter et al. 2006) and the Atlantic and Mississippi Flyways Double-crested Cormorant Management Plan (Atlantic Flyway Council and Mississippi Flyway Council 2010).

GREAT BLUE HERON POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Great blue herons are a common widespread wading bird that occurs throughout most of North America and occurs throughout the year in most of the United States, including Georgia (Vennesland and Butler 2020). Great blue herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons. Great blue herons feed mainly on fish, but they may also capture invertebrates, amphibians, reptiles, birds, and mammals (Vennesland and Butler 2020).

Kushlan et al. (2002) estimated the population size of great blue herons to be 83,000 breeding pairs across North America. In 2006, the breeding population of great blue herons was approximately 69,331 breeding pairs or 138,662 adult herons in the southeastern United States (Hunter et al. 2006). The overall population objective for great blue herons in the southeastern United States is 50,000 to 100,000 breeding pairs (Hunter et al. 2006). A survey of great blue herons in Mississippi found that the population peaked in mid-winter as migrant birds arrived (Glahn et al. 1999). The peak population in Georgia is also likely to occur in mid-winter. The total breeding population of great blue herons in Georgia is unknown and the number of great blue herons that migrate through and winter in Georgia is unknown.

[11]Reported take for double-crested cormorants during 2019 was based on authorized take by the USFWS.

From 1966 through 2019, the number of great blue herons observed in Georgia along BBS routes has shown an increasing trend estimated at 2.2% per year. From 1970 through 2019, the number of great blue herons observed in areas of Georgia surveyed during the CBC has increased at an estimated rate of 2.0% per year. The number of great blue herons present in the state likely fluctuates throughout the year and varies from year to year. A quantitative population estimate of great blue herons in Georgia is currently not available.

Table 3.7 shows the number of great blue herons lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, the non-lethal hazing methods that WS used in Georgia to disperse great blue herons included vehicle activity, pyrotechnics, hand tools, and the noise associated with the discharge of a firearm. In addition, from FY 2017 through FY 2021, WS lethally removed great blue herons using a firearm to alleviate damage. Based on requests for assistance received by WS previously and in anticipation of receiving additional requests for assistance, WS could lethally take up to 150 great blue herons annually in the state. The increased level of take analyzed is in anticipation of requests to address threats of aircraft strikes at airports. The take of up to 150 great blue herons would represent 0.1% of the estimated 138,662 nesting great blue herons in the southeastern United States.

Table 3.7 – Great blue herons addressed by WS in Georgia, FY 2017 – FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	6	12
2018	1	12
2019	7	22
2020	3	11
2021	2	29

From 2016 through 2019, other entities in the state have reported lethally removing an average of 83 great blue herons per year in the state pursuant to depredation permits issued by the USFWS. If the average annual take of great blue herons by other entities were reflective of take that would occur in the future, the combined WS take and take by other entities would total 233 great blue herons. The cumulative take of 233 great blue herons in the state would represent 0.2% of the 138,662 great blue herons estimated to nest in the southeastern United States. WS take of great blue herons would only occur at levels authorized by the USFWS through the issuance of depredation permits. All take by WS would occur at the discretion of the USFWS; therefore, WS take would only occur when permitted by the USFWS pursuant to the MBTA.

GREAT EGRET POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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. 2020). Great egrets occur in freshwater, estuarine, and marine wetlands. 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 more than 95% (McCrimmon et al. 2020). During surveys conducted in 1911 and 1912, the total known nesting population of great egrets was approximately 1,000 to 1,500 breeding pairs in 13 colonies in seven states. Following regulations that ended plume-hunting, great egret populations began recovering in the late 1920s and 1930s (McCrimmon et al. 2020).

In Georgia, great egrets occur statewide during the migration periods and the nesting season and can be found throughout the year in the coastal region (McCrimmon et al. 2020). Since 1966, the number of great egrets observed in areas of Georgia surveyed during the BBS has shown an annual increasing trend estimated at 0.1% per year (Sauer et al. 2019). A breeding population estimate from Partners in Flight

(2020) is not available for Georgia. The number of great egrets observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 3.1% per year from 1970 through 2019 (Meehan et al. 2020). The number of great egrets that winter or migrate through Georgia annually is not currently available. Kushlan et al. (2002) estimated the population size to be greater than 183,000 breeding great egrets across North America. Wetlands International (2022) estimated the North America population to be 270,000 great egrets. BirdLife International (2019) considers the great egret to be a species of "*least concern.*" In the North American Waterbird Conservation Plan, Kushlan et al. (2002) ranked the great egret as a species "*not currently at risk.*"

Table 3.8 shows the number of great egrets lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. Since FY 2017, WS has employed non-lethal hazing methods to disperse great egrets using pyrotechnics, hand tools, vehicle activity, and the noise associated with the discharge of a firearm. WS also used lethal methods to remove great egrets that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, the lethal take of great egrets by WS occurred from the use of firearms.

Table 3.8 – Great egrets addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	24	195
2018	13	51
2019	28	97
2020	11	155
2021	12	85

Based on the number of requests received to alleviate damage or threats of damage associated with great egrets, the number of great egrets addressed previously to alleviate those requests, and in anticipation of receiving additional requests for assistance, WS could lethally take up to 50 great egrets annually in the state. Based on a population of 183,000 great egrets in North America, an annual take of up to 100 great egrets by WS would represent 0.03% of the estimated population.

From 2016 through 2019, other entities have reported to the USFWS the lethal take of an average of 77 great egrets per year with the highest reported take occurring in 2017, when other entities reported the take of 103 great egrets. If other entities take 77 great egrets per year and WS take reached 50 great egrets, the cumulative take of 127 great egrets would represent 0.07% of the population in North America, which Kushlan et al. (2002) estimated at 183,000 great egrets. If lethal take by other entities reached 103 great egrets per year and WS take reached 50 great egrets, the cumulative take would represent 0.08% of the population estimated at 183,000 great egrets.

The take of great egrets can only occur when authorized by the USFWS pursuant to the MBTA. Therefore, the take of great egrets by WS would only occur when authorized by the USFWS. In addition, the take of great egrets by WS would only occur at levels authorized by the USFWS. The permitting of take by the USFWS would ensure the cumulative take of great egrets occurred within allowable take levels to achieve desired population objectives for the species.

SNOWY EGRET POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Snowy egrets are medium-sized herons with entirely white plumage that are identifiable through their black legs and yellow feet (Parsons and Master 2020). Similar to great egrets, people sought snowy egrets for their plumage to meet demands for the millinery trade in the late 1800s and early 1900s, which caused severe population declines across their range. After the passage of laws that ended plume hunting, populations of snowy egrets began to rebound and snowy egrets appeared to expand their breeding range in the United States (Parsons and Master 2020). Snowy egrets nest in coastal and inland wetlands but nesting colony locations often change from year to year. In the United States, snowy egrets nest along the eastern and southern coasts with localized breeding colonies occurring at inland wetland locations. Snowy egrets are partially migratory with interior nesting egrets showing southward movements in the fall. Snowy egrets feed on a wide range of invertebrate and vertebrate species, including earthworms, annelid worms, shrimp, prawns, crayfish, snails, freshwater and marine fish, frogs, toads, snakes, and lizards (Parsons and Master 2020).

In Georgia, snowy egrets occur throughout the year along the coastal areas of the state with breeding colonies occurring inland across most of the state. Snowy egrets can occur nearly statewide during the migration periods (Parsons and Master 2020). The number of snowy egrets observed along routes surveyed in the state during the BBS has shown an increasing trend from 1966 through 2019 estimated at 0.2% per year (Sauer et al. 2019). The number of snowy egrets observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 3.2% per year from 1970 through 2019 (Meehan et al. 2020).

When developing the Southeast United States Waterbird Conservation Plan, Hunter et al. (2006) placed snowy egrets in the southeastern United States into the planning and responsibility action level, which is the second lowest tier in action priority. The waterbird conservation for the Americas plan ranks snowy egrets as a species of high concern in the Western Hemisphere (Kushlan et al. 2002). Species of high concern are those species that are not highly imperiled but are known or thought to be declining and have some known or potential threat in addition to the declining population trends (Kushlan et al. 2002). Known or potential threats could include habitat degradation and loss along with competition for nest sites with cattle egrets, which share similar habitat requirements (Burger 1978, Hunter et al. 2006, Parsons and Master 2020). The snowy egret population in the southeastern Bird Conservation Regions is approximately 45,000 breeding pairs. Approximately 7,000 breeding pairs of snowy egrets occur in those Bird Conservation Regions that include portions of Georgia (Hunter et al. 2006).

From FY 2017 through FY 2021, WS only received requests for assistance associated with snowy egrets in Georgia during FY 2021. During FY 2021, WS dispersed 14 snowy egrets using hand tools, pyrotechnics, and the noise associated with discharge of a firearm. In addition, WS lethally removed one snowy egret using a firearm to alleviate damage during FY 2021. Based on previous requests for assistance involving snowy egrets and in anticipation of receiving additional requests for assistance, WS could lethally remove up to 25 snowy egrets per year in Georgia. The lethal take of up to 25 snowy egrets by WS would represent 0.2% of the breeding population in those Bird Conservation Regions that include portions of Georgia.

In addition to those activities that WS conducts to alleviate damage and threats of damage, other entities have also addressed snowy egrets to alleviate damage and threats of damage. The USFWS has issued depredation permits to other entities for the take of snowy egrets in the state. Entities issued depredation permits reported lethally removing an average of 57 snowy egrets per year from 2016 through 2019, with the highest annual reported take occurring in 2018 when people reported taking 92 snowy egrets. If other entities take 57 snowy egrets per year in Georgia and WS take reached 25 snowy egrets, the cumulative take of 82 cattle egrets would represent 0.6% of the population in those Bird Conservation Regions that include portions of Georgia estimated at 14,000 snowy egrets (7,000 breeding pairs). If the lethal take of cattle egrets in Georgia by other entities reached 92 snowy egrets per year and WS take reached 25 snowy egrets, the cumulative take would represent 0.8% of the population estimated at 14,000 snowy egrets.

The take of snowy egrets by WS would only occur after the USFWS issued a depredation permit and only at levels permitted; therefore, the USFWS would determine the appropriate cumulative take level for snowy egrets and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

CATTLE EGRET POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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 2020). Today, cattle egrets occur across much of North America, including Georgia (Telfair II 2020). As their name implies, cattle egrets are closely associated with cattle where they feed on invertebrates disturbed by foraging livestock, primarily grasshoppers, crickets, and flies. Cattle egrets also consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2020).

The population in North America may range from 750,000 to 1,500,000 cattle egrets (Mid-Atlantic/New England/Maritimes Region Waterbird Conservation Plan 2006). Wetlands International (2022) estimated the North American population at 1 million cattle egrets. The Southeast United States Regional Waterbird Conservation Plan ranks cattle egrets in the "*population control*" action level indicating that populations are increasing to a level where damage to economic ventures or adverse effects to populations of other species are occurring (Hunter et al. 2006). Cattle egrets' broad use of terrestrial habitats relative to other waterbirds may be contributing to their population increase and the range expansion (Hunter et al. 2006, Telfair II 2020). Cattle egrets may also be contributing to the declining trends of little blue herons and snowy egrets, given their aggressive behavior and use of similar nesting habitats (Hunter et al. 2006, Telfair II 2020).

The cattle egret population in the southeastern Bird Conservation Regions is approximately 350,000 breeding pairs. Approximately 59,000 breeding pairs of cattle egrets occur in those Bird Conservation Regions that include portions of Georgia (Hunter et al. 2006). The Southeast United States Waterbird Conservation Plan calls for the reduction of cattle egret populations in the southeastern Bird Conservation Regions to less than 200,000 breeding pairs of cattle egrets with 19,000 breeding pairs in those Bird Conservation Regions that include portions of Georgia. Therefore, the Southeast United States Waterbird Conservation Plan calls for reducing the population by 300,000 cattle egrets in the southeastern United States (Hunter et al. 2006). In those Bird Conservation Regions that include portions of Georgia, the Southeast United States Waterbird Conservation Plan calls for reducing the breeding population by approximately 40,000 cattle egrets (Hunter et al. 2006). Along routes surveyed in Georgia during the BBS, the number of cattle egrets observed has shown a declining trend estimated at -0.7% annually from 1966 through 2019 (Sauer et al. 2019). From 1970 through 2019, the number of cattle egrets observed in areas of Georgia surveyed during the CBC has shown an increasing trend estimated at 0.5% per year (Meehan et al. 2020).

Table 3.9 shows the number of cattle egrets addressed in Georgia by WS from FY 2017 through FY 2021 to alleviate damage. From FY 2017 through FY 2021, WS dispersed an average of 302 cattle egrets per year in Georgia using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. In addition, WS used lethal methods to take cattle egrets in Georgia from FY 2017 through FY 2021 (see Table 3.9). From FY 2017 through FY 2021, the lethal take of cattle egrets by WS occurred from the use of firearms.

Based on previous requests for assistance and in anticipation of additional efforts to manage damage, WS could lethally remove up to 100 cattle egrets annually. As discussed previously, approximately 59,000 breeding pairs of cattle egrets are found in those Bird Conservation Regions that include portions of Georgia. The lethal take of up to 100 cattle egrets by WS would represent 0.09% of the breeding population in those Bird Conservation Regions that include portions of Georgia.

Table 3.9 – Cattle egrets addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	27	93
2018	13	196
2019	75	344
2020	73	555
2021	5	321

From 2016 through 2019, other entities reported to the USFWS the lethal take of an average of 43 cattle egrets per year, with the highest reported take occurring in 2019 when other entities reported the take of 74 cattle egrets. If other entities take 43 cattle egrets per year in Georgia and WS take reached 100 cattle egrets, the cumulative take of 143 cattle egrets would represent 0.1% of the population in those Bird Conservation Regions that include portions of Georgia estimated at 118,000 cattle egrets (59,000 breeding pairs). If the lethal take of cattle egrets in Georgia by other entities reached 74 cattle egrets per year and WS take reached 100 cattle egrets, the cumulative take would represent 0.2% of the population estimated at 118,000 cattle egrets.

The take of cattle egrets can only occur when authorized by the USFWS pursuant to the MBTA. Therefore, the take of cattle egrets by WS would only occur when authorized by the USFWS. In addition, the take of cattle egrets by WS would only occur at levels authorized by the USFWS. The permitting of take by the USFWS would ensure the cumulative take of cattle egrets occurred within allowable take levels to achieve desired population objectives for the species.

BLACK-CROWNED NIGHT-HERON POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The black-crowned night-heron nests on every continent except Antarctica and Australia. In North America, black-crowned night-herons nest throughout most of the contiguous United States and south-central Canada (Hothem et al. 2020). Nesting black-crowned night-herons in the United States and Canada migrate southward to winter in the southern United States, Mexico, and the Caribbean. Similar to other heron species, black-crowned night herons feed primarily on fish and are gregarious nesters (Hothem et al. 2020).

In Georgia, black-crowned night-herons nest in the southern half of the state but may occur in other areas of the state during their spring and fall migration (Hothem et al. 2020). In areas of the state surveyed during the BBS, the number of black-crowned night-herons observed has shown a declining trend estimated at -1.0% per year from 1966 through 2019 (Sauer et al. 2019). Hunter et al. (2006) estimated the breeding population in the southeastern United States at 7,333 breeding pairs with a range of 5,000 to 10,000 black-crowned night-herons. The regional population objective was set at 9,000 to 20,000 black-crowned night-herons (Hunter et al. 2006). The breeding population in the Southeastern Coastal Plain, which includes a large portion of Georgia where black-crowned night-herons nest, has been estimated at 1,333 breeding pairs with a population objective of 18,000 breeding pairs (Hunter et al. 2006). The number of black-crowned night-herons observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 2.8% per year from 1970 through 2019 (Meehan et al. 2020). The number of black-crowned night-herons that nest or migrate through Georgia is currently unknown.

From FY 2017 through FY 2021, WS did not receive requests for direct operational assistance involving black-crowned night-herons in Georgia. WS did not receive requests for direct operational assistance to manage damage associated with black-crowned night herons in Georgia during FY 2017 through FY

2021. Similarly, no take of black-crowned night-herons by other entities was reported to the USFWS from 2016 through 2019.

WS anticipates lethally removing up to 50 black-crowned night-herons annually to alleviate damage and threats of damage in Georgia. As was stated earlier, WS anticipated annual take level for each species is not a prescribed take level but is a maximum take level that WS anticipates could occur annually to alleviate damage. No take of black-crowned night-herons would occur by WS in Georgia unless authorized by the USFWS through the issuance of a depredation permit pursuant to the MBTA. Therefore, any take by WS would occur at the discretion of the USFWS in consideration of the take level allowable for the species. The permitting of the take by the USFWS ensures WS take of black-crowned night-herons is below a level that would cause undesirable adverse effects on heron populations in the state.

YELLOW-CROWNED NIGHT-HERON POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Yellow-crowned night-herons nest in forested wetlands, swamps, and bayous throughout portions of the eastern United States (Watts 2020). Nesting normally occurs in small colonies and rarely with other waterbirds. Yellow-crowned night-herons are secretive nesters, and because of its coloring and selection of nest sites in heavy canopy, it is difficult to observe. Its diet consists heavily of crustaceans, both saltwater and freshwater (Watts 2020). Nesting yellow-crowned night-herons in most of the United States migrate southward to winter in Central and South America (Watts 2020).

In Georgia, yellow-crowned night-herons nest in the southern half of the state but may occur nearly statewide during their spring and fall migration (Watts 2020). In areas of the state surveyed during the BBS, the number of yellow-crowned night-herons observed has shown a slight declining trend estimated at -0.3% per year from 1966 through 2019 (Sauer et al. 2019). The breeding population in the Southeastern Coastal Plain, which includes a large portion of Georgia where yellow-crowned night-herons nest, has been estimated at 1,200 breeding pairs with the regional population estimated at 21,300 breeding pairs (Hunter et al. 2006). A population objective for yellow-crowned night-herons in the southeastern United States has been set at 40,000 to 60,000 breeding pairs with 6,000 breeding pairs occurring in the Southeastern Coastal Plain (Hunter et al. 2006). The number of yellow-crowned night-herons observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 8.5% per year from 1970 through 2019 (Meehan et al. 2020).

From FY 2017 through FY 2021, WS only addressed yellow-crowned night-herons to alleviate damage or threats of damage during FY 2017 (see Table 3.10). Because of increased nesting activity near airports in the state, WS anticipates receiving additional requests for assistance to manage threats associated with yellow-crowned night-herons. Based on previous requests for assistance and in anticipation of additional efforts to manage damage and threats associated with yellow-crowned night-herons, WS could lethally remove up to 50 yellow-crowned night-herons annually to alleviate damage and threats of damage.

Table 3.10 – Yellow-crowned night-herons addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	9	18
2018	0	0
2019	0	0
2020	0	0
2021	0	0

If WS lethally removes up to 50 yellow-crowned night-herons to alleviate damage and threats, the take would represent 2.1% of the estimated breeding population in the Southeastern Coastal Plain. From 2016 through 2019, other entities reported lethally removing nine yellow-crowned night-herons in Georgia during 2017. Other entities did not report lethal take of yellow-crowned night-herons during 2016 and from 2018 through 2019. If other entities in Georgia take nine yellow-crowned night herons annually and if WS removal reached 50 yellow-crowned night-herons annually, the average annual take would be 59 yellow-crowned night-herons. The cumulative annual take of 59 yellow-crowned night-herons would represent 2.5% of the estimated breeding population in the Southeastern Coastal Plain. However, the reported take of yellow-crowned night-herons by other entities likely occurred by WS where the take occurred by WS as a sub-permittee under a depredation permit issued to another entity. Given the limited take of yellow-crowned night-herons proposed and the permitting of the take by the USFWS pursuant to the MBTA, the removal of up to 50 yellow-crowned night-herons would not adversely affect populations of yellow-crowned night-herons in the state.

WHITE IBIS POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The white ibis, with its long downcurved bill, white plumage, and gregarious habits, makes it an icon of the freshwater and estuarine wetlands of the southeast United States (Heath et al. 2020). The white ibis feeds primarily on aquatic crustaceans and insects using their decurved bill to probe beneath the surface of the water in soft soil substrate (Heath et al. 2020). Similar to other colonial waterbirds, ibises nest in large nesting colonies primarily in live and dead woody vegetation with nesting occurring along the coast from South Carolina to Florida and extending from Florida to Louisiana. Breeding also occurs along the coastal areas of Mexico and the Caribbean Islands. Non-breeding individuals and groups can also be found further inland along the Gulf Coast of the United States and parts of Mexico (Heath et al. 2020).

In the southeastern United States, the breeding population has been estimated at approximately 150,000 pairs with an objective set between 100,000 and 500,000 pairs (Hunter et al. 2006). Hunter et al. (2006) classified white ibis as a species in need of "*management attention*" at the regional level. Of primary concern are large-scale population shifts that have occurred since the 1930s as breeding birds abandon nesting locations in the region. Overall, the regional population appears to be stable to slightly increasing as birds shift to new breeding locations (Hunter et al. 2006). Other concerns raised by Hunter et al. (2006) were associated with the species close relationship with crawfish and catfish aquaculture production. Population shifts and increases in the overall population in the region could be influenced by the presence and production of aquaculture. If aquaculture production declines for economic reasons, the availability of the artificial food source would also decline, which could induce additional population shifts and lead to overall population declines (Hunter et al. 2006).

Like other colonial waterbirds, the population of white ibises is currently not known in Georgia, but Hunter et al. (2006) estimated the breeding population at 10,000 pairs, which is an overall nesting population estimated at 20,000 white ibis in Georgia. From 1966 through 2019, the number of white ibises observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 0.8% per year (Sauer et al 2020). The number of white ibis observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 4.8% per year from 1970 through 2019 (Meehan et al. 2020).

Table 3.11 shows the number of white ibis lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. Since FY 2017, WS has employed non-lethal hazing methods to disperse white ibis using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. WS also used lethal methods to remove white ibis that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, the lethal take of white ibis by WS occurred from the use of firearms.

Table 3.11 – White ibis addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	146	1,991
2018	0	14
2019	26	229
2020	2	128
2021	4	3

Based on the number of requests received to alleviate damage or threats of damage associated with white ibises, the number of white ibises addressed previously to alleviate those requests, and in anticipation of receiving additional requests for assistance, WS could lethally take up to 300 white ibises annually in Georgia to alleviate damage or threats of damage. Based on a nesting population estimated at 20,000 white ibises in the state, an annual take of up to 300 white ibis by WS would represent 1.5% of the estimated statewide nesting population. However, take is also likely to occur during the winter and migration periods; therefore, the annual take is likely to represent a smaller percentage of the nesting population.

From 2016 through 2019, other entities reported lethally removing an average of 41 white ibis per year in Georgia with the highest annual take occurring in 2017 when other entities lethally removed 137 white ibis. If other entities in Georgia take 41 white ibis annually and if WS removal reached 300 white ibis annually, the average annual take would be 341 white ibis. The cumulative annual take of 341 white ibis would represent 1.7% of the estimated statewide nesting population. If the take by other entities reached 137 white ibis per year, the cumulative take by WS and other entities would represent 2.2% of the estimated nesting population in Georgia.

The take of white ibises by WS would only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA would ensure take by WS and by other entities would occur within allowable levels to achieve the desired population objectives for white ibis in Georgia.

BLACK VULTURE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Historically, black vultures occurred in the southeastern United States along with Texas, parts of Arizona, and Mexico (Buckley et al. 2022). However, black vultures are expanding their range northward in the eastern United States and now occur as far north as Vermont and New Hampshire (Wilbur 1983, Rabenold and Decker 1989, Buckley et al. 2022). In winter, black vultures migrate south from the most northern part of their range but are a locally resident species throughout much of their range (Parmalee and Parmalee 1967, Rabenold and Decker 1989). Black vultures occur in virtually all habitats but are most abundant where forest interrupts open land. Nesting occurs in caves, crevices among rocks, brush piles, thickets, abandoned buildings, and in hollow logs, stumps, and tree trunks (Buckley et al. 2022).

Black vultures are highly social, roosting communally with turkey vultures in trees, electric towers, and other structures (Buckley et al. 2022) where they can cause property damage. Vultures often occupy roosts for many years and in some cases decades (Buckley et al. 2022). The diet of black vultures consists primarily of carrion; however, black vultures can also be predatory, killing and consuming domestic young livestock (pigs, lambs, calves), young birds, mammals, reptiles, and fish (Buckley et al. 2022).

In Georgia, black vultures occur statewide throughout the year (Buckley et al. 2022). According to BBS trend data provided by Sauer et al. (2020), the number of black vultures observed along routes surveyed in the state has increased at an annual rate of 4.1% from 1966 through 2019. Based on BBS data, Partners in Flight (2020) estimated the statewide breeding population at 760,000 black vultures. The number of black vultures observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 3.8% per year (Meehan et al. 2020).

Table 3.12 shows the number of black vultures lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. Since FY 2017, WS has employed non-lethal hazing methods to disperse black vultures using pyrotechnics, effigies, vehicle activity, and the noise associated with the discharge of a firearm. WS also used lethal methods to intentionally remove black vultures that employees identified as causing damage or threats of damage (see Table 3.12). From FY 2017 through FY 2021, the intentional lethal take of black vultures by WS occurred from the use of firearms and euthanasia after live-capture using hand capture, cage traps, and hand nets. Based on previous requests for assistance and in anticipation of additional efforts to address black vultures under Alternative 1, WS could lethally remove up to 3,000 black vultures annually, which includes black vultures that WS could take unintentionally while targeting other animals. If WS annual lethal removal reached 3,000 black vultures, the annual take would represent 0.4% of the estimated breeding population in the state, which Partners in Flight (2020) estimated at 760,000 black vultures.

Table 3.12 – Black vultures addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	6	87
2018	46	267
2019	78	167
2020	33	108
2021	112	728

From 2016 through 2019, other entities reported to the USFWS the average take of 99 black vultures per year in Georgia. If other entities in Georgia take 99 black vultures annually and if WS removal reached 3,000 black vultures annually, the average annual take would be 3,099 black vultures. The cumulative annual take of 3,099 black vultures would represent 0.4% of the estimated statewide breeding population if the population remained at least stable.

The take of black vultures would only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA would ensure take by WS and by other entities would occur within allowable levels to achieve the desired population objectives for black vultures in Georgia.

TURKEY VULTURE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Turkey vultures occur throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenold and Decker 1989, Kirk and Mossman 2020). Turkey vultures prefer areas that include a mix of farmland and forest. Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Kirk and Mossman 2020). 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 feed on a wide range of wild and domestic carrion (Kirk and Mossman 2020).

In Georgia, turkey vultures occur statewide and throughout the year (Kirk and Mossman 2020). From 1966 through 2019, the number of turkey vultures observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 3.6% per year (Sauer et al 2020). Based on BBS data, Partners in Flight (2020) estimated the statewide breeding population at 190,000 turkey vultures. The number of turkey vultures observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 4.6% per year from 1970 through 2019 (Meehan et al. 2020).

Table 3.13 shows the number of turkey vultures lethally removed or dispersed by WS to alleviate damage and threats from FY 2017 through FY 2021. Since FY 2017, WS has employed non-lethal hazing methods to disperse turkey vultures using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. WS also used lethal methods to intentionally remove turkey vultures that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, the intentional lethal take of turkey vultures by WS occurred from the use of firearms and euthanasia after live capture in cage traps and foothold trap.

Table 3.13 – Turkey vultures addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	16	84
2018	28	226
2019	18	99
2020	12	92
2021	46	564

Based on the number of requests received to alleviate damage or threats of damage associated with turkey vultures, the number of turkey vultures addressed previously to alleviate those requests, and in anticipation of receiving additional requests for assistance, WS could lethally take up to 500 turkey vultures annually in Georgia to alleviate damage or threats of damage. Based on a nesting population estimated at 190,000 turkey vultures in the state, an annual take of up to 500 turkey vultures by WS would represent 0.3% of the estimated statewide nesting population.

From 2016 through 2019, other entities reported lethally removing an average of 35 turkey vultures per year in Georgia with the highest annual take occurring in 2018 and 2019 when other entities lethally removed 40 turkey vultures each year. If other entities in Georgia take 35 turkey vultures annually and if WS removal reached 500 turkey vultures annually, the average annual take would be 535 turkey vultures. The cumulative annual take of 535 turkey vultures would represent 0.3% of the estimated statewide nesting population. If the take by other entities reached 40 turkey vultures per year, the cumulative take by WS and other entities would represent 0.3% of the estimated nesting population in Georgia.

The take of turkey vultures by WS would only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of the take by the USFWS pursuant to the MBTA would ensure take by WS and by other entities would occur within allowable levels to achieve the desired population objectives for turkey vultures in Georgia.

OSPREY POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Bierregaard et al. 2020). In North America, osprey nest across Canada, Alaska, the northern United States, and along the coasts. Northern nesting osprey migrate southward to winter along the coast of the southern United States in Central and South America (Bierregaard et al. 2020).

In Georgia, osprey occur primarily along the coastal areas of the state and primarily during the breeding season (Bierregaard et al. 2020). From 1966 through 2019, the number of osprey observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 4.7% per year (Sauer et al 2020). Based on BBS data, Partners in Flight (2020) estimated the statewide breeding population at 2,800 ospreys. The number of ospreys observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 5.7% per year from 1970 through 2019 (Meehan et al. 2020).

From FY 2017 through FY 2021, WS only addressed ospreys in Georgia during FY 2021 when WS dispersed two ospreys from areas where damages or threats of damages were occurring using pyrotechnics. No lethal take of ospreys occurred by WS in Georgia from FY 2017 through FY 2021. WS anticipates addressing ospreys using non-lethal dispersal methods; however, WS could use lethal methods to remove ospreys when non-lethal methods are ineffective or are determined to be inappropriate using WS Decision model. An example could include osprey that pose an immediate strike threat at an airport where attempts to disperse the osprey are ineffective. Based on previous requests for assistance to manage damage associated with osprey and in anticipation of receiving an increasing number of requests for assistance, WS could lethally take up to 10 ospreys annually in the state to alleviate damage.

In addition, WS could destroy up to 10 osprey nests that are associated with damage to structures, including eggs contained within the nest. WS would destroy eggs using addling or by breaking open the eggs. WS would remove nests by hand and/or using hand tools. Egg-laying in osprey occurs from mid-April through late-June with late-April through mid-June being the primary period when eggs are laid. Nestlings may be present in nests from early-June through early-September with the peak occurring from early-June through late-August (Bierregaard et al. 2020). The removal of the nest and eggs would occur in an attempt to cause the osprey to abandon the nest site and to disperse the osprey from the area. The take of active osprey nests, including the removal of osprey eggs, is prohibited by the MBTA unless authorized through the issuance of a depredation permit by the USFWS.

Based on a nesting population estimated at 2,800 ospreys in the state, an annual take of up to 10 ospreys by WS would represent 0.4% of the estimated statewide nesting population. Other entities did not report the take of ospreys in the state from 2016 through 2019. The take of osprey by WS would only occur when permitted and only at levels authorized on depredation permits issued by the USFWS. The limited removal of nests is generally regarded has having minimal impacts on a species' overall population. Based on the limited number of nests that could be removed and the permitting of any removal by the USFWS, the destruction of up to 10 osprey nests and associated eggs have minimal impacts on statewide breeding populations of osprey.

AMERICAN CROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

American crows have a wide range, are extremely abundant, and are found all across the United States and Canada (Verbeek and Caffrey 2021). America crows occur in a variety of habitats, particularly areas with scattered trees and small woodlots. The range and population of American crows expanded as European settlers began clearing forests, planting trees around homesteads in the prairies, and tilling the soil for agricultural production (Verbeek and Caffrey 2021).

American crows occur throughout Georgia and are present throughout the year (Verbeek and Caffrey 2021). From 1966 through 2019, the number of American crows observed along routes surveyed in the state during the BBS has shown an increasing trend estimated at 0.6% annually. However, from 2009 through 2019, the number of American crows observed has shown a decreasing trend estimated at -1.9% per year (Sauer et al. 2019). Based on BBS data, Partners in Flight (2020) estimated the statewide breeding population to be 860,000 American crows. The number of American crows present in Georgia increases each year during the winter migration period as crows that nest farther north spend the winter in the state. The number of American crows observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019 estimated at 0.5% per year (Meehan et al. 2020). Roosts containing a high number of American crows could occur in Georgia during the fall and winter. However, the number of American crows present in a roost varies from roost to roost and from year to year.

Table 3.14 shows the number of American crows lethally removed or dispersed by WS to alleviate damage and threats in Georgia from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed an average of 46 American crows per year in Georgia to manage damage or reduce threats using pyrotechnics, hand tools, vehicle activity, and the noise associated with the discharge of a firearm. WS also used lethal methods to remove American crows that employees identified as causing damage or threats of damage. From FY 2017 through FY 2021, WS lethally removed an average of eight American crows per year in Georgia to alleviate damage or threats of damage. From FY 2017 through FY 2021, the lethal take of American crows by WS occurred from the use of firearms.

Table 3.14 – American crows addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	6	15
2018	16	39
2019	6	7
2020	1	0
2021	12	168

Based on the number of requests received to alleviate damage or threats of damage caused by American crows and the number of American crows addressed previously to alleviate those requests, WS anticipates that personnel could lethally take up to 200 American crows annually in Georgia to alleviate damage or threats of damage. When using the Compound DRC-1339 Concentrate – Bird Control (EPA Reg. No. 56228-63) label or the Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder Depredation label to take American crows, WS would calculate take estimates using the Take Estimation Program developed by the National Wildlife Research Center. The Take Estimation Program includes inputs for meteorological and environmental conditions, such as ambient temperature, cloud cover, and wind, which influence bird feeding rates and DRC-1339 mortality (Homan et al. 2005, Homan et al. 2011, Homan et al. 2013). Bioenergetics models do not require a numerical estimate of size of the targeted population, which avoids the bias, high variance, and chance events that decrease precision and accuracy of counting blackbirds, crows, and starlings at roosts or at bait sites (Faanes and Bystrak 1981). For additional information on the bioenergetics model that WS would use to estimate crow, blackbird, and starling mortality, see Homan et al. (2005), Homan et al. (2011), Homan et al. (2013), and Stahl et al. (2016).

Based on the estimated breeding population in the state, an annual take of up to 200 American crows by WS would represent 0.02% of the estimated 860,000 breeding American crows in Georgia. However, most take by WS would occur during the fall and winter when the number of American crows present in the state is likely higher as they migrate to the state. The number of American crows present in the state during the fall and winter is unknown but is likely higher than the breeding population as American crows that nest farther north arrive in the state. For example, several million American crows have used a communal roost location in southwestern Oklahoma (Johnson 1994), which is higher than the estimated statewide breeding population in Oklahoma. WS would continue to address damage associated with American crows using non-lethal dispersal methods; however, if deemed appropriate using the WS Decision Model, WS personnel could employ lethal methods.

As discussed previously, people can take American crows without a depredation permit from the USFWS under a depredation order (see 50 CFR 21.150). Pursuant to the depredation order, the USFWS requires that people report the number of American crows they take each year. From 2016 through 2019, other entities in Georgia reported to the USFWS the average lethal take of five American crows per year. If other entities take an average of five American crows per year and WS take reached 200 American crows, the cumulative take of 205 American crows would represent 0.02% of the estimated breeding population in the state.

It is unknown whether the reported take accurately reflects the actual take because it is likely that some take of American crows pursuant to the depredation order goes unreported. The number of American crows lethally removed by private individuals to alleviate damage is likely minimal because the primary method that people use to alleviate damage is shooting, which has limitations for killing crows. Private individuals use firearms primarily as a form of hazing rather than to remove crows, despite some limited take likely occurring. The continued take of American crows by other entities pursuant to the depredation order is likely to be a small contributor to the cumulative take of American crows annually. Although some take is likely to occur, WS does not expect take to reach a high magnitude.

In addition, people can hunt American crows during an annual hunting season in Georgia. In 2022, people could harvest American crows in the state from early November through the end of February. During the hunting season, the GDNR placed no limit on the number of American crows that people can shoot (GDNR 2023). Hunters harvesting crows during the annual hunting season are not required to report the number of American crows they harvest to the USFWS or the GDNR; therefore, the actual harvest of crows is unknown. The number of crows that people harvest annually in Georgia in unknown. Given the relative abundance of American crows in Georgia and the long-term stable to increasing population trends observed, the take of crows by other entities to alleviate damage or threats of damage and the take of crows during the annual hunting season is likely of low magnitude.

BARN SWALLOW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Barn swallows are one of the most abundant and widespread of the swallow species. Breeding populations occur throughout North America, Europe, and Asia with wintering populations present in Central and South America, southern Spain, Morocco, Egypt, Africa, the Middle East, India, Indochina, Malaysia, and Australia (Brown and Brown 2020). They feed almost exclusively on flying insects at all times of the year and are very distinguishable by their sharp turns and diving flight patterns used to catch prey (Brown and Brown 2020). They build their cup-shaped mud nests almost exclusively on human-made structures.

In Georgia, barn swallows occur statewide during the breeding season and spring and fall migration periods. Along routes surveyed in the state during the BBS, the number of barn swallows observed has shown an increasing trend estimated at 2.9% annually from 1966 through 2019. Partners in Flight (2020) estimated the breeding population in the state to be 750,000 barn swallows. Barn swallows migrate south after the breeding season and are not observed in those areas surveyed in the state during the CBC (Meehan et al. 2020).

Table 3.15 shows the number of barn swallows addressed by WS to alleviate damage from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS used non-lethal methods to disperse barn swallows, including pyrotechnics and the noise associated with the discharge of a firearm. In addition, WS used firearms to take barn swallows from FY 2017 through FY 2021. Based on the colonial nesting behavior of barn swallows, WS could lethally remove up to 200 barn swallows annually in Georgia to alleviate damage and supplement non-lethal hazing methods. An annual take by WS of up to 200 barn swallows would represent 0.03% of the estimated statewide breeding population of 750,000 barn swallows.

Table 3.15 – Barn swallows addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	0	0
2018	0	0
2019	0	30
2020	5	17
2021	1	273

When receiving a request for assistance involving barn swallow nests, WS would work with entities to identify projects, such as bridge maintenance or removal, prior to the breeding season. Therefore, WS personnel or other entities could monitor those sites and remove any barn swallow nests as swallows construct the nests before they become active nests requiring a depredation permit to remove. In addition, WS personnel and/or other entities would monitor nesting sites until the end of the breeding season or until the completion of projects to ensure re-nesting does not re-occur and if re-nesting does occur, that WS personnel remove those inactive nests prior to the laying of eggs. If swallows disperse from the location after the initial nest removal early in the nesting season, re-nesting is likely to occur in other locations. Through monitoring and communication, WS and the cooperating entity can minimize the need to address active nests containing eggs and/or nestlings.

If WS receive a request to address barn swallow nests on bridges or other structures, WS personnel would monitor for nest building activity and would remove nests with high-pressured washers and/or by hand. Therefore, nests would primarily be inactive (no eggs or nestlings); however, some take of active nests could occur. The intent of removing barn swallow nests at the onset of nest construction is to disperse the barn swallows. If dispersal occurs early, re-nesting in other areas is likely. Those birds would likely disperse to other areas to nest when faced with repeated nest failures. WS does not expect the removal of inactive nests and the dispersal of adult barn swallows to have any adverse effects on local populations because no lethal take from nest removal or dispersal activities would occur. The take of barn swallows by WS, including the take of active nests 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.

The USFWS did not receive reports of other entities taking barn swallows in the state from 2016 through 2019. Like many other bird species, the take of barn swallows by WS to alleviate damage could only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits, including the removal of active nests. In addition, the take of barn swallows, including the take of active nests, would only occur at levels permitted by the USFWS. Therefore, the USFWS would have the opportunity to consider cumulative take by all entities to achieve the desired population management levels for barn swallows in Georgia.

CLIFF SWALLOW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Cliff swallows nest across most of North America, except the extreme Arctic region and the extreme southeastern United States (Brown et al. 2020). Cliff swallows build nests in colonies on cliff sides, building eaves, bridges, highway culverts, dams, or large trees. They spend their winters in South America. Historically, cliff swallows were associated with the mountain ranges in western North America. However, the construction of highway culverts, bridges, and buildings have facilitated the range expansion of cliff swallows into the eastern United States and southern Canada (Brown et al. 2020)

Cliff swallows are present in Georgia during the migration periods (Brown et al. 2020) but their presence in the state during the breeding season appears to be increasing. In Georgia, the number of cliff swallows observed along routes surveyed during the BBS has shown an annual increase of 17.6% per year from 1966 through 2019 (Sauer et al. 2019). Using data from the BBS, Partners in Flight (2020) estimated the breeding population in Georgia to be 140,000 cliff swallows. In addition, cliff swallows migrate through Georgia during the spring and fall as they move between their nesting and wintering areas. However, the number of cliff swallows that migrate through Georgia is unknown. Because cliff swallows are not present in Georgia during those periods when the CBC is conducted, trend data for cliff swallows from the CBC is not available.

From FY 2017 through FY 2021, WS only addressed cliff swallows during FY 2021 when WS lethally removed two cliff swallows to alleviate damage in Georgia. Based on the colonial nesting behavior of cliff swallows and in anticipation of receiving requests associated with nesting activities, WS could lethally remove up to 300 cliff swallows annually in the state to alleviate damage and to supplement non-lethal harassment methods. The lethal removal of up to 300 cliff swallows by WS would represent 0.2% of the breeding population in the state estimated at 140,000 cliff swallows.

As discussed previously, when receiving a request for assistance regarding nests, WS would work with entities to identify projects, such as bridge maintenance or removal, prior to the breeding season where swallows could nest. Therefore, WS personnel or other entities could monitor those sites and remove any cliff swallow nests as swallows construct the nests before they become active nests requiring a depredation permit to remove. In addition, WS personnel and/or other entities would monitor nesting sites until the end of the breeding season or until the completion of projects to ensure re-nesting does not re-occur and if re-nesting does occur, that WS personnel remove those inactive nests prior to the laying of eggs. If swallows disperse from the location after the initial nest removal early in the nesting season, re-nesting is likely to occur in other locations. Through monitoring and communication, WS and the cooperating entity can minimize the need to address active nests containing eggs and/or nestlings.

If WS receive a request to address cliff swallow nests on bridges or other structures, WS personnel would monitor for nest building activity and would remove nests with high-pressured washers and/or by hand. Therefore, nests would primarily be inactive (no eggs or nestlings); however, some take of active nests could occur. The intent of removing cliff swallow nests at the onset of nest construction is to disperse the cliff swallows. If dispersal occurs early, re-nesting in other areas is likely. Those birds would likely disperse to other areas to nest when faced with repeated nest failures. WS does not expect the removal of inactive nests and the dispersal of adult cliff swallows to have any adverse effects on local populations because no lethal take from nest removal or dispersal activities would occur. The take of cliff swallows by WS, including the take of active nests 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.

Other entities could also take cliff swallows in Georgia to alleviate damage. However, from 2016 through 2019, other entities did not report the lethal removal of cliff swallows in the state. As discussed in Section 1.5.1, the USFWS is responsible for managing migratory bird species pursuant to the MBTA, including cliff swallows. Through the issuance of depredation permits, the USFWS would have the opportunity to consider WS take and take by all entities to achieve the desired population objectives for cliff swallows in the state.

EUROPEAN STARLING POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

As their common name implies, European starlings are native to Europe. Colonization of North America by the European starling began in 1890 when a person with good intentions released 80 starlings into Central Park within New York City. The released birds were able to exploit the resources in the area and have since spread throughout the continent. 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. Continued westward expansion had occurred by 1941 with populations expanding from Idaho to New Mexico. 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. After 80 years from the initial introduction, the starling had become one of the most common birds in North America (Feare 1984, Cabe 2020).

As their range expansion in North America demonstrates, European starlings are highly adaptable and thrive in a wide range of habitats; however, they are most often associated with disturbed areas created by people (Homan et al. 2017, Cabe 2020). Their diet consists of insects, fruits, berries, seeds, and spilled grain. European starlings are highly social birds; feeding, roosting, and migrating in flocks at all times of the year. European starlings are aggressive cavity nesters that can evict native cavity nesting species (Homan et al. 2017, Cabe 2020). In the absence of natural cavities, European starlings will nest in structures, such as exhaust vents, soffits, streetlights, mailboxes, and attics. Although few conclusive studies exist, evidence suggests European starlings can have a detrimental effect on native species (Homan et al. 2017, Cabe 2020).

In Georgia, European starlings occur statewide and throughout the year (Cabe 2020). From 1966 through 2019, the number of starlings observed along routes surveyed during the BBS has shown a decreasing trend in the state estimated at -1.9% annually. Using data from the BBS, Partners in Flight (2020) estimated the statewide breeding population at 690,000 European starlings. From 1970 through 2019, the number of starlings observed in those areas of the state surveyed during the CBC has shown a declining trend estimated at -1.7% per year (Meehan et al. 2020).

Table 3.16 shows the number of European starlings lethally removed or dispersed in Georgia by WS to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed European starlings using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. WS also lethally removed European starlings using firearms from FY 2017 through FY 2021. Based on previous requests for assistance, the likelihood of European starlings to occur in large flocks, and in anticipation of additional efforts to address requests associated with European starlings, WS could lethally remove up to 10,000 European starlings annually in Georgia. If WS used the Compound DRC-1339 Concentrate – Bird Control (EPA Reg. No. 56228-63) label to take European starlings and other blackbird species, WS would calculate take estimates using the Take Estimation Program developed by the National Wildlife Research Center, as discussed previously.

Table 3.16 – European starlings addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	25	0
2018	108	1,305
2019	19	110
2020	35	800
2021	85	1,167

The take of 10,000 European starlings would represent 1.5% of the estimated breeding population in Georgia. However, most requests to address large roosts occur during migration periods and during the winter when the population may increase above the 690,000 European 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. Homan et al. (2017) indicated that annual mortality of European starlings ranges from 40% to 50% and could vary from 30% to 80% depending on location and weather conditions.

An estimated 60 to 75 million European starlings die from natural causes each year in North America (Homan et al. 2017). Causes of mortality include disease, predation, and starvation, but none of those activities likely regulates the population of European starlings (Homan et al. 2017). Homan et al. (2017) indicated the major factor limiting the European starling population was the availability of nest sites. The annual lethal removal of European starlings by the national WS program, including those European starlings lethally removed annually in Georgia, are a small percentage of the number of European starlings that die from natural causes (Homan et al. 2017).

Because European starlings are a non-native species in North America, the MBTA does not afford European starlings protection from take. A depredation permit from the USFWS is not required for people to take European starlings and there are no requirements to report the take of European starlings to the USFWS; therefore, the number of European starlings that other entities lethally remove in Georgia is unknown.

Pursuant to Executive Order 13112 and Executive Order 13751, the National Invasive Species Council has designated the European starling as meeting the definition of an invasive species. Lowe et al. (2000) ranked the European starling as one of the 100 worst invasive species in the world. Activities associated with European starlings would occur pursuant to Executive Order 13112 and Executive Order 13751, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damage.

AMERICAN ROBIN POPULATION – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The American robin is the largest, most abundant, and most widespread North American thrush (Vanderhoff et al. 2020). The conspicuous nature of the American robin and their close association with human habitation, make the robin one of the most recognizable birds in the United States (Vanderhoff et al. 2020). Robins are often the harbinger of spring in many parts of the northern latitudes of North America, but they can occur throughout the year in Georgia (Vanderhoff et al. 2020).

From 1966 through 2019, the number of American robins observed in Georgia along BBS routes has shown a slightly increasing trend estimated at 0.1% per year (Sauer et al. 2019). Partners in Flight (2020) estimated the breeding population in Georgia to be 880,000 American robins based on BBS data. The number of American robins observed in areas of Georgia surveyed during the CBC has shown an increasing trend estimated at 0.7% per year from 1970 through 2019 (Meehan et al. 2020).

From FY 2017 through FY 2021, WS only addressed American robins during FY 2020. During FY 2020, WS lethally removed one American robin using a firearm and dispersed 79 American robins using pyrotechnics and the noise associated with the discharge of a firearm. During the winter, American robins often occur in large flocks and roost together in larger numbers. Based on the flocking behavior of American robins, WS anticipates lethally removing up to 200 American robins annually to alleviate damage or reduce threats in the state. Although WS could address American robins during the breeding season, most activities would occur during the migration periods when American robins occur in large flocks. The take of 200 American robins by WS would represent 0.02% of the estimated breeding population within Georgia.

The USFWS did not receive reports of other entities taking American robins in the state from 2016 through 2019. The take of American robins by WS would only occur after the USFWS issued permits to WS allowing the take to occur. In addition, take would only occur at levels the USFWS allowed in those permits. Therefore, the cumulative take of American robins in the state would occur at the discretion of the USFWS. The USFWS would have the opportunity to restrict take to meet desired population objectives.

HOUSE SPARROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

People introduced house sparrows to North America from England in the 1850s and the species has since spread throughout the continent (Fitzwater 1994, Lowther and Cink 2020). House sparrows occur in nearly every habitat, except dense forests, alpine areas, grasslands, and desert environments. They prefer human-altered habitats and are abundant on farms and in cities and suburbs (Lowther and Cink 2020). House sparrows are not migratory in North America and are year-round residents wherever they occur, including those house sparrows found in Georgia (Lowther and Cink 2020). Nesting locations often occur in areas of human activities and house sparrows are considered "*...fairly gregarious at all times of year*" with nesting occurring in small colonies or clumped distribution (Lowther and Cink 2020). Large flocks of sparrows can also occur in the winter as birds forage and roost together.

Partners in Flight (2020) estimated the breeding population in Georgia to be 270,000 house sparrows. In Georgia, the number of house sparrows observed in areas surveyed during the BBS has shown a downward trend estimated at -5.0% annually since 1966. From 2009 through 2019, the number of house sparrows observed along BBS routes in the state has also shown a declining trend estimated at -6.0% annually (Sauer et al. 2019). From 1970 through 2019, the number of house sparrows observed annually in areas of Georgia surveyed during the CBC has shown a declining trend estimated at -4.8% per year (Meehan et al. 2020). Robbins (1973) suggested that declines in the house sparrow population were occurring because of changes in farming practices, which result in cleaner operations with little waste grain. One aspect of changing farming practices that might be a factor is 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.

Table 3.17 shows the number of house sparrows lethally removed or dispersed in Georgia by WS to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed house sparrows using the noise associated with the discharge of a firearm. WS also lethally removed house sparrows using firearms from FY 2017 through FY 2021. Based on the likelihood of house sparrows occurring in flocks and in anticipation of additional efforts to address requests associated with house sparrows, WS could lethally remove up to 300 house sparrows annually in Georgia.

Table 3.17 – House sparrow addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	5	8

Because the MBTA does not afford house sparrows protection from take, a depredation permit from the USFWS is not required for people to take house sparrows and there are no requirements to report the take of house sparrows to the USFWS; therefore, the number of house sparrows that other entities lethally remove in the state is unknown. If WS lethally removed up to 300 house sparrows annually in the state, the take would represent 0.1% of the estimated statewide breeding population in Georgia. House sparrows are non-indigenous and often have negative effects on native birds, primarily through competition for nesting sites; therefore, many wildlife biologists and ornithologists consider sparrows to be an undesirable component of North American wild and native ecosystems. Any reduction in house sparrow populations in North America could provide some benefit to native bird species by reducing competition for resources. WS take of house sparrows to reduce damage and threats would comply with Executive Order 13112 and Executive Order 13751.

EASTERN MEADOWLARK POPULATION – DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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. 2022). Eastern meadowlarks occur throughout the eastern United States, but their range can be highly dependent on habitat availability. Eastern meadowlarks are associated with grassy fields, pastures, cultivated areas, groves, open pinewoods, and prairies (Jaster et al. 2022).

In Georgia, eastern meadowlarks occur throughout the year in the open, grassy areas of the state where they feed primarily on invertebrates and some plant material, such as weed seeds, grains, and some fruits (Jaster et al. 2022). The number of eastern meadowlarks observed along routes surveyed in Georgia during the BBS has shown a declining trend estimated at -4.2% annually from 1966 through 2019 (Sauer et al. 2019). Partners in Flight (2020) estimated the statewide breeding population at 240,000 eastern meadowlarks. From 1970 through 2019, CBC data shows a general decreasing trend for eastern meadowlarks in Georgia estimated at -4.2% per year (Meehan et al. 2020).

Table 3.18 shows the number of eastern meadowlarks addressed by WS in Georgia to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed eastern meadowlarks in Georgia using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. From FY 2017 through FY 2021, the lethal take of eastern meadowlarks in Georgia by WS occurred from the use of firearms. Based on previous requests for assistance, WS could lethally remove up to 200 eastern meadowlarks annually.

Table 3.18 – Eastern meadowlarks addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	43	26
2018	20	32
2019	4	37
2020	0	0
2021	9	348

WS would continue to use non-lethal hazing methods to address eastern meadowlarks, with lethal methods employed to reinforce the use of non-lethal methods to prevent habituation. Based on the estimated statewide breeding population of 240,000 eastern meadowlarks, WS take of up to 200 eastern meadowlarks would represent 0.08% of the estimated breeding population in Georgia.

Other entities have also reported to the USFWS the take of eastern meadowlarks in Georgia. From 2016 through 2019, other entities have reported to the USFWS an average lethal take of 19 eastern meadowlarks per year with the highest reported take occurring in 2016 when other entities reported the take of 38 eastern meadowlarks. If other entities take 19 eastern meadowlarks per year and WS take reached 200 eastern meadowlarks, the cumulative take of 219 eastern meadowlarks would represent 0.09% of a population estimated at 240,000 eastern meadowlarks. If lethal take by other entities reached 38 eastern meadowlarks per year and WS take reached 200 eastern meadowlarks, the cumulative take would represent 0.1% of the population estimated at 240,000 eastern meadowlarks.

The take of eastern meadowlarks to alleviate damage or threats would not likely reach a magnitude where adverse effects to the eastern meadowlark population would occur. The declining trends associated with the BBS and the CBC surveys are likely associated with habitat loss across the range of the eastern meadowlark (Jaster et al. 2022). The International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as a species that is "*near threatened*" (BirdLife International 2020). The International Union for Conservation of Nature and Natural Resources assigned the ranking based on a rapidly declining population trend in North America (BirdLife International 2020). Although the International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as "*near threatened,*" the USFWS has not classified the eastern meadowlark as an endangered or threatened species pursuant to the ESA. The permitting of the take by the USFWS through the issuance of depredation permits pursuant to the MBTA ensures the USFWS has the opportunity to consider the cumulative take of eastern meadowlarks as part of population management objectives for the species.

RED-WINGED BLACKBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The red-winged blackbird is one of the most abundant bird species in North America and is a commonly recognized bird that occurs in a variety of habitats (Yasukawa and Searcy 2020). 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 2020). Red-winged blackbirds are primarily associated with emergent vegetation in freshwater wetlands and upland habitats during the breeding season and will nest in marsh vegetation, roadside ditches, saltwater marshes, rice paddies, hay fields, pastureland, fallow fields, suburban habitats, and urban parks (Yasukawa and Searcy 2020).

In Georgia, red-winged blackbirds are present in the state throughout the year (Yasukawa and Searcy 2020). The number of red-winged blackbirds observed along routes surveyed in the state during the BBS has shown a declining trend estimated at -2.3% annually from 1966 through 2019. Partners in Flight (2020) estimated the current statewide breeding population at 630,000 red-winged blackbirds. From 1970 through 2019, the number of red-winged blackbirds observed in areas of the state surveyed during the CBC is showing a declining trend estimated at -0.9% per year (Meehan et al. 2020).

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, including Georgia (Yasukawa and Searcy 2020). The fall migration period for red-winged blackbirds generally occurs from early October through mid-December, with the peak occurring from mid-October through early December (Yasukawa and Searcy 2020). Migratory red-winged blackbirds are present in their wintering areas until departing on their spring migration from mid-February through mid-May, with the peak occurring from late February through late April (Yasukawa and Searcy 2020). During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species. Therefore, the number of blackbirds, including red-winged blackbirds, increases substantially in the state as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations (Meanley et al. 1966). Like other blackbirds, nothing visual would distinguish red-winged blackbirds that were from the local breeding population and those red-winged blackbirds that migrate into the state from other areas.

Table 3.19 shows the number of red-winged blackbirds addressed by WS in Georgia to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed red-winged blackbirds in Georgia using pyrotechnics, vehicle activity, hand tools, and the noise associated with the discharge of a firearm. From FY 2017 through FY 2021, the lethal take of red-winged blackbirds in

Georgia by WS occurred from the use of firearms. Based on previous requests for assistance, WS could lethally remove up to 200 red-winged blackbirds annually.

Table 3.19 – Red-winged blackbirds addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	1	0
2018	62	168
2019	11	34
2020	1	32
2021	50	578

With an estimated statewide breeding population of 630,000 red-winged blackbirds, the take of 200 red-winged blackbirds annually would represent 0.03% of the breeding red-winged blackbird population in Georgia. However, most activities associated with red-winged blackbirds would occur when large concentrations of red-winged blackbird are present in the winter. Therefore, the take of up to 200 red-winged blackbirds would likely represent a much smaller percentage of the statewide breeding population. The number of red-winged blackbirds that winter in the state is unknown and likely fluctuates throughout the year and from year to year.

Other entities have also reported to the USFWS the take of red-winged blackbirds in Georgia. From 2016 through 2019, other entities have reported to the USFWS an average lethal take of 17 red-winged blackbirds per year with the highest reported take occurring in 2018 when other entities reported the take of 46 red-winged blackbirds. If other entities take 17 red-winged blackbirds per year and WS take reached 200 red-winged blackbirds, the cumulative take of 217 red-winged blackbirds would represent 0.03% of a population estimated at 630,000 red-winged blackbirds. If lethal take by other entities reached 46 red-winged blackbirds per year and WS take reached 200 red-winged blackbirds, the cumulative take would represent 0.04% of the population estimated at 630,000 red-winged blackbirds.

BROWN-HEADED COWBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Brown-headed cowbirds are another species commonly found in mixed-species flocks of blackbirds during migration periods. Breeding populations of brown-headed cowbirds in the northern portion of their breeding range are migratory with cowbirds present throughout the year in much of the eastern United States and along the West Coast (Lowther 2020). Brown-headed cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 2020). Brown-headed cowbirds still commonly occur in open grassland habitats but also inhabit urban and residential areas.

Brown-headed cowbirds occur statewide in Georgia and are present in the state throughout the year (Lowther 2020). The number of brown-headed cowbirds observed in areas of Georgia surveyed during the BBS has shown an increasing trend estimated at 1.4% annually from 1966 through 2019. Partners in Flight (2020) estimated the statewide breeding population at 1.1 million brown-headed cowbirds based on data from the BBS. The number of brown-headed cowbirds observed in areas of Georgia surveyed during the CBC has shown a decreasing trend estimated at -0.5% per year (Meehan et al. 2020).

Table 3.20 shows the number of brown-headed cowbirds addressed by WS in Georgia to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed brown-headed cowbirds in Georgia using pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. From FY 2017 through FY 2021, the lethal take of brown-headed cowbirds in

Georgia by WS occurred from the use of firearms. Based on previous requests for assistance, WS could lethally remove up to 100 brown-headed cowbirds annually.

Table 3.20 – Brown-headed cowbirds addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	0	0
2018	38	1,200
2019	0	0
2020	4	200
2021	2	0

With an estimated statewide breeding population of 1.1 million brown-headed cowbirds, the take of 100 brown-headed cowbirds annually would represent 0.01% of the breeding brown-headed cowbird population in Georgia. However, most activities associated with brown-headed cowbirds occur when large concentrations of cowbirds are present in the winter. Therefore, the take up of up 100 brown-headed cowbirds would likely represent a much smaller percentage of the statewide breeding population. The number of brown-headed cowbirds that winter in the state is unknown and likely fluctuates throughout the year and from year to year.

Other entities have also reported to the USFWS the take of brown-headed cowbirds in Georgia. From 2016 through 2019, other entities reported to the USFWS the take of 36 brown-headed cowbirds in 2018. If other entities take 36 brown-headed cowbirds per year and WS take reached 100 brown-headed cowbirds, the cumulative take of 136 brown-headed cowbirds would represent 0.01% of a population estimated at 1.1 million brown-headed cowbirds. Like other blackbird species, take of brown-headed cowbirds is likely to occur during the migration periods when large numbers of brown-headed cowbirds are present in the state. The numbers of blackbirds present in the state likely increases as migratory blackbirds begin arriving in the state during the fall and winter.

COMMON GRACKLE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Common grackles are a semi-colonial nesting species often associated with urban and residential environments (Peer and Bollinger 2020). The breeding range of the common grackle includes Canada and the contiguous United States east of the Rocky Mountains, with common grackles found throughout the year in the United States except for the far northern and western portion of the species' range (Peer and Bollinger 2020). 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. The planting of trees in residential areas has also likely led to expansion of the species range into the western United States (Peer and Bollinger 2020).

The common 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 (Peer and Bollinger 2020). During the migration periods, common grackles can occur in mixed species flocks of blackbirds and are commonly seen foraging and roosting in flocks with other blackbird species (Peer and Bollinger 2020). Common grackles occur statewide and are present throughout the year in Georgia (Peer and Bollinger 2020). Large numbers of nesting common grackles can occur in open woodlands, swamps, marshes, pine forests, hammocks, and suburban areas.

Partners in Flight (2020) estimated the breeding population in Georgia at 780,000 common grackles. The number of common grackles observed along BBS routes surveyed in the state has shown a downward trend from 1966 through 2019 estimated at -3.2% annually. From 1970 through 2019, the number of common grackles observed in areas of the state surveyed during the CBC has shown a decreasing trend estimated at -2.1% per year (Meehan et al. 2020).

Table 3.21 shows the number of brown-headed cowbirds addressed by WS in Georgia to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed common grackles in Georgia using pyrotechnics and the noise associated with the discharge of a firearm. From FY 2017 through FY 2021, the lethal take of common grackles in Georgia by WS occurred from the use of firearms. Based on previous requests for assistance, WS could lethally remove up to 100 common grackles annually.

Table 3.21 – Common grackles addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	3	7
2018	3	0
2019	0	800
2020	9	0
2021	37	800

The take of up to 100 common grackles would represent 0.01% of the estimated breeding population in Georgia. Similar to other blackbird species, most activities associated with common grackles occur when large concentrations of grackles are present in the winter. Therefore, the take up of up 100 common grackles would likely represent a much smaller percentage of the statewide breeding population. The number of common grackles that winter in the state is unknown and likely fluctuates throughout the year and from year to year.

Other entities have also reported to the USFWS the take of common grackles in Georgia. From 2016 through 2019, other entities reported to the USFWS the take of three common grackles in 2017 and two common grackles in 2018. If other entities take three common grackles per year and WS take reached 100 common grackles, the cumulative take of 103 common grackles would represent 0.01% of a population estimated at 780,000 common grackles. Like other blackbird species, take of common grackles is likely to occur during the migration periods when large numbers of common grackles are present in the state. The numbers of blackbirds present in the state likely increases as migratory blackbirds begin arriving in the state during the fall and winter.

BOAT-TAILED GRACKLE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The boat-tailed grackle is a coastal species, residing from the Gulf coast of Texas to the coasts of the eastern United States, as far north as Long Island. It seldom resides far inland, except in Florida, where it is widespread across the peninsula. In Georgia, boat-tailed grackles are primarily residents of the coastal marshes (Post et al. 2020). They build their nests in colonies between stalks of marsh vegetation, in bushes, such as mangrove, or in the top branches of trees that grow on the cheniers (Lowery 1981, Post et al. 2020). Based on banding data, boat-tailed grackle populations are relatively sedentary, with little movement during the traditional fall and spring migration periods, except for breeding populations along the northern Atlantic coast that tend to move southward along the coast during the fall migration period (Post et al. 2020). Overall, winter movements are "*poorly understood*", but may be related to the availability of food during the winter (Post et al. 2020).

In Georgia, the number of boat-tailed grackles observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 3.9% per year from 1966 through 2019 (Sauer et al. 2019). Partners in Flight (2020) estimated the breeding population to be 28,000 boat-tailed grackles in Georgia.

From 1970 through 2019, the number of boat-tailed/great-tailed grackles observed in areas of the state surveyed during the CBC showed a general declining trend estimated at -0.2% per year (Meehan et al. 2020)[12].

Table 3.22 shows the number of boat-tailed grackles addressed by WS in Georgia to alleviate damage and threats from FY 2017 through FY 2021. From FY 2017 through FY 2021, WS dispersed boat-tailed grackles in Georgia using pyrotechnics, hand tools, vehicle activity, and the noise associated with the discharge of a firearm. From FY 2017 through FY 2021, the lethal take of boat-tailed grackles in Georgia by WS occurred from the use of firearms. Based on previous requests for assistance, WS could lethally remove up to 100 boat-tailed grackles annually.

Table 3.22 – Boat-tailed grackles addressed by WS in Georgia, FY 2017 - FY 2021

Fiscal Year	Lethal Take	Dispersed
2017	1	0
2018	13	0
2019	0	0
2020	11	0
2021	18	368

The take of up to 100 boat-tailed grackles would represent 0.4% of the estimated breeding population in Georgia. The USFWS did not receive reports of other entities taking boat-tailed grackles in the state from 2016 through 2019. WS expects the take of boat-tailed grackles by other entities to be of low magnitude when compared to the statewide estimated breeding population for Georgia.

ADDITIONAL TARGET BIRD SPECIES

WS has addressed limited numbers of additional target bird species previously or WS anticipates addressing a limited number of additional bird species if WS implements Alternative 1. 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 individuals. WS anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. If WS implements Alternative 1, WS could receive requests for assistance to use lethal methods to remove some of those bird 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[13]. Appendix E also addresses the potential impacts associated with implementing Alternative 1 on the populations of those species.

AVIAN DISEASE SURVEILLANCE AND MONITORING

As part of disease monitoring and surveillance, WS could collect samples from birds. Examples of strategies for collecting samples in birds that WS could implement include investigating sick/dead birds, conducting surveillance in live wild birds, conducting surveillance of hunter-harvested birds, and/or conducting environmental sampling. Implementation of those sampling strategies to detect or monitor avian diseases would not adversely affect avian populations in the state. For example, the sampling (*e.g.*, drawing blood, feather sample, fecal sample) and the subsequent release of live-captured birds would not

[12]The Meehan et al. (2020) currently combines the CBC trend estimate for the boat-tailed grackle and the great-tailed grackle.

[13]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.

result in adverse effects because WS personnel would release those birds unharmed on site. In addition, collecting samples from birds that were sick, dying, or harvested by hunters would not result in the additive lethal take of birds that would not have already occurred in the absence of sampling. Therefore, sampling birds for pathogens would not adversely affect the populations of any of the birds addressed in this EA nor would sampling result in any take of birds that would not have already occurred in the absence of sampling (*e.g.*, hunter harvest).

EFFECTS ON THE PUBLIC'S ESTHETIC ENJOYMENT OF BIRDS

Public opinion about the best ways to reduce conflicts between people and animals is highly variable, making the implementation and conduct of damage management programs extremely complex. Some people express concerns that proposed activities could interfere with their enjoyment of recreational activities and their esthetic enjoyment of birds. Another concern is WS activities would result in the loss of esthetic benefits of birds to the public. People generally regard animals as providing economic, recreational, and esthetic benefits (Decker and Goff 1987), and the mere knowledge that animals exist is a positive benefit to many people. Esthetics is the philosophy regarding the nature of beauty, or the appreciation of beauty. Therefore, esthetics is truly subjective depending on what an observer regards as beautiful.

Today, many households have indoor or outdoor pets and some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing animals. Therefore, the public reaction can be variable and mixed to animal damage management because there are numerous philosophical, esthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and animals.

Animal 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 animals exist and contribute to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and may take the form of direct consumptive use (*e.g.*, using parts of or the entire animal) or non-consumptive use (*e.g.*, viewing the animal in nature or in a zoo, photographing) (Decker and Goff 1987). Birds may provide similar benefits to people who enjoy viewing certain bird species and knowing they are part of natural ecosystems.

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and originate from experiences, such as looking at photographs and films of animals, reading about animals, or benefiting from activities or contributions of animals (*e.g.*, 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).

In 2011, the USFWS and the United States Department of Commerce (2011) found over 3 million people participated in wildlife-associated recreation in Georgia, including people that participated in hunting, fishing, and wildlife watching. In total, people spent nearly $4.6 billion on wildlife recreation in Georgia during 2011 (USFWS and the United States Department of Commerce 2011).

Public attitudes toward animals vary considerably. Some people believe that WS should capture and translocate all animals to another area to alleviate damage or threats those animals pose. In some cases, people directly affected by animals strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of animals from specific locations or sites. Some people totally opposed to animal damage management want WS to teach tolerance for damage and threats caused by animals, and that people should never kill animals. Some of the people who oppose removal of animals do so because of human-affectionate bonds with individual animals. Those human-affectionate bonds are similar to attitudes of a pet owner and result in esthetic enjoyment.

In some cases, the presence of overabundant bird species offends people, such as starlings, pigeons, or feral species, such as domestic waterfowl. To such people, those species represent pests that are nuisances, which upset the natural order in ecosystems, and are carriers of diseases transmissible to people or other animals. In those situations, the presence of overabundant species can diminish their overall enjoyment of other animals by what they view as a destructive presence of such species. Offended parties associate the proliferation of overabundant species as a nuisance threat that maintains an unbalanced relationship with natural resources and personal enjoyment of esthetics.

In the wild, few animals in the United States have life spans approaching those of people. Mortality is high among wildlife populations and specific individuals among a species may experience death early in life. Mortality in wildlife populations is a natural occurrence and people who form affectionate bonds with animals experience loss of those animals over time in most instances. A number of professionals in the field of psychology have studied human behavior in response to attachment to pet animals (Gerwolls and Labott 1994, Marks et al. 1994, Zasloff 1996, Ross and Baron-Sorensen 1998, Archer 1999, Meyers 2000). Similar observations are probably applicable to close bonds that could exist between people and wild animals. As observed by researchers in human behavior, normal human responses to loss of loved ones proceed through phases of shock or emotional numbness, sense of loss, grief, acceptance of the loss or what cannot be changed, healing, and acceptance and rebuilding, which leads to resumption of normal lives (Lefrancois 1999). Those people who lose companion animals, or animals for which they may have developed a bond and affection, can proceed through the same phases as with the loss of human companions (Gerwolls and Labott 1994, Boyce 1998, Meyers 2000). However, they usually establish a bond with other individual animals after such losses. Although they may lose the sense of enjoyment and meaning from the association with those animals that die or are no longer accessible, they usually find establishing an association with new individual animals or through other relational activities to be similarly meaningful (Weisman 1991). Through this process of coping with the loss and establishing new affectionate bonds, people may avoid compounding emotional effects resulting from such losses (Lefrancois 1999).

WS only conducts activities on properties where the property owner or property manager signs a work initiation document allowing WS personnel to conduct activities and personnel would only target those birds identified as causing damage or posing a threat of damage. In addition, other birds of the same species would likely continue to be present in the affected area and people would tend to establish new bonds with those remaining birds. In addition, human behavior processes usually result in individuals ultimately returning to normalcy after experiencing the loss of association with a wild animal that an entity removed from a specific location.

Even in the absence of any involvement by WS, other entities could conduct activities to alleviate damage or threats of damage. Because other entities could remove birds causing damage or posing a threat of damage, the involvement of WS in removing those birds would not likely be additive to the number of birds that could be removed in the absence of involvement by WS. In addition, activities that could occur under the alternative approaches by WS would occur on a relatively limited portion of the total area in Georgia, and the portion of various bird species' populations removed would typically be low (see preceding discussion). In localized areas where WS removes a bird or birds, dispersal of birds from adjacent areas typically contributes to repopulation of the area. The amount of time required to repopulate an area would vary and would depend on the level of removal and bird population levels in nearby areas. Those target species addressed in this EA are relatively abundant. As discussed previously, the effects on target bird populations from damage management activities would be relatively low if WS implemented Alternative 1, and opportunities to view, hear, or see evidence of birds would still be available over the majority of land area of the state.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia using only non-lethal methods

If WS implements Alternative 2, WS would only use non-lethal methods to resolve damage or threats of damage associated with target bird species in Georgia. No intentional lethal removal of target bird species would occur by WS. Non-lethal methods generally disperse, exclude, or live-capture birds. Methods intended to disperse birds from areas where they are causing damage or posing a threat of damage are generally visual or auditory deterrents, such as lights, lasers, pyrotechnics, propane cannons, or air horns. Exclusion methods would prevent target bird species from accessing a resource and could disperse those birds to other areas where resources are unprotected. Exclusion methods could include overhead wires, fencing, and netting. WS could also live-capture target bird species and then translocate those birds to appropriate habitat for release. WS could continue to use aircraft and UAVs to survey, monitor, and track birds in Georgia. In addition, WS could use UAVs to haze birds.

DIRECT EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

As discussed for Alternative 1, WS has used non-lethal methods to disperse target bird species. For example, from FY 2017 through FY 2021, WS used non-lethal methods to disperse an average of 302 cattle egrets per year in the state to alleviate damage or threats of damage (see Table 3.9). The intent associated with the use of auditory and visual deterrents is to elicit a flight response by scaring birds from an area where damage is occurring or where damage could occur. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of individual birds or the ability of a bird to survive, especially if the exposure to the stressor was chronic. If stress occurs to a bird from the scaring associated with hazing, the negative effects associated with causing a flight response could be exacerbated by other deleterious stressors already occurring (*e.g.*, disease, food availability). The stress from hazing could negatively affect the health of a bird, interfere with the raising of young, and/or increase energy needs. A similar concern would occur when using exclusion methods, which could prevent birds from accessing a resource (*e.g.*, food source, nesting locations). When using methods to live-capture a bird or birds, injuries or death could occur during the process of capturing a bird. Constantly monitoring and addressing captured birds soon after capture can reduce the likelihood of injuries and death. In addition, making appropriate modifications to live-capture methods can reduce injuries.

The use of non-lethal methods to capture, disperse, or exclude birds would generally have minimal effects on the overall population of a bird species because those methods would not harm individual birds. WS personnel would not employ non-lethal methods over large geographical areas or apply those methods at such an intensity that birds would be unable to access essential resources (*e.g.*, food sources, habitat) for extended durations. The use of UAVs by WS to monitor and/or haze birds would not occur at such frequency or at an intensity level that would adversely affect bird populations. UAVs used by WS would spend a very small amount of time at any location during surveys, tracking, and/or hazing birds. Similarly, the use of aircraft by WS to monitor and/or track birds would not occur at such frequency or at an intensity level that would adversely affect bird populations. Aircraft used by WS would spend a very small amount of time at any location during surveys and/or tracking birds.

WS could also live-capture a limited number of birds and translocate them to appropriate habitat for release. Translocation often occurs during the migration periods when birds are moving between nesting and wintering areas. Translocating birds for release into appropriate habitat would generally have no impacts on a species' population. WS could also attach leg bands or other identifying markers (*e.g.*, patagial tags) for identification purposes to birds after live-capture. Live-capturing and attaching identifying markers would only occur after WS or another entity received the appropriate permits from the USFWS and the United States Geological Survey to attach those identifying markers on birds. In addition, authorization from the GDNR may be required to use leg bands or other markers. When using leg bands, WS would use band sizes indicated in the North American Bird Banding Manual developed by the United States Geological Survey. Because the intent of using identifying markers is to monitor natural movement patterns and to identify individual birds, researchers have designed those methods to allow for natural movements and limit adverse effects on the bird species. 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*".

WS anticipates using leg bands and other identifying markers on a very limited basis because of the time and cost required to live-capture birds. WS would primarily use leg bands in conjunction with the use of translocation. Attaching a leg band to a bird that WS translocated would aid in identifying the bird if it returned to the area where damage was occurring. WS anticipates attaching identifying markers on a limited number of birds.

Overall, the use of non-lethal methods by WS in Georgia to exclude, capture, or haze birds would have no effect on the population of a bird species. WS would not employ non-lethal methods over large geographical areas at such intensity levels that resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Therefore, direct effects that relate to a bird population would not occur by WS from implementation of Alternative 2. WS does not anticipate any cumulative effects to occur associated with WS use of non-lethal methods even when considered with the use of non-lethal by other entities. Although non-lethal methods can elicit a flight response or exclude birds, the cumulative use of non-lethal methods by all entities is not likely to rise to a level that would have any effect on the populations of target bird species

INDIRECT EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

As discussed previously, the use of non-lethal methods by WS to exclude, capture, or haze target bird species would have no effect on the populations of target bird species. WS would not employ non-lethal methods over large geographical areas at such intensity levels that resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over a wide geographical scope. Therefore, indirect effects that relate to the population of a target bird species would not occur by WS from implementation of Alternative 2.

Implementation of Alternative 2 by WS would not prevent other entities from using many of the lethal methods identified in Appendix B to take birds in Georgia. WS anticipates the lethal take of birds would continue to occur by other entities if WS implements Alternative 2 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1. Therefore, WS anticipates the indirect effects associated with implementing Alternative 2 would be similar to those indirect effects discussed for Alternative 1 because the lethal take of birds in the state would continue to occur by other entities.

CUMULATIVE EFFECTS ON BIRD POPULATIONS FROM IMPLEMENTING ALTERNATIVE 2

WS does not anticipate any cumulative effects to occur associated with WS use of non-lethal methods even when considered with the use of non-lethal methods by other entities. Although non-lethal methods would likely elicit a flight response, the cumulative use of non-lethal methods by all entities is not likely to rise to a level that would have an effect on the population of a bird species.

Although implementation of this alternative would limit WS to using only non-lethal methods, entities other than WS could continue to use lethal methods. Implementation of Alternative 2 by WS would not prevent the USFWS and/or the GDNR from continuing to issue depredation permits or other authorizations for the take of birds in Georgia and would not limit the ability to take non-native bird species. The continued use of many non-lethal methods can often lead to the habituation of birds to those methods (*i.e.*, showing no response or limited movements), which can decrease the effectiveness of those methods (Conover 2002, Seamans and Gosser 2016).

As discussed previously for Alternative 1, the take of many of the target bird species has occurred by other entities previously. Therefore, the lethal take of bird species by other entities would likely continue if WS implemented Alternative 2. For example, the USFWS and/or the GDNR could continue to issue a depredation permit or authorizations that allow the recipient to use lethal methods when non-lethal methods become less effective at excluding and/or dispersing birds. In addition, people could lethally take some bird species without the need for a depredation permit from the USFWS when the MBTA does not protect those species, such as house sparrows, rock pigeons, and European starlings. People can lethally take certain species pursuant to depredation/control orders without the need for a depredation permit from the USFWS, such as red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, American crows, and fish crows. People could continue to take waterfowl and other harvestable species (*e.g.*, crows, mourning doves) during annual hunting seasons in the state.

WS anticipates the lethal take of birds would continue to occur by other entities if WS implements Alternative 2 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1. Therefore, WS anticipates the cumulative effects associated with implementing Alternative 2 would be similar to those cumulative effects discussed for Alternative 1 because the lethal take of birds in the state would continue to occur by other entities.

Alternative 3 - WS would recommend an integrated methods approach to managing bird damage in Georgia through technical assistance only

Under a technical assistance only alternative, WS would recommend an integrated methods approach similar to Alternative 1 and Alternative 2; however, WS would not provide direct operational assistance under this alternative. Using information that a requester provides or from a site visit by an employee, WS personnel would recommend methods and techniques based on their use of the WS Decision Model. In some instances, information provided to the requester by WS could result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. In addition, WS personnel could assist people with the process for applying for their own depredation permit from the USFWS and authorization from the GDNR. In accordance with WS Directive 2.301, WS personnel could assist people with applying for a depredation permit from the USFWS by completing a USFWS Migratory Bird Permit Application or Review form (WS Form 37).

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 3

When discussing damage management options with the person requesting assistance, WS personnel could recommend and demonstrate the use of both non-lethal and lethal methods that were legally available for use to alleviate damage. Those people receiving technical assistance from WS could implement those methods recommended by WS, employ other methods not recommended by WS, seek assistance from other entities, or take no further action. If WS implements Alternative 3, WS would have no direct effect on bird populations because WS personnel would not provide direct operational assistance.

Despite WS not providing direct operational assistance to resolve damage and threats associated with birds, those people experiencing damage caused by birds could alleviate damage by employing those methods legally available or by seeking assistance from other entities. Implementation of Alternative 3 by WS would not prevent other entities from using lethal and non-lethal methods and would not prevent the USFWS and/or the GDNR from authorizing the lethal take of birds in the state. The take of red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, American crows, and fish crows could occur pursuant to the blackbird depredation order without the need for a depredation permit. The take of Muscovy ducks could occur under the control order and the take of non-native bird species (*e.g.*, rock pigeons, house sparrows, European starlings) could occur without the need for a depredation permit or authorization from the USFWS or the GDNR. Take of certain harvestable bird species would continue to occur during the hunting season for those species (*e.g.*, doves, crows, waterfowl, turkeys).

WS anticipates the lethal take of birds would continue to occur by other entities if WS implements Alternative 3 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1 or Alternative 2. Therefore, WS anticipates the indirect and cumulative effects associated with implementing Alternative 3 would be similar to those indirect and cumulative effects discussed for Alternative 1 and Alternative 2 because the exclusion, dispersal, and lethal take of birds in the state would continue to occur by other entities. As discussed for Alternative 1, the lethal take of birds to alleviate damage in Georgia has occurred and would continue to occur by entities other than WS.

With the oversight of the USFWS and the GDNR, it is unlikely that implementation of Alternative 3 by WS would adversely affect bird populations. However, if direct operational assistance is not available from WS or other entities, it is possible that frustration caused by the inability to reduce damage and associated losses could lead to an increase in the illegal use of methods and take. People have resorted to the illegal use of chemicals and methods to resolve wildlife damage issues (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

Alternative 4 - WS would not provide any assistance with managing damage caused by birds in Georgia

If WS implements Alternative 4, WS would have no direct involvement with any aspect of addressing damage caused by those bird species addressed in this EA and would provide no technical assistance. When contacted about damage or the threat of damage associated with those bird species addressed in this EA, WS would refer those people to other entities, such as the USFWS, GDNR, and/or private entities.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 4

If WS implemented Alternative 4, WS would not have direct effects on target bird populations because WS would not provide any assistance involving those bird species addressed in this EA. However, like the other alternative approaches, other entities could continue to use non-lethal and lethal methods to address damage caused by birds. Implementation of Alternative 4 by WS would not prevent the USFWS and/or the GDNR from continuing to authorize the take of birds in Georgia. The take of red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, American crows, and fish crows could occur under the blackbird depredation order without the need for a depredation permit. The take of Muscovy ducks could occur under the control order and the take of non-native bird species could occur without the need for a depredation permit or authorization from the USFWS or the GDNR.

Take of certain harvestable bird species would continue to occur during the hunting season for those species. People could continue to address certain non-native species, such as house sparrows, European starlings, and rock pigeons, without the need for a depredation permit or other authorization. Therefore, WS anticipates the indirect and cumulative effects associated with implementing Alternative 4 would be similar to those indirect and cumulative effects discussed for the other alternative approaches because other entities would continue to use non-lethal and lethal methods to alleviate bird damage.

3.1.2 Issue 2 - Effects on the Populations of Non-target Wildlife Species, Including Threatened and Endangered Species

As discussed previously, a concern would be the potential impacts to non-target species, including threatened or endangered species, from the use of methods to resolve damage caused by birds. When using methods, WS could unintentionally live capture, disperse, or kill non-target animals. Discussion on the potential direct, indirect, and cumulative effects of the alternative approaches on the populations of non-target animal species, including threatened or endangered species, occurs below for each of the alternative approaches identified in Section 2.4.1.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia (Proposed Action/No Action)

If WS implements Alternative 1, WS could provide both technical assistance and direct operational assistance to those persons requesting assistance. When providing direct operational assistance, WS employees could use lethal and/or non-lethal methods in an integrated methods approach to reduce damage and alleviate risks of damage associated with those target bird species addressed in this EA.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ANALYSIS ON NON-TARGET POPULATIONS

WS personnel have experience and receive training in wildlife identification, which allows them to identify individual species and to identify damage or recognize damage threats associated with birds. In addition, WS personnel have knowledge in the use patterns of methods available to resolve animal damage, which allows them to select the most appropriate method(s) to address animal damage and minimize impacts on non-target species.

WS personnel use a decision-making process for evaluating and responding to requests for assistance detailed in the WS Decision Model (see WS Directive 2.201), which Slate et al. (1992) describes in more detail. Using the WS Decision Model, WS personnel would formulate a management strategy, which would include the method or methods the employee determines to be practical for use to alleviate damage or reduce risks caused by the target bird species. When determining the appropriate method or methods, WS personnel would consider risks to non-target animals from the use of a method or methods. Despite WS efforts to reduce risks to non-target animals, the use of a method or methods could exclude, disperse, capture, or kill non-target animals unintentionally. A discussion of the risks to non-target animals and the potential effects on the populations of non-target animals if WS implements Alternative 1 occurs below.

Risks to non-target animals associated with available methods

The risks to non-target animals associated with WS providing technical assistance during the implementation of Alternative 1 would be similar to those risks to non-target animals discussed for

Alternative 3. Therefore, to reduce redundancy, the effects associated with WS providing technical assistance that would occur if WS implements Alternative 1 occur in the discussion for Alternative 3. Similarly, the risks to non-target animals from the use of non-lethal methods during the implementation of Alternative 1 would be similar to those risks to non-target animals discussed for Alternative 2. To reduce redundancy, the risks to non-target animals from the use of non-lethal methods if WS implements Alternative 1 occur in the discussion for Alternative 2.

In regard to risks to non-target animals, the primary risk would be associated with lethal methods because the use of lethal methods could result in the death of a non-target animal. Lethal methods that WS employees could use and/or recommend would include the use of a firearm, egg destruction (*i.e.*, puncturing, breaking, oiling, or shaking an egg), euthanasia after live-capture, Avitrol, and the avicide DRC-1339.

- *Firearms*

The use of firearms is essentially selective for target species because WS personnel would identify target bird species prior to application. There is a slight risk of misidentifying bird species, especially when target and non-target species have a similar appearance. There is also a slight risk of unintentional take of non-target animals if a projectile strikes a non-target animal after passing through a target bird, if misses occur, or if a non-target animal is near a target bird when using a shotgun. WS personnel can minimize risks by using appropriate firearms, by being aware of what is near or beyond the target bird, and by training to be proficient with the use of a firearm.

Although the use of firearms can reduce the number of birds using a location (similar to dispersing birds), the use of a firearm is most often used to supplement and reinforce the noise associated with non-lethal methods. The noise produced when discharging a firearm could disperse non-target animals from an area. In those cases, non-target species nearby could temporarily leave the immediate vicinity but would most likely return after conclusion of the action. 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. WS personnel would not employ firearms over large geographical areas or use firearms at such an intensity level that WS would cause harm to a non-target animal by dispersing and preventing them from accessing essential resources (*e.g.*, food sources, habitat).

- *Egg Destruction*

WS personnel could make eggs of certain target bird species unviable by puncturing the egg, breaking the egg, shaking the egg, or oiling the egg. The destruction of eggs would essentially be selective for target species because WS personnel would identify the eggs of target bird species prior to application. The EPA has ruled that use of corn oil to oil eggs is exempt from registration requirements under the FIFRA. Therefore, WS does not anticipate direct or indirect effects to occur from destroying eggs of target bird species.

- *Euthanasia after Live Capture*

Because live capture of birds using other methods would occur prior to using euthanasia methods, WS personnel would identify target bird species prior to using euthanasia methods. WS could euthanize target bird species using carbon dioxide or cervical dislocation. WS personnel would use euthanasia methods in accordance with WS Directive 2.505. Therefore, WS does not anticipate effects to occur from the use of euthanasia methods following live capture.

➢ *Snap Traps*

WS could occasionally use snap traps when targeting a cavity nesting bird species, such as a European starling. WS personnel would place snap traps inside a nest box so as the target bird species enters the nest box, they trigger the trap. The opening of the nest box would limit access to bird species of similar size to the target species or smaller. WS could use snap traps on the sides of residences or other buildings in residential areas and commercial sites where cavity-nesting birds may be entering into a structure to nest. WS would place the nest box containing the snap trap over the existing opening in the structure. Therefore, WS does not anticipate direct or indirect effects to occur from the use of snap traps because of the locations where WS could use them.

➢ *4-Aminopyridine (Avitrol)*

Avitrol is the commercial product name of a flock dispersal method available for public use to manage damage associated with some bird species. The active ingredient of Avitrol is 4-Aminopyridine. Although Avitrol is a flock dispersing method, birds that ingest a treated particle often die. When ingested in sufficient doses, Avitrol is acutely toxic to all vertebrate species; therefore, a concern does exist from exposure of non-target animals to 4-Aminopyridine (EPA 2007). The primary risks would occur from non-target species that also consume the different bait types, such as granivorous birds (De Grazio et al. 1971, De Grazio et al. 1972, Schafer et al. 1974, Schafer and Marking 1975, Stickley et al. 1976, Somer et al. 1981). Several label requirements of Avitrol products address risks to non-target animals, such as pre-baiting a site using untreated bait to monitor for the presence of non-target animals and diluting treated bait with untreated bait. When using Avitrol, WS personnel would follow all label requirements to minimize the risk to non-target animals consuming the treated bait (USDA 2023*a*).

If WS personnel observe non-target animals feeding on untreated bait during pre-treatment observations, WS personnel would not use bait treated with Avitrol at those locations. In addition, product labels require diluting treated bait with untreated bait to minimize non-target hazards and to avoid bait aversion by target species. Mixing treated bait with untreated bait minimizes the likelihood of non-target animals finding and consuming treated bait.

The bait type selected can also limit the likelihood that non-target species would consume treated bait because non-target species may not prefer some bait types, or the bait is too large for a non-target animal to consume. For example, the applicator may use bait formulated on whole kernel corn, which pigeons will consume but the corn kernel is too big for smaller bird species to ingest. Once WS personnel place treated bait at a location, WS would continue to monitor the location for the presence of non-target animals in accordance with label requirements. If WS personnel observe non-target animals feeding on bait, WS would abandon those locations. In addition, when pre-baiting a potential location, WS can acclimate target birds to a feeding schedule; therefore, baiting can occur at specific times to ensure target bird species quickly consume bait, especially when large flocks of target species are present. The acclimation period allows treated bait to be present only when WS personnel have conditioned target birds to be present at the site and provides a higher likelihood that target bird species consume treated bait, which would make the treated bait unavailable to non-target species. In addition, WS personnel would follow label requirements regarding picking up uneaten bait at the end of each day. The baiting directions for products containing 4-Aminopyridine generally require that in areas where uneaten bait might be a hazard to other animals, the applicator must pick up uneaten bait at the end of each day.

During the re-registration process for 4-Aminopyridine, the EPA (2007) concluded there was a chronic exposure risk to birds and mammals that may consume a sublethal dose of treated bait over several days. The EPA (2007) stated that feeding on sublethal doses of treated bait may not necessarily result in the death of a non-target animal, but death could occur because the effects of ingesting a sublethal dose could reduce feeding or make the animal more vulnerable to predation by predators. However, the EPA (2007) concluded the amount of treated bait eaten would likely result in quick mortality; thus, providing minimal opportunities for chronic exposure. Bait treated with 4-Aminopyridine does not appear to have cumulative effects in birds (Schafer and Marking 1975, EPA 2007).

An additional concern would be secondary toxicity risks associated with predators and scavengers feeding on birds that ingested Avitrol. Secondary risks appear to be low because birds rapidly metabolize 4-Aminopyridine and 4-Aminopyridine does not bioaccumulate in the tissue of birds (Schafer et al. 1974, Holler and Schafer 1982, Schafer 1991). Some hazards may occur to predatory species consuming unabsorbed chemical in the gastrointestinal tract of affected or dead birds (Schafer 1981, Holler and Schafer 1982). In a laboratory study, Schafer et al. (1974) fed red-winged blackbirds killed by 4-Aminopyridine to canines, Norway rats (*Rattus norvegicus*), black-billed magpies (*Pica hudsonia*), and three species of raptors for up to 20 days. None of the animals were adversely affected by consuming red-winged blackbirds killed by 4-Aminopyridine (Schafer et al. 1974). However, there are some secondary risks to scavengers and predators with some reported deaths of predatory birds (EPA 2007). In accordance with the label requirements of 4-Aminopyridine, WS would retrieve carcasses to the extent possible following treatment with 4-Aminopyridine to minimize secondary hazards associated with scavengers feeding on carcasses.

Because 4-Aminopyridine is toxic to fish, WS would not apply bait treated with 4-Aminopyridine directly to water. In addition, WS would not apply bait treated with 4-Aminopyridine in areas where surface water was present and to intertidal areas below the mean high-water mark. WS would not contaminate water by cleaning equipment used to prepare, handle, or apply bait treated with 4-Aminopyridine and would not contaminate water when disposing of waste associated with preparing, handling, or applying bait. Most formulations of 4-Aminopyridine prohibit the use of treated bait within 25 feet of permanent bodies of water.

The half-life of 4-Aminopyridine under aerobic conditions ranges from three to 32 months (EPA 2007). However, based on the use pattern of 4-Aminopyridine, the EPA (2007) concluded that following the label requirements would reduce the ecological risks of exposure. Through a programmatic risk assessment, WS has determined the use of Avitrol to manage bird damage poses a low risk to the environment, including risks to non-target animals (USDA 2023*a*). WS would only use those formulations of 4-Aminopyridine that the EPA has approved for use in accordance with the FIFRA and that the Georgia Department of Agriculture has approved for use in Georgia. WS will reduce risks to non-target species by following the label requirements of the products WS personnel use in Georgia. From FY 2017 through FY 2021, WS did not use 4-Aminopyridine in Georgia. WS anticipates using 4-Aminopyridine infrequently.

- *DRC-1339 Avicide*

If WS implements Alternative 1, another chemical method that WS could use to manage damage associated with certain bird species is the avicide DRC-1339. WS is proposing the use of the avicide DRC-1339 because of its high toxicity to certain bird species that cause damage (*e.g.*, pigeons, crows, blackbirds, starlings, gulls) (DeCino et al. 1966, Besser et al. 1967, West et al. 1967, Schafer 1972). In addition, WS is proposing the continued use of the avicide DRC-1339 because of its low toxicity to many mammals, sparrows, and finches (Schafer and Cunningham 1966, Apostolou 1969, Schafer 1972, Schafer et al. 1977, Matteson 1978, Cunningham et al. 1979, Schafer 1981, Schafer 1991, Cummings et al. 1992, Sterner et al. 1992, Johnston et al. 1999). Despite the low toxicity of DRC-1339 to many mammals, sparrows, and finches, a common concern regarding the use of DRC-1339 is the potential risks to non-target animals.

The national WS program has registered two formulations of DRC-1339 with the EPA that could be available for WS to use when registered for use in a state. Those formulations restrict the use of DRC-1339 to certain areas where target bird species are causing damage or posing a threat of damage. The Livestock, Nest, and Fodder Depredations label (EPA Reg. #56228-29) would be available to manage crows causing damage to livestock, causing damage to silage/fodder bags, and crows feeding on the eggs or young of federally designated threatened or endangered species. WS can only use DRC-1339 formulated under the Livestock, Nest, and Fodder Depredations label in rangeland and pastureland areas where crows prey upon newborn livestock; refuges or other areas where crows prey upon the eggs and/or young of federally designated threatened or endangered species or other species of designated to be in need of special protection, and within 25 feet of silage/fodder bags that have been damaged or are likely to be damaged by crows. WS has not registered the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 for use in Georgia. Therefore, WS would not use the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 until WS submitted an application to the Georgia Department of Agriculture to register the formulation in the state and the Georgia Department of Agriculture has approved the formulation for use by WS in the state. WS anticipates using the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 infrequently in the future.

The Bird Control label (EPA Reg. #56228-63) of DRC-1339 could be available to manage blackbirds, cowbirds, grackles, starlings, crows, pigeons, and Eurasian collared-doves at commercial animal operations and staging areas along with gulls at gull colonies and gull feeding or loafing sites. The Bird Control label defines commercial animal operations as areas where cattle, swine, sheep, goats, poultry, game birds, or furbearers are confined primarily for the purpose of production for commercial markets. The Bird Control label defines staging areas as non-crop areas where target birds gather to feed, loaf, or roost such as stubble fields, harvested dormant hay fields, open grassy or bare-grounded non-crop areas, non-crop borders of crop areas, roads, roadsides, paved or concrete surfaces, secured parking areas, rooftops, power utilities, airports, dumps, landfills, and other industrial and commercial structures or sites. The Bird Control label defines gull feeding and loafing sites as areas where target gull species feed or loaf at airports, industrial sites, dumps, or landfills, or other crops areas if the target gull species pose immediate threats to threatened or endangered species or pose immediate human health or safety hazards that cannot be readily resolved by other means. WS has not registered the Bird Control formulation of DRC-1339 for use in Georgia. Therefore, WS would not use the Bird Control formulation of DRC-1339 until WS submitted an application to the Georgia Department of Agriculture to register the formulation in the state and the Georgia Department of Agriculture has approved the formulation for use by WS in the state. WS anticipates using the Bird Control formulation of DRC-1339 infrequently in the future.

DRC-1339 Primary Hazard Profile: The primary risk to non-target animals would be ingesting bait treated with DRC-1339. The likelihood of a non-target animal obtaining a lethal dose of DRC-1339 would be dependent on: (1) frequency of encountering the bait, (2) length of feeding bout, (3) the bait dilution rate, (4) an animal's propensity to select against the treated bait, and (5) the susceptibility of the non-target species to DRC-1339.

As discussed previously, some bird species that cause damage to agricultural and other resources, such as blackbirds, crows, starlings, and pigeons, are highly sensitive to the avicide DRC-1339 (*i.e.*, toxic effects occur at very small doses). However, some bird and mammal species are less sensitive to the avicide DRC-1339 (*i.e.*, toxic effects occur at very high doses). For example, the median acute lethal dose (LD_{50})[14] 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 is approximately 1.33 mg/kg (DeCino et al. 1966). In comparison, the median lethal dose (LD_{50}) of DRC-1339 for horned larks (*Eremophila*

[14]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.

alpestris) is 232 mg/kg and more than 320 mg/kg for white-crowned sparrows (*Zonotrichia leucophrys*) (Eisemann et al. 2003).

In a cage study, Cummings et al. (1992) found that 75 (79%) of the 95 red-winged blackbirds and brown-headed cowbirds allowed to feed for one hour on rice treated with DRC-1339 and diluted 1:27 with untreated rice (*i.e*., one particle of rice treated with DRC-1339 mixed with 27 particles of untreated rice) died. However, under the same conditions, none of the 42 savannah sparrows (*Passerculus sandwichensis*), song sparrows (*Melospiza melodia*), chipping sparrows (*Spizella passerina*), and white-crowned sparrows died when allowed to feed for one hour on rice treated with DRC-1339 and diluted 1:27 with untreated rice. Similarly, Cummings et al. (1992) found that 80 (94%) of the 85 red-winged blackbirds and brown-headed cowbirds allowed to feed for 12 hours on rice treated with DRC-1339 and diluted 1:27 with untreated rice died. Under the same conditions, none of the 30 savannah sparrows, field sparrows (*Spizella pusilla*), and white-crowned sparrows died when allowed to feed for 12 hours on rice treated with DRC-1339 and diluted 1:27 with untreated rice.

However, DRC-1339 can be highly toxic to some non-target species, such as mourning doves, northern bobwhite (*Colinus virginianus*), American robins (*Turdus migratorius*), and northern cardinals (*Cardinalis cardinalis*). Estimates of the median lethal dose (LD_{50}) of DRC-1339 are available for over 55 species of birds (Eisemann et al. 2003). The ingestion of DRC-1339 does not appear to impact avian reproduction until a bird ingests enough DRC-1339 that toxicity occurs (USDA 2001).

Concerns have been 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). The EPA (2020) has described the up-and-down method as "…*a way to determine the toxicity of chemicals with fewer test animals by using sequential dosing steps*." 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 study designs that were more rigorous (Bruce 1985, Bruce 1987, Lipnick et al. 1995). Therefore, acute and chronic toxicity data gathered prior to EPA guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

To minimize risks to non-target species, WS personnel would follow label requirements when using bait treated with DRC-1339. Many of the label requirements of the avicide DRC-1339 would reduce the risk of non-target animals finding and ingesting bait treated with DRC-1339. Before using bait treated with DRC-1339, WS personnel must use untreated pre-bait at a potential location to monitor for target bird species' use of the location, the acceptance of the target bird species to the potential bait-type, and to monitor for non-target animal use of the location. In addition, label requirements of DRC-1339 may restrict where WS personnel could apply treated bait. For example, the Compound DRC-1339 Concentrate – Bird Control (EPA Reg. #56228-63) label prohibits the use of bait treated with DRC-1339 within 50 feet of permanent manmade or natural bodies of water to minimize risks of runoff and water contamination. In addition, the label restricts the use of bait treated with DRC-1339 to specific locations, such as at commercial animal operations.

As required by the label, WS personnel would pre-bait and monitor all potential bait sites for use by non-target animals as outlined in the pre-treatment observations section of the label. If WS personnel observe non-target animals feeding on the pre-bait, WS personnel would abandon those plots and no baiting would occur at those locations. Similarly, if the target species does not readily accept the pre-bait, WS would abandon that location. Once WS personnel determine a location to be appropriate to place treated baits based on pre-treatment observations, they would place bait at the location.

Through pre-baiting, applicators can acclimate target birds to feed at certain locations at certain times. By acclimating target bird species to a feeding schedule, baiting can occur at specific times to ensure target bird species quickly consume the bait, especially when large flocks of target species are present. The acclimation period conditions target bird species to be present at a location shortly after the applicator places treated bait. Therefore, acclimating target birds to a feeding schedule provides a higher likelihood that target bird species consume treated bait quickly after placing the bait at a location, which makes it unavailable to non-target animals. In addition, with many blackbird species, including crows, when present in large numbers, those species tend to exclude non-target animals from a feeding area due to their aggressive behavior and by the large number of conspecifics present at the location (Glahn et al. 1990). Therefore, risks to non-target species from consuming treated bait only occur when treated bait is present at a bait location.

WS personnel would mix treated bait with untreated bait per label requirements when placing bait at sites to minimize the likelihood of non-target animals finding and consuming treated bait. The bait type selected can also limit the likelihood that non-target species would consume treated bait because non-target species may not prefer some bait types. WS would not apply treated bait in areas where threatened or endangered species may consume the bait. Once WS personnel place treated bait at sites, they would continue to monitor those sites daily to observe for non-target animal feeding. If WS personnel observe non-target animals feeding on bait, WS personnel would abandon those sites.

DRC-1339 Secondary Hazards: Secondary risks associated with the use of DRC-1339 would primarily be associated with scavengers and predators feeding on birds that had died after ingesting DRC-1339. When ingested, studies show that target bird species rapidly metabolize and excrete DRC-1339. In European starlings administered DRC-1339 dosages well above the LD_{50} for starlings, Cunningham et al. (1979) found that European starlings had metabolized or excreted nearly 90% of the DRC-1339 dosage amount within 30 minutes of applying the dosage. Within 2.5 hours, Peoples and Apostolou (1967) detected more than 98% of a DRC-1339 dose delivered to starlings in their feces. Similar results may occur in other bird species (Eisemann et al. 2003). Once death occurs, DRC-1339 concentrations appear to be highest in the gastrointestinal tract of birds, but other tissue of carcasses may also contain residues (Giri et al. 1976, Cunningham et al. 1979, Johnston et al. 1999) with residues diminishing more slowly in the kidneys (Eisemann et al. 2003). Kreps (1974) noted three American crows were found dead following the use of DRC-1339 to manage a local rock pigeon population that apparently died after ingesting treated bait from the crop of dead pigeons.

Most residue tests to detect DRC-1339 in tissues of birds that have died after ingesting DRC-1339 used dosages that far exceeded the known acute lethal oral dose for those species tested and the dosages far exceeded the level of DRC-1339 dosage that a target bird could ingest from treated bait. For example, Johnston et al. (1999) found DRC-1339 residues in the breast tissue of boat-tailed grackles using acute DRC-1339 doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for boat-tailed grackles is ≤ 1 mg/kg (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 or in breast tissue (Johnston et al. 1999). Cunningham et al. (1979) fed carcasses of birds that died from DRC-1339 to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed. Cunningham et al. (1979) concluded that cats, owls, and magpies would be at risk only after exclusively eating starlings killed with DRC-1339 for 30 continuous days. Similarly, the risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999). WS would retrieve all dead birds to the extent possible following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

The 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, Smith 1999). Smith (1999) used field personnel and dogs to search for dead non-target animals but did not find any non-target animal carcasses that exhibited histological signs consistent with DRC-1339 poisoning. However, DRC-1339 is a slow-acting avicide and thus, some birds could have moved to areas not searched by the study participants before dying.

DRC-1339 is highly toxic to aquatic invertebrates. Therefore, the DRC-1339 label prohibits applying bait treated with DRC-1339 within 50 feet of permanent manmade or natural bodies of water except the Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder Depredations (EPA Reg. #56228-29) label allows for the use of treated bait within 50 feet of bodies of water if baited sites are under constant observation while baits are exposed. In addition, WS would not use bait treated with DRC-1339 when water runoff is likely to occur. WS would not apply treated bait directly to water, to areas where surface water was present, or to intertidal areas below the mean high-water mark. WS would not contaminate water by the cleaning of equipment or disposal of waste.

DRC-1339 Environmental Degradation: 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 is approximately 25 hours with the identified metabolites having a low toxicity (EPA 1995). DRC-1339 is also highly soluble in water, does not hydrolyze, and photodegrades quickly in water with a half-life estimated at 6.3 hours in summer, 9.2 hours in spring sunlight, and 41 hours during winter (EPA 1995). DRC-1339 binds tightly with soil and has low mobility (EPA 1995).

***Risks of Crows Caching Bait Treated with DRC-1339*:** Additional concerns occur regarding the risks to non-target animals associated with crow behavior of caching surplus food, including the possibility of caching bait treated with DRC-1339. Crows generally cache surplus food by making a small hole in the soil using their bill, by pushing the food item under the substrate, or by covering food items with debris (Verbeek and Caffrey 2021). Distances traveled from where crows gather a food item to where they cache the item varies. Kilham (1989) found that crows could travel up to 100 meters to cache food while Cristol (2001, 2005) found that crows could travel up to 2 kilometers to cache food. Caching activities appear to occur throughout the year but may increase when food supplies are low. Therefore, the potential for crows to carry treated baits from a bait site to surrounding areas exists as part of their food caching behavior.

For risks to occur from a non-target animal finding cached bait treated with DRC-1339, it would have to locate the cached bait and the bait-type used would have to be palatable or selected for by the non-target animal. In addition, the non-target animal consuming the treated bait would have to consume a lethal dose from a single bait. If the non-target animal did not ingest a lethal dose by eating a single treated cached bait, the non-target animal would have to ingest several treated baits (either from cached bait or from the bait site) to obtain a lethal dose.

Given the best environmental fate information available and the improbability of a non-target animal locating enough treated bait(s) sufficient to produce lethal effects, the risks to non-target animals from crows caching treated bait would be low. When baiting, WS personnel would mix treated baits with untreated bait to minimize non-target hazards directly at the bait site and to minimize the likelihood of target species developing bait aversion. Because WS personnel would dilute treated bait, often times up to one treated bait for every 25 untreated baits, the probability of a crow selecting treated bait and then caching the bait is further reduced.

Effects on non-target animal populations from unintentional take

As discussed previously, the potential effects on non-target animal populations associated with the use of non-lethal methods would be similar to those potential effects discussed for Alternative 2. Similarly, the potential effects associated with WS providing technical assistance would be similar to those potential effects discussed for Alternative 3. Of primary concern would be WS use of lethal methods because those methods could result in the unintentional death of a non-target animal, which could potentially affect the populations of non-target animals.

However, WS does not anticipate the unintentional lethal removal of non-target animals to occur at such a frequency or intensity that would affect the population of a non-target species. No lethal removal of non-target animals has occurred by WS during prior activities to manage bird damage in the state. If WS implements Alternative 1, WS anticipates the unintentional lethal removal of non-target animals during activities to reduce damage or threats to human safety associated with birds in Georgia to be extremely low to non-existent. WS would continue to monitor the activities conducted to ensure those activities or methodologies used in bird damage management do not adversely affect the populations of non-target animals. Methods available to resolve and prevent bird damage or threats when employed by trained, knowledgeable personnel can be selective for target species. WS would annually report to the USFWS and/or the GDNR any non-target bird take to ensure those agencies have the opportunity to consider take by WS as part of management objectives.

- *Rusty Blackbird Population Impact Analysis*

During the development and scoping process for this EA, WS and others identified a concern regarding the potential effects of damage management activities on the declining populations of rusty blackbirds. The rusty blackbird is one of the most rapidly declining bird species in North America (Greenberg et al. 2011, Avery 2020). Avery (2020) summarizes the potential factors that may be influencing the current decline in the rusty blackbird population, which may include loss of wintering habitat, contaminants on the breeding grounds, damage management activities targeting other blackbird species, and increasing disturbance to breeding habitats in the boreal forest. Disease factors may also be contributing to the population decline (Barnard et al. 2010, Greenberg and Matsuoka 2010).

The rusty blackbird is one of the most ecologically specialized of the blackbird species in North America, both in its feeding habits and habitat uses (Avery 2020). During the nesting season, rusty blackbirds occur across the wet forests of Alaska and Canada, with breeding populations also occurring in some of the wet forested regions of the northeastern United States (Avery 2020). Trend data from the BBS shows an annual decline of -2.6% across all survey routes from 1966 through 2019 with a 0.4% annual increase occurring from 2009 through 2019 (Sauer et al. 2019)[15]. The Partners in Flight (2020) estimated the

[15] Avery (2013) stated, "*Estimating abundance of this species has been difficult and inexact, given inaccessible breeding habitat (much of it north of BBS routes) and mixing with other blackbirds on wintering grounds*."

breeding population in North America at 6.8 million rusty blackbirds, with a breeding population in the United States estimated at 930,000 rusty blackbirds.

The fall migration period for rusty blackbirds begins in early September and ends in early December (Avery 2020). Rusty blackbirds pass through and winter in the southern and east-central portions of the United States, including Georgia; however, their distribution across their wintering range is spotty (Avery 2020). From 1970 through 2019, the number of rusty blackbirds observed in areas of North America surveyed during the CBC has shown a declining trend estimated at -2.3% per year (Meehan et al. 2020). However, from 2009 through 2019, the number of rusty blackbirds in areas of North America surveyed during the CBC has shown an increasing trend estimated at 1.3% per year (Meehan et al. 2020). No winter population estimates are available (Avery 2020). The spring migration back to nesting areas for rusty blackbirds begins in late February and ends in mid-May (Avery 2020).

The habitat of the rusty blackbird through its winter range typically consists of swamps, wet woodlands, and pond edges (Rosenberg et al. 1991, Luscier et al. 2010, Greenberg et al. 2011, Avery 2020). On their wintering grounds, rusty blackbirds typically forage in areas with shallow water (Luscier et al. 2010, Greenberg et al. 2011, DeLeon 2012, Avery 2020). DeLeon (2012) suggested rusty blackbirds selected wintering habitat based on the availability of shallow water and speculated the presence of shallow water and prey availability could have a greater impact on rusty blackbird populations than changes in forested wetlands alone. The ephemeral nature of some shallow water and moist soil habitats may provide some explanation for the annual variability in the presence or absence of rusty blackbirds in wintering areas (Luscier et al. 2010, DeLeon 2012, Avery 2020).

Greenberg et al. (2011) stated "*Rusty blackbirds appeared to depend on two distinct dietary items: (1) small acorns and pecans, which are often eaten while associating with common grackles, whose large, strong bills are able to crack nutshells; and (2) invertebrates picked from water or soil, or captured after flipping leaf litter and floating vegetation*." Luscier et al. (2010) found rusty blackbirds in agricultural fields adjacent to wetlands and bottomland forest near national wildlife refuges and wildlife management areas but wintering rusty blackbirds were not typically associated with large open agricultural fields that lacked nearby forests or wetlands.

Rusty blackbirds may associate with other blackbird species during the migration periods and during the winter season but tend to prefer more woodland roosts and forage areas than the other blackbird species (Avery 2020). Greenberg et al. (2011) stated, '*Most rusty blackbirds are found either in single-species roosts or mixed with some red-winged blackbirds*." Rusty blackbirds usually comprise less than 1% of large mixed-species blackbird roosts (Neff and Meanley 1952, Meanly 1971, White et al. 1985, Stickley 1987, Dolbeer et al. 1997, Avery 2020). During surveys in the Mississippi Alluvial Valley conducted by Luscier et al. (2010), surveyors detected an average of 26 ± 8 (range 1-160) rusty blackbirds at sites surveyed during 2006, 19 ± 5 rusty blackbirds (range 1-100) during 2007, and an average of 27± 8 (range 1-1,000) rusty blackbirds at survey sites during 2008. DeLeon (2012) found the average flock size of rusty blackbirds in areas of Louisiana surveyed was 20.6 ± 3.4 rusty blackbirds in 2010 and 19.7 ± 3.5 rusty blackbirds during 2011. From 1970 through 2019, the numbers of rusty blackbirds observed in areas of the state surveyed during the CBC have shown a declining trend estimated at -6.1% per year. From 2009 through 2019, the number of rusty blackbirds observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -7.9% per year (Meehan et al. 2020).

There is a concern from the potential cumulative take of rusty blackbirds in Georgia across all known damage management activities. Of primary concern is the unintentional take of rusty blackbirds during the use of the avicide DRC-1339. Rusty blackbirds are not a target species on the current labels for the avicide DRC-1339; therefore, rusty blackbirds would be non-target animals when conducting activities using DRC-1339 and primarily when using the Compound DRC-1339 Concentrate – Bird Control (EPA

Reg. No. 56228-63) label. As per the label requirements for Compound DRC-1339 Concentrate – Bird Control, applicators must first use untreated pre-bait to monitor for bait acceptance by the target species and to monitor for the presence of non-target animals feeding on pre-bait prior to baiting areas, including the presence of rusty blackbirds. Like other non-target animals, if an applicator observes rusty blackbirds feeding on pre-bait, they must abandon those sites or continue to pre-bait those locations until the applicator no longer observes rusty blackbirds per the label requirements of the avicide DRC-1339.

From FY 2017 through FY 2022, no lethal take of rusty blackbirds has occurred by WS in Georgia. WS could occasionally address rusty blackbirds in Georgia using non-lethal hazing methods. Because rusty blackbirds do flock together in the winter and do occasionally occur in mixed species flocks, WS could intentionally address rusty blackbirds if WS implements Alternative 1, including some limited intentional take that WS anticipates would occur infrequently and would involve a small number of rusty blackbirds per year (5 or less) (see Appendix E). In addition, there is some concern about the potential unintentional take of rusty blackbirds because they are similar in appearance to other blackbird species (primarily Brewer's blackbirds) and may be misidentified especially when in flocks with other blackbirds and grackles. However, no unintentional take of rusty blackbirds has occurred in Georgia by WS. From 2016 through 2019, other entities in Georgia have not reported the take of rusty blackbirds to the USFWS.

As discussed in Appendix E, WS could take up to five rusty blackbirds per year throughout Georgia; however, WS anticipates addressing rusty blackbirds primarily using non-lethal methods with lethal take occurring infrequently. WS anticipated take of up to five rusty blackbirds is not a prescribed take level but is a maximum take level that WS anticipates could occur annually to alleviate damage. The anticipated take of up to five rusty blackbirds per year would include any unintentional take that could occur by WS during activities targeting other animals. The take of five rusty blackbirds by WS would represent less than 0.001% of a breeding population in the United States estimated at 930,000 rusty blackbirds.

The effects associated with damage management activities targeting other blackbird species on the overall population of rusty blackbirds are unknown (Avery 2020). However, Greenberg and Droege (1999) speculated that damage management activities associated with other blackbird species were not an important cause of the species' decline. Based on the use patterns of methods, including the label requirements of the avicide DRC-1339, activities under this alternative are not likely to have effects on the rusty blackbird population. WS would continue to monitor activities to evaluate the potential effects on the populations of non-target wildlife, including rusty blackbirds. The monitoring process would allow WS to adapt and modify activities to avoid any potential effects on the rusty blackbird population. In addition, the intentional take of rusty blackbirds can only occur when authorized by the USFWS pursuant to the MBTA and the take of rusty blackbirds must be reported to the USFWS.

WS impact on biodiversity

WS does not attempt to eradicate any species of native wildlife in the state. WS operates in accordance with applicable federal and state laws and regulations enacted to ensure species viability. WS personnel would use or recommend the use of methods that target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population is generally temporary because immigration from adjacent areas or natural reproduction replaces those birds that an entity removes. WS operates on a small percentage of the land area in Georgia and would only target those birds identified as causing damage or posing a threat. Therefore, bird damage management activities conducted pursuant to any of the alternative approaches would not adversely affect biodiversity in the state.

Implementation of Alternative 1 would also provide WS with the widest range of methods to address requests for assistance associated with reducing risks of certain target bird species feeding on other wildlife or competing with other wildlife for resources. For example, American crows often feed on the eggs, nestlings, and fledglings of other bird species, including threatened or endangered species. Thus, WS could receive requests for assistance to manage predation risks on threatened or endangered species associated with American crows or other predatory bird species.

Risks to species designated as threatened or endangered pursuant to the Endangered Species Act

WS would make special efforts to avoid jeopardizing threatened or endangered species through biological evaluations of potential effects and the establishment of special restrictions or minimization measures through consultation with the USFWS and/or the National Marine Fisheries Service. 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 consultations with the USFWS and/or the National Marine Fisheries Service pursuant to Section 7 of the ESA to ensure compliance. WS also conducts consultations 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)].

Some of the bird species addressed in this EA occur statewide in Georgia and are present in the state throughout the year. If WS implements Alternative 1, WS could conduct activities to manage damage caused by those bird species when an entity requests such assistance. Therefore, WS could conduct activities to manage damage in areas where threatened or endangered species occur. However, 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. During the development of this EA, WS reviewed the current list of species designated as threatened or endangered in Georgia as determined by the USFWS and the National Marine Fisheries Service. WS conducted a review of potential impacts of implementing Alternative 1 on each of those species designated as threatened or endangered in the state by the USFWS and the National Marine Fisheries Service (see Table C-1 in Appendix C). The evaluation took into consideration the direct and indirect effects of implementing Alternative 1 to alleviate damage caused by birds. WS reviewed the status, critical habitats designations, and current known locations of those species. As part of the review process, WS prepared and submitted a biological evaluation to the USFWS as part of the consultation process pursuant to Section 7 of the ESA.

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 Georgia under the jurisdiction of the National Marine Fisheries Service, including any designated critical habitat. In addition, based on the use patterns of methods currently available and based on current life history information for those species under the jurisdiction of the USFWS, WS has made a no effect determination for several species currently listed in the state (see Table C-1 in Appendix C). For several species listed within the state, WS has determined that the proposed activities "*may affect*" those species but those effects would be solely beneficial, insignificant, or discountable, which would warrant a "*not likely to adversely affect*" determination. Based on those determinations, WS initiated informal consultation with the USFWS for those species that a "*may affect, not likely to adversely affect*" determination was made (see Table C-1 in Appendix C). The USFWS concurred with WS determination that activities conducted pursuant to the proposed action would not likely adversely affect those species (P. Maholland, USFWS, pers. comm. 2023).

Since completion of the consultation, the USFWS has proposed designating the Ocmulgee skullcap (*Scutellaria ocmulgee*) as a threatened species in Georgia. The Ocmulgee skullcap is an herbaceous perennial plant only known to occur in riparian areas associated with the Savannah River and the Ocmulgee River watersheds within Georgia and South Carolina. Ocmulgee skullcap is associated with moist, calcareous hardwood forests on north to northeast facing slopes of river bluffs and their floodplains (USFWS 2020*b*). The forested areas along river bluffs and floodplains in the Savannah River and the Ocmulgee River watersheds are generally not areas where WS conduct activities associated with bird species. Based on the use patterns of the methods and the location where WS uses those methods, the proposed activities would not jeopardize the continued existence of the Ocmulgee skullcap.

The USFWS has also designated critical habitat in Georgia for some of the species listed as threatened or endangered. Table C-2 in Appendix C provides a list of those species with critical habitat designated in Georgia along with WS effects determination. WS has determined implementation of Alternative 1 would have no effect on any critical habitat designated in Georgia. WS based the effects determinations on a review of the activities that WS could conduct if WS implemented Alternative 1. The USFWS concurred with WS effects determination for critical habitats designated in Georgia (P. Maholland, USFWS, pers. comm. 2023). WS would continue to review the species listed as threatened or endangered by the USFWS and the National Marine Fisheries Service, including any designated or proposed critical habitat, and would continue to consult with the USFWS and/or the National Marine Fisheries Service as appropriate.

Risks to species designated by the GDNR as threatened, endangered, or rare species and species of greatest conservation concern

Appendix D shows those species considered threatened, endangered, or rare by the GDNR within the state. As discussed in Appendix E, WS could receive requests for assistance to manage damage associated with swallow-tailed kites and American kestrels, which the GDNR has designated as rare in the state. In addition, WS could address bald eagles, which the GDNR has designated as threatened. Table E-2 identifies those species of greatest conservation concern that WS could address infrequently and/or would likely address only a few individuals annually, primarily to reduce the risks of an aircraft striking those species when they occur on or near an airport or military facility. WS anticipates addressing those species primarily using non-lethal methods. WS would only use non-lethal dispersal methods to address bald eagles in the state and would work with the USFWS to determine when activities require the appropriate permits.

WS take of those bird species designated by the GDNR as rare and those species identified in Table E-2 would only occur when authorized by the USFWS and/or the GDNR and only at levels authorized. WS would not provide direct operational assistance that specifically targets any species that are also designated as threatened or endangered by the USFWS pursuant to the ESA.

Based on the review of those species identified in Appendix D and Appendix E, WS has determined that the proposed activities would not have population-level impacts on those species designated by the GDNR as rare or species of greatest conservation concern. WS would continue to review the species of greatest conservation concern designated by the GDNR and would consult with the GDNR, as appropriate, when WS determines activities may have population-level impacts on those species.

Alternative 2 – WS would continue the current integrated methods approach to managing damage caused by birds in Georgia using only non-lethal methods

Implementation of Alternative 2 would require WS to only recommend and use non-lethal methods to manage and prevent damage associated with target bird species. WS would provide technical assistance and direct operational assistance by recommending and/or using only non-lethal methods. Using the WS Decision Model, WS personnel would consider the potential effects to non-target animals from the potential use of non-lethal methods when formulating a management strategy for each request for assistance. Non-lethal methods have the potential to cause adverse effects to non-target animals primarily through live-capture, exclusion, and dispersal.

If WS implemented Alternative 2, the possible negative physiological and/or behavioral effects that negative stimuli could cause are a concern, which could reduce the fitness of a non-target animal, or the ability of a non-target animal to survive, especially if the exposure to the stressor was chronic. The stress caused during the use of non-lethal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs.

DIRECT, INDIRECT, AND CUMULATIVE EFFECTS ON NON-TARGET ANIMAL POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

In general, the use of non-lethal methods to disperse, exclude, or capture target birds from areas would have no effect on the populations of non-target animals because those methods generally would not occur with such frequency and would not occur at an intensity level that would cause adverse effects. Therefore, WS does not anticipate direct or indirect effects to occur to any non-target species. Based on the use pattern of methods and the activities that WS could conduct to manage damage or threats of damage caused by target bird species, WS does not anticipate cumulative effects to occur to any non-target species. Activities conducted by WS would not occur with such frequency and would not occur at an intensity level that would cause cumulative adverse effects. WS has not received any reports or documented any cumulative effects associated with WS use of non-lethal methods from previous activities associated with managing damage caused by target bird species in the state.

Risks to non-target animals associated with available methods

Section I in Appendix B describes the non-lethal methods that would be available for WS personnel to use if WS implemented Alternative 2. The potential effects associated with specific methods or a category of methods occurs below.

- *Human Presence*

Human presence will include physical actions that WS could use to haze target bird species and consideration of WS employees conducting activities to manage bird damage in the state. Like the intent of many non-lethal methods, the presence of people and the physical actions of clapping, waving, or yelling can disperse birds from an area through auditory and visual cues. With many visual and auditory methods intended to disperse animals from a location, the primary concern would be the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of a non-target animal or the ability of a non-target animal to survive, especially if the exposure to the stressor was chronic. Activities conducted by WS can involve repeated visits to the same area until WS and/or another entity reduces damage or threats of damage. In some cases, such as airports, WS employees may be present in areas multiple times a day and on a regular basis. However, like other visual and auditory stimuli, non-target animals often habituate to the presence of people, especially in areas where non-target animals frequently encounter people, such as urban areas. In addition, non-target animals are likely to return to the area once WS personnel are no longer present. The presence of WS personnel would not occur at a magnitude or intensity level that would cause harm to a non-target animal by preventing them from accessing essential resources (*e.g.*, food sources, habitat).

➢ *Modifying Cultural Practices*

When providing technical assistance, WS could recommend that people requesting assistance modify behaviors that may be contributing to bird damage or threats of damage. However, in those cases, the entity experiencing damage or threats of damage would be responsible for implementing the recommendations made by WS personnel.

➢ *Limited Habitat Modification*

WS could also recommend limited modification of habitat in some situations, such as pruning trees to make them less attractive to roosting blackbird species. In those cases, the entity experiencing damage or threats of damage would be responsible for implementing the recommendations made by WS personnel. WS employees would recommend habitat modifications in limited circumstances where modifications could result in the dispersal of target bird species from an area or make an area less attractive to those species. WS employees would not recommend habitat modifications over large areas and would not recommend modifications to the extent that would result in the removal or modification of large areas of habitat. The use of habitat modifications would generally be restricted to urban areas, airports, industrial parks, office complexes, and other areas where human activities are high. WS personnel would not recommend habitat modification at a magnitude or intensity level that would cause harm to non-target animals by reducing available habitat.

➢ *Supplemental Feeding and Lure Crops*

Providing a supplemental food source and/or planting and maintaining lure crops could be methods that WS recommends to entities experiencing damage or threats of damage associated with birds. Similar to other recommendations that WS could make when providing technical assistance, the entity requesting assistance would be responsible for providing a supplemental food source and/or planting and maintaining lure crops. WS employees would not recommend the use of supplemental feeding or the use of lure crops over large areas and would not recommend modifying habitat to plant lure crops to the extent that would result in the removal or modification of large areas of habitat. The use of lure crops is likely to occur in areas already modified for agriculture production.

➢ *Exclusionary Devices*

Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary exclusionary methods are netting and overhead lines but could include fencing and surface coverings. The use of exclusionary methods may include floating plastic balls or wire grids across water retention ponds to prevent birds from using the ponds because they pose a bird strike threat to aircraft. Exclusionary methods could include using overhead wires in outdoor eating areas at a restaurant to discourage birds from attempting to take food from customers. The use of exclusionary methods is primarily associated with areas modified by people because birds are posing a threat to human health and safety or causing damage to a resource valued by people, such as buildings, infrastructure, turf, and agricultural commodities.

Given the expense of excluding birds from large areas, exclusionary methods are often restricted to small areas around high value resources (*e.g.*, netting over a small grain research plot). Therefore, purchase and installation of exclusionary devices would primarily occur by the entity experiencing damage or threats of damage. In addition, exclusionary methods may have limited application because their use could restrict people's access to the resource. For example, netting installed to prevent birds from nesting on a bridge could prevent access to people that inspect the safety of the bridge. Netting over an aquaculture pond may require repeated daily removal to feed aquaculture stock in a pond. Any exclusionary device installed to prevent access of target species also potentially excludes non-target species. However, WS personnel and other entities would not employ exclusionary devices over large geographical areas or use those devices at such an intensity level 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. Through a programmatic risk assessment, WS has determined the use of exclusionary devices to manage wildlife damage poses a low risk to the environment, including risks to non-target animals (USDA 2023*b*).

- *Visual Scaring Techniques*

Several visual scaring methods would be available for WS personnel to recommend and/or use to manage damage. The intent associated with the use of visual dispersal methods would be to elicit a flight response by scaring target birds from an area where damage was occurring or where damage could occur. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of non-target animals, or the ability of non-target animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur a non-target animal would have to encounter a visual dispersal method and the resulting visual stimuli would have to elicit a negative response. Like other non-lethal methods, WS personnel would not employ visual dispersal methods over large geographical areas or use those devices at such an intensity level 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.

- *Trained Dogs*

WS could use and/or recommend trained dogs to disperse waterfowl in areas where they are causing damage or posing a threat of damage. Only authorized WS personnel can use trained dogs and personnel can only use trained dogs to conduct specific functions. Pursuant to WS Directive 2.445, "*WS personnel shall control and monitor their trained dogs at all times. A trained dog is considered controlled when the dog responds to the command(s) of WS personnel by exhibiting the desired or intended behavior as directed*." Therefore, WS personnel would use dogs that are proficient in the skills necessary to disperse waterfowl in a manner that was responsive to the handler's commands. To ensure proper monitoring and control, WS personnel use various methods and equipment, such as muzzles, electronic training collars, harnesses, leashes, voice commands, global positioning system collars, and telemetry collars. Because WS personnel would only use trained dogs that are responsive to commands, WS personnel can call back dogs if they determine the dogs begin approaching a non-target species. Therefore, the use of trained dogs would not have adverse effects on the populations of non-target species.

- *Electronic Hazing Devices, Pyrotechnics, Propane Cannons*

Like the use of visual dispersal methods, the intent with the use of auditory dispersal methods, such as electronic hazing devices, pyrotechnics, and propane cannons, is to illicit a flight response in target bird species by mimicking distress calls or producing a novel or adverse noise. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of non-target animals, or the ability of non-target animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur, non-target animals would have to be within hearing distance at the time WS personnel used an auditory method and the resulting noise stimuli would have to elicit a negative response. Like other non-lethal methods, WS personnel would not use those methods over large geographical areas or at such an intensity level 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.

- *Paintballs*

As described on product labeling and Safety Data Sheets, paintballs are non-toxic to people and do not pose an environmental hazard. However, consumption may cause toxicosis in dogs, which is potentially fatal without supportive veterinary treatment (Donaldson 2003). Although unknown, Donaldson (2003) speculated the there is an osmotic diuretic effect resulting in an abnormal electrolyte and fluid balance in dogs that consume paintballs. Most affected dogs recovered within 24 hours (Donaldson 2003). WS would store paintballs in accordance with manufacturer's recommendations to prevent dogs and other non-target animals from consuming paintballs. Based on the product labeling, Safety Data Sheets, and the use pattern of paintballs, WS does not anticipate the use of paintballs would have any effect on non-target animals and their populations.

- *High-pressure Water Spray*

WS would primarily use high-pressure water spray to remove inactive nests on bridges, buildings, and other structures. WS could occasionally use high-pressure water spray to disperse roosts of birds in urban settings. WS would use high-pressure water spray in situations where other methods were ineffective or where the noise produced by other methods was prohibited or of concern. Requests for assistance associated with roosting birds often occur in areas where the fecal droppings of birds are posing a threat to human health and safety, causing property damage, and are esthetically displeasing. Those roosting areas are often associated with residential and commercial areas. Some concern could arise from water runoff during activities. For instance, water could soak into the soil, runoff into nearby streams, enter a municipal sewer system, and/or enter into a municipal storm water system.

WS does not anticipate effects to non-target animals would occur from removing inactive nests because nests or parts of nests are likely to fall after birds abandon the nests at the end of the nesting season as nests deteriorate from weather and other natural processes. In addition, WS often attempts to remove nests as a bird is constructing the nest, which would also limit the amount of debris falling under the location of the nest or nests. WS does not anticipate removing nests using high-pressure water spray with any frequency or intensity that would result in effects to non-target species. WS does not anticipate effects to non-target animals would occur because WS would not introduce anything other than water and nesting materials into the soil, streams, sewer systems, and/or storm water systems, which is a process that occurs normally during rain events and from the natural deterioration of nests. In addition, WS does not anticipate using high-pressure water spray with any frequency or intensity that would result in effects.

- *Live traps*

Live traps (*e.g*., cage traps, pigeon traps, decoy traps) generally allow a target bird species to enter inside the trap but prevent the bird from exiting the trap. When using live-traps, WS personnel generally use bait and/or a lure to attract target bird species and to encourage a target bird or birds to enter the trap. Live traps have the potential to capture non-target species if they enter inside the trap. The placement of live-traps in areas where target species are active and the use of target-specific attractants would likely minimize the capture of non-target animals. WS personnel would attend to live-traps appropriately, which would allow them to release any non-target animals captured unharmed. For example, under the blackbird depredation order, when using a live-trap to capture blackbirds, WS personnel would check live-traps at least once every day (see 50 CFR 21.150). Therefore, WS personnel could release any non-target animals captured in live traps. WS does not anticipate the use of live-traps would adversely affect non-target animal populations because WS personnel would check live-traps appropriately and could release non-target animals unharmed.

- *Nets*

Nets (*e.g.*, cannon nets, mist nets, bow nets, dipping nets) are a live-capture method that restrain birds once captured. Nets have the potential to capture non-target species. Net placement in areas where target species are active, and the use of target-specific attractants would likely minimize the capture of non-target animals. WS personnel would attend to nets appropriately, which would allow them to release any non-target animals captured unharmed.

Nets could include the use of net guns, net launchers, cannon/rocket nets, drop nets, hand nets, bow nets, and mist nets. Nets are virtually selective for target individuals because application would occur by attending personnel or WS personnel would check nets frequently to address any live-captured animals. Therefore, WS personnel could release any non-target animals captured using nets on site. WS personnel would handle any non-target animals captured so as to ensure the survivability of the animal if released. Even though live capture of an animal 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 cannon or rocket assemblies during deployment. The likelihood of cannon or rocket assemblies striking a non-target animal is extremely low because a non-target animal must be present when WS personnel activate the net and the non-target animal must be in a position where the assemblies strike the animal. WS personnel would position nets so the net envelops target birds upon deployment, which would minimize the risk of assemblies striking a non-target animal.

When using nets, WS personnel would often use a bait to attract target species and to concentrate target species in a specific area to ensure the net completely envelopes target birds. Therefore, WS personnel could abandon sites if non-target use of the area was high or could refrain from firing the net at a time when non-target animals were present. WS does not anticipate the use of nets would adversely affect non-target animal populations because WS personnel would be present on site or would attend to nets appropriately and could release non-target animals unharmed.

- *Modified Padded Foothold Trap*

As discussed in Appendix B, WS would primarily use modified padded foothold traps on top of poles at airport and military facilities to live-capture raptors that were posing an aircraft strike risk. Elevating modified padded foothold traps on poles to live-capture raptors at airports would limit risk of exposure for many non-target animals. WS could occasionally place modified padded foothold traps on the ground or submerge the trap in shallow water to live-capture larger bird species, such as white pelicans. WS would place modified padded foothold traps in areas frequently used by the target bird species. When using modified padded foothold traps, WS personnel would monitor the traps frequently. WS personnel would remove the modified padded foothold trap or disengage the trap to prevent capture when not in use. Elevating a trap on a pole, placing traps in areas frequently used by a target bird species, and monitoring the trap would minimize risks of non-target animals encountering and triggering a trap. WS does not anticipate the use of modified padded foothold traps would adversely affect non-target animal populations because WS personnel would check those traps appropriately and could release non-target animals unharmed.

- *Nest Destruction*

WS personnel would remove nests by hand, with hand tools, or by high-power water spray, which would allow WS personnel to identify the nest to bird species prior to removal. WS personnel have experience and receive training in wildlife identification, which allows them to identify individual species. WS personnel would be familiar with the nests of a target species before destroying a nest; therefore, it is highly unlikely WS personnel would inadvertently destroy the nest of a non-target species. Nest destruction would have no effect on non-target animals or their populations because WS personnel would identify the species using the nest prior to destroying it.

- *Translocation*

WS often uses translocation when damage or threats of damage occur during the migratory periods when many bird species do not have well defined territories as birds migrate to and/or through the state. WS would primarily translocate raptor species and primarily when those species present an aircraft strike risk at airports. WS does not anticipate live capturing and releasing target species to have any effect on non-target species. Although raptor species translocated to other areas could feed on prey species, Schafer et al. (2002) found that the majority of translocated red-tailed hawks dispersed from the release site within five days of translocation indicating that inundation of discharged species in a release area is not a likely consequence.

- *Aircraft*

Low-level flights have the potential to disturb wildlife. Aerial operations could be an important method for surveying, monitoring, and tracking birds in Georgia. Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying aircraft to monitor the status of many animal populations, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (USFWS 2022), and colonial waterbirds (Speich 1986). Low-level flights also occur when entities use aircraft to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1996).

A number of studies have looked at responses of various wildlife species to aircraft overflights. The National Park Service (1995) reviewed the effects of aircraft overflights on wildlife and suggested that adverse effects could occur to certain species. Some species will frequently or at least occasionally show an adverse response to even minor overflights. However, it appears that the more serious potential adverse effects occur when overflights are chronic (*i.e.*, they occur daily or more often over long periods). Chronic exposures often involve areas near commercial airports and military flight training facilities. Aerial operations conducted by WS rarely occur in the same areas on a daily basis, and aircraft used by WS actually spend little time flying over those particular areas.

The effects on wildlife from military-type aircraft have been studied extensively (Air National Guard 1997) and were found to have no expected adverse effects on wildlife. In general, the greatest potential for impacts to occur exists when overflights are frequent, such as hourly and over many days that could represent "*chronic*" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species often habituate to overflights, which would naturally minimize any potential adverse effects where such flights occur on a regular basis. Therefore, aircraft used by WS should have far less potential to cause any disturbance to wildlife than military aircraft because the military aircraft produce much louder noise and would be flown over certain training areas many more times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997).

Examples of species or species groups that people have studied with regard to the issue of aircraft-generated disturbance are as follows:

WATERBIRDS AND WATERFOWL: Low-level overflights of two to three minutes in duration by a fixed-wing airplane and a helicopter produced no "*drastic*" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Anser caerulescens atlantica*) to human disturbance on a sanctuary area and estimated the energetic cost of such disturbance. Belanger and Bedard (1989, 1990) observed that disturbance rates exceeding two per hour reduced goose use of the sanctuary by 50% the following day. They also observed that about 40% of the disturbances caused interruptions in feeding that would require an estimated 32% increase in nighttime feeding to compensate for the energy lost. They concluded that managers should strictly regulate overflights of sanctuary areas to avoid adverse effects. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*Mareca americana*), gadwall (*M. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the daily activities of the species. Thus, there is little to no potential for any adverse effects on waterbirds and waterfowl.

RAPTORS: The Air National Guard analyzed and summarized the effects of overflight studies conducted by numerous federal and state government agencies and private organizations (Air National Guard 1997). Those studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (see Ellis 1981, Fraser et al. 1985, Lamp 1989, United States Forest Service 1992 as cited in Air National Guard 1997). A study conducted on the impacts of overflights to bald eagles suggested that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). During the study, observations were made of more than 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10% of the time during aircraft overflights. Evidence also suggested that golden eagles were not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Finally, one other study found that eagles were particularly resistant to disturbances flushing them from their nests (see Awbrey and Bowles 1990 as cited in Air National Guard 1997). Therefore, there is considerable evidence that overflights during aerial operations would not adversely affect eagles.

Mexican spotted owls (*Strix occidentalis lucida*) (Delaney et al. 1999) did not flush when chain saws and helicopters were greater than 110 yards away; however, owls flushed to these disturbances at closer distances and were more prone to flush from chain saws than helicopters. Owls returned to their pre-disturbance behavior 10 to 15 minutes following the event and researchers observed no differences in nest or nestling success (Delaney et al. 1999), which indicates that aircraft flights did not result in adverse effects on owl reproduction or survival.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period because results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights but found that ferruginous hawks (*B. regalis*) were sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft (White and Thurow 1985). White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco* spp.), and golden eagles were "*incredibly tolerant*" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief, and the overflights never limited productivity.

Grubb et al. (2010) evaluated golden eagle response to civilian and military (Apache AH-64) helicopter flights in northern Utah. Study results indicated that golden eagles exposed to flights ranging from 100 to 800 meters along, towards, and from behind occupied cliff nests did not adversely affect eagle courtship, nesting, and fledglings, indicating that no special management restrictions were required in the study location.

The above studies indicate raptors were relatively unaffected by aircraft overflights, including those by military aircraft that produce much higher noise levels. Therefore, aerial operations would have little or no potential to affect raptors adversely.

PASSERINES: Reproductive losses have been reported in one study of small territorial passerines ("*perching*" birds that included sparrows, blackbirds) after exposure to low altitude overflights (see Manci et al. 1988 as cited in Air National Guard 1997), but natural mortality rates of both adults and young are high and variable for most species. The research review indicated passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which indicated quieter noise would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988, United States Forest Service 1992). Those studies and reviews indicated there is little or no potential for aerial operations to cause adverse effects on passerine bird species.

DOMESTIC ANIMALS AND SMALL MAMMALS: A number of studies with laboratory animals (*e.g.*, rodents [Borg 1979]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have demonstrated that they can habituate to noise. Long-term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "*fight or flight*" response, while marked, does not appear to have any long-term health consequences on small mammals (Air National Guard 1997). Small mammals habituate, although with difficulty, to sound levels greater than 100 dbA (United States Forest Service 1992).

Information on the effects of aerial overflights demonstrates the relative tolerance most wildlife species have of overflights, even those that involve noise at high decibels, such as from military aircraft. In general, the greatest potential for impacts to occur exists when overflights are frequent, such as hourly and over many days that could represent "*chronic*" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species often habituate to overflights, which would naturally minimize any potential adverse effects where such flights occur on a regular basis. Therefore, aircraft used by WS should have far less potential to cause any disturbance to wildlife than military aircraft because the military aircraft produce much louder noise and would be flown over certain training areas many more times per year, and yet were found to have no expected adverse effects on wildlife (Air National Guard 1997).

WS would only conduct aerial activities on a very small percentage of the land area of the state, which indicates that WS would not expose most wildlife to aerial overflights. Further lessening the potential for any adverse effects would be that such flights occur infrequently throughout the year.

➢ *Unmanned Aerial Vehicles*

WS could use UAVs to locate and haze target bird species. WS could use UAVs to elicit a flight response by scaring target birds from an area where damage was occurring or where damage could occur. WS could also use UAVs with the intent of locating or monitoring individuals or groups of birds and their associated nests or eggs. WS would not purposefully pursue non-target animals with UAVs. WS would not generally conduct activities with UAVs over or in close proximity to locations where colonial waterbirds are currently nesting unless requested by the property owner or manager. In those cases, WS can work with the property owner or manager to maintain minimal distances from nesting colonials of waterbirds to minimize disturbance.

Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of non-target animals, or the ability of non-target animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur, non-target animals would have to visually encounter UAVs and/or be within hearing distance at the time WS personnel used UAVs and the resulting visual and/or auditory stimuli would have to elicit a negative response. Like other non-lethal methods, WS personnel would not employ UAVs over large geographical areas or use UAVs at such an intensity level 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.

➢ *Anthraquinone and Methyl Anthranilate*

Anthraquinone and methyl anthranilate are available as chemical repellents to discourage or disrupt particular behaviors of wildlife. Anthraquinone naturally occurs in some plant species, such as aloe. Methyl anthranilate naturally occurs in grapes and often occurs as a flavor additive in food, candy, and soft drinks. Taste repellents containing anthraquinone or methyl anthranilate are commercially available and available for use by the public. Products containing anthraquinone or methyl anthranilate are liquids that people apply directly to susceptible resources and require target bird species to ingest the product. Applying products containing anthraquinone or methyl anthranilate to a food source, such as turf, often makes the food source unpalatable to a target bird species, such as waterfowl. Some commercially available products allow the use of methyl anthranilate in fogging applications that act as an olfactory repellent. The use of methyl anthranilate in fogging applications can disperse target bird species in areas where they congregate in large numbers, such as a blackbird roost at an industrial facility. When inhaled, the methyl anthranilate fog acts as a mild irritant to birds (see further discussion in Appendix B). Methyl anthranilate is slightly toxic to fish and aquatic invertebrates. The EPA (2015) stated, "*No risk to the environment are expected when* [anthraquinone and methyl anthranilate] *are used according to the label instructions*".

Because repellents containing anthraquinone and methyl anthranilate are general use pesticides that the public can purchase and use, WS may recommend their use to people when providing technical assistance. WS would infrequently use repellents containing anthraquinone or methyl anthranilate when providing direct operational assistance. WS personnel would only recommend and/or use those chemical repellents registered with the EPA pursuant to the FIFRA and registered with the Georgia Department of Agriculture for use in the state. People, including WS personnel, are required to follow the product label when using repellents. Product labels for the repellents have use restrictions to limit exposure of non-target animals. WS would follow label requirements when using repellents containing anthraquinone or methyl anthranilate. WS does not anticipate using repellents containing anthraquinone or methyl anthranilate with any frequency or at an intensity level that their use would affect non-target animals.

➢ *Nicarbazin*

Commercial products are available that contain the active ingredient nicarbazin that, when ingested by target bird species, can reduce the hatchability of eggs laid. Nicarbazin is the only reproductive inhibitor currently registered with the EPA for certain bird species and the only reproductive inhibitor approved for use in Georgia by the Georgia Department of Agriculture. In Georgia, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons, European starlings, red-winged blackbirds, Brewer's blackbirds, common grackles, boat-tailed grackles, and brown-headed cowbirds, which is available as a general use commercial product available to the general public under the trade name OvoControl® P.

Use restrictions of OvoControl® P limit its use to rooftops or other flat paved or concrete surfaces and limited to use in secured areas with limited public access. Nicarbazin is available for use on rooftops or other flat paved or concrete surfaces in non-food areas of manufacturing facilities, power utilities, hospitals, food processing plants, distribution centers, oil refineries and processing centers, chemical plants, rail yards, schools, campuses, military bases, seaports, hotels, apartments, condominiums, maintenance yards, shopping malls, feed mills, airports and other commercial or industrial locations. In addition, applicators must ensure that children and pets do not come in contact with the bait and applicators cannot apply the product within 20 feet of any body of water, including lakes, ponds, or rivers. Commercial products containing the active ingredient nicarbazin were also available for Canada geese and domestic waterfowl in the past; however, those products are no longer available and the manufacturer has not registered those products with the Georgia Department of Agriculture for use in Georgia.

Exposure of non-target animals to nicarbazin could occur from direct ingestion of the bait or from secondary hazards associated with wildlife consuming birds that have eaten treated bait. Several label restrictions of nicarbazin would reduce risks to non-target wildlife from direct consumption of treated bait (EPA 2005). The current label for nicarbazin requires applicators condition target birds to a daily feeding routine using untreated bait. Conditioning would occur when target birds habituate to a daily feeding routine. If the applicator cannot condition target bird species to feed on the untreated bait within 30-days, then the applicator must abandon the site. In addition, applicators can only apply nicarbazin using an automatic wildlife feeder that is programmed to release bait once a day. Applicators must monitor baiting locations periodically for non-target animal activity. The label also requires the applicator ensure target birds consume a daily dose of bait within 15 minutes. The locations of application can further minimize risks to non-target animals (*e.g.*, on rooftops).

When consumed by birds, nicarbazin is broken down into the two base components of 4,4'-dinitrocarbanilide (DNC) and 2-hydroxy-4,6-dimethylpyrimidine (HDP), which are then rapidly excreted. Nicarbazin is only effective in reducing the hatchability of eggs when blood levels of DNC are sufficiently elevated in a bird species. To maintain the high blood levels required to reduce egg hatch, birds must consume nicarbazin daily at a sufficient dosage that appears to be variable depending on the bird species (Yoder et al. 2005, Avery et al. 2006). For example, to reduce egg hatch in Canada geese, geese must consume nicarbazin at 2,500 ppm compared to 5,000 ppm required to reduce egg hatch in pigeons (Avery et al. 2006, Avery et al. 2008*b*). In pigeons, consuming nicarbazin at a rate that would reduce egg hatch in Canada geese did not reduce the hatchability of eggs (Avery et al. 2006). With the rapid excretion of the two components of nicarbazin (DNC and HDP) in birds, non-target birds would have to consume nicarbazin daily at sufficient doses to reduce the rate of egg hatching.

Secondary hazards also exist from wildlife consuming target birds 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 a non-target animal would have to consume HDP at a level to allow for absorption of DNC into the bloodstream. In addition, a non-target animal would have to consume an appropriate level of DNC and HDP from a carcass daily to produce any negative reproductive effects because current evidence indicates a single dose does not limit reproduction. To be effective, a target bird must consume nicarbazin (both DNC and HDP) daily during the duration of the reproductive season to limit the hatchability of eggs.

Therefore, to experience the reproductive effects of nicarbazin, a non-target animal would need to consume the carcass of a target bird species daily and a high enough level of DNC and HDP would have to be available in the carcass and consumed for nicarbazin to affect the reproduction of a non-target animal. Based on the risks and likelihood of non-target 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 would be extremely low (EPA 2005).

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

Potential effects of implementing alternative 2 on eagles

If WS implemented Alternative 2, WS would only conduct limited activities near active eagle nests and Important Eagle Use Areas in accordance with the National Bald Eagle Management Guidelines (USFWS 2007*b*). The categories from the guidelines that would encompass most of these activities are Category D (off-road vehicle use), Category E (motorized watercraft use), Category F (non-motorized recreation and human entry), and Category H (blasting and other loud, intermittent noises). Those categories generally call for a buffer of 330 to 660 feet around active nests for Category D, Category E, and Category F activities, and a half mile buffer for Category H activities. Although similar guidelines do not exist for golden eagles, WS would apply those guidelines when encountering golden eagles. In addition, golden eagles do not nest in Georgia but may be present during the migration periods and during the winter. WS does not expect the use of non-lethal methods to agitate or bother a bald eagle or golden eagle to a degree that causes, or is likely to cause, a decrease in its productivity or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. WS based this determination on its adherence to the national bald eagle management guidelines (see USFWS 2007*b*).

Alternative 3 - WS would recommend an integrated methods approach to managing bird damage in Georgia through technical assistance only

Under a technical assistance alternative, WS would have no direct impact on non-target species, including threatened or endangered species. Those persons requesting assistance could employ methods that WS personnel recommend or provide through loaning of equipment. Using the WS Decision Model, WS personnel would base recommendations from information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize impacts on non-target animals associated with the methods that personnel recommend or loan. Methods recommended could include non-lethal and lethal methods as deemed appropriate by the WS Decision Model and as permitted by laws and regulations. The only method that would not be available under a technical assistance only alternative would be DRC-1339, which is only available for use by WS employees.

The potential impacts to non-target animals under this alternative would be variable and based on several factors. If people employed methods as recommended by WS, the potential impacts to non-target animals would likely be similar to Alternative 1. If people who were provided technical assistance did not use the recommended methods and techniques correctly or if people used methods that WS did not recommend, the potential impacts on non-target species, including threatened or endangered species, would likely be higher when compared to Alternative 1.

The potential impacts of hazing and exclusionary methods on non-target species would be similar to those described for Alternative 1. Hazing and exclusionary methods would be easily obtainable and simple to employ. Because identification of targets would occur when employing shooting as a method, the potential impacts to non-target species would likely be low under this alternative. However, the knowledge and experience of the person could influence their ability to distinguish between similar bird species correctly.

Those people experiencing damage from birds may implement methods and techniques based on the recommendations of WS. The knowledge and skill of those persons implementing recommended methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in non-target animal removal when compared to the non-target animal removal that could occur by WS under Alternative 1.

If WS provided technical assistance to people but those people did not implement any of the recommended actions and conducted no further action, the potential to remove non-target animals would be lower when compared to Alternative 1. If those persons requesting assistance implemented recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-target animals would be similar to Alternative 1. If WS made recommendations on the use of methods to alleviate damage but people did not implement those methods as recommended by WS or if people used those methods recommended by WS inappropriately, the potential for lethal removal of non-target animals would likely increase under a technical assistance only alternative. Therefore, the potential impacts to non-target animals, including threatened or endangered 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 threatened or endangered species.

When the damage caused by wildlife reaches a level where assistance does not adequately reduce damage or where assistance is not available, people sometimes resort to using chemical toxicants that are illegal for use on the intended target species that often results in loss of both target and non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by people frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can result in the indiscriminate take of wildlife species.

People requesting assistance are likely to use lethal methods because a damage threshold has been met for that person and has triggered them to seek assistance to reduce damage. The potential impacts on non-target animals by those persons experiencing damage would be highly variable. People whose bird damage problems that were not effectively resolved by non-lethal control methods would likely resort to other means of legal or illegal lethal control. This could result in less experienced persons implementing control methods and could lead to greater take of non-target wildlife than the proposed action.

WS recommendation that birds be harvested during the regulated season by private entities to alleviate damage would not increase risks to non-target animals. Shooting would essentially be selective for target species and the unintentional lethal removal of non-target animals would not likely increase based on WS recommendation of the method.

The ability to reduce negative effects caused by birds to wildlife species and their habitats, including threatened or endangered species, would be variable under this alternative. The skills and abilities of the person implementing damage management actions would determine the risks to non-target animals.

Alternative 4 – WS would not provide any assistance with managing damage caused by birds in Georgia

Under this alternative, WS would not provide any assistance with managing damage associated with birds in the state. Therefore, no direct impacts to non-target animals or threatened or endangered species would occur by WS under this alternative. Risks to non-target animals and threatened or endangered species would continue to occur from those people who implement damage management activities on their own or through recommendations by other federal, state, and private entities. Although some risks could occur from those people who use methods in the absence of any involvement by WS, those risks would likely be low, and would be similar to those risks under the other alternative approaches.

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 approach. The risks to non-target animals and threatened or endangered species would be similar across the alternative approaches because most of those methods described in Appendix B would be available for use by people if WS implements this alternative approach. If people apply those available methods as intended, risks to non-target animals would be minimal to non-existent. If people apply those available methods incorrectly or without knowledge of animal behavior, risks to non-target animals could be higher if WS implements this alternative. If frustration from the lack of available assistance causes those persons experiencing bird damage to use methods that are not legally available for use, risks to non-target animals could be higher if WS implements this alternative. People have resorted to the use of illegal methods to resolve wildlife damage, which has resulted in the lethal take of non-target animals (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003).

3.1.3 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. An evaluation of the threats to human health and safety associated with the methods available under the alternative approaches occurs below for each of the four alternative approaches carried forward for further analysis.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia (Proposed Action/No Action)

If WS implements Alternative 1, WS personnel would assess the damage or threat occurring, evaluate the management methods available, and formulate a management strategy to alleviate damage or reduce the risk of damage. A WS employee would formulate a management strategy by selecting from those methods described in Appendix B that the employee determines to be practical for use. WS employees who conduct activities to alleviate bird damage would be knowledgeable in the use of methods, the wildlife species responsible for causing damage or threats, and WS directives. WS personnel would incorporate that knowledge into the decision-making process inherent with the WS Decision Model, which they would apply when addressing threats and damage caused by birds. Therefore, when evaluating management methods and formulating a management strategy for each request for assistance, WS employees would consider risks to human health and safety associated with methods.

For example, WS personnel would consider the location where activities could occur. Risks to human safety from the use of methods would likely be greater in highly populated urban areas in comparison to rural areas that are less densely populated. If WS personnel conducted activities on rural private property, where the property owner or manager could control and monitor access to the property, the risks to human safety from the use of methods would likely be lower. 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. In general, WS personnel would conduct activities when human activity was minimal (*e.g*., early mornings, at night) or in areas where human activity was minimal (*e.g*., in areas closed to the public).

WS personnel receive training in the safe use of methods and would follow the safety and health guidelines required by WS directives (*e.g*., see WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635, WS Directive 2.640). For example, WS employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.605. In addition, WS personnel would also follow WS Directive 2.635 that establishes guidelines and standard training requirements for health, safety, and personal protection from zoonotic diseases. When responding to oil spills and other hazardous materials operations, WS personnel would follow WS Directive 2.640. When using watercraft, WS employees would follow the guidelines in WS Directive 2.630. In addition, WS use of methods would comply with applicable federal, state, and local laws and regulations (see WS Directive 2.210).

Before providing direct operational assistance, WS and the entity requesting assistance would sign a work initiation document that would indicate the methods the cooperating entity agrees to allow WS to use on the property they own or manage. Thus, the cooperating entity would be aware of the methods that WS could use on property they own or manage, which would help identify any risks to human safety associated with the use of those methods. WS personnel would also make the cooperator requesting assistance aware of threats to human safety associated with the use of methods.

Besides direct operational assistance, WS could also recommend methods to people when providing technical assistance. As described previously, technical assistance would consist of WS personnel providing recommendations on methods the requester could use themselves to resolve damage or threats of damage without any direct involvement by WS. Technical assistance could also consist of occasionally providing methods to a requester that might have limited availability, such as propane cannons. If people receiving technical assistance use methods according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to those risks if WS personnel were using those methods. If people use methods without guidance from WS or apply those methods inappropriately, the risks to human safety could increase. The extent of the increased risk would be unknown and variable. However, methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods. If WS implements Alternative 1, risks to human health and safety associated with WS personnel providing technical assistance would be identical to those risks discussed if WS implemented Alternative 3. A discussion of threats to human health and safety for the methods discussed in Appendix B occurs below.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

Section I and Section II in Appendix B discuss several non-chemical methods that would be available for use by WS. When using non-chemical lethal methods, WS personnel would dispose of carcasses in accordance with WS Directive 2.515 and would comply with requirements in depredation orders, control orders, depredation permits, and/or authorizations issued by the USFWS and/or the GDNR for activities associated with birds. WS personnel would also notify the cooperator requesting assistance of threats to human safety associated with the use of methods. Risks to human safety from activities and methods would be similar to the other alternative approaches because the same methods would be available. If people misuse or apply those methods 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.

No adverse effects to human safety have occurred from WS use of non-chemical methods to alleviate bird damage in the state from FY 2017 through FY 2022. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low (USDA 2019*c*, USDA 2019*d*, USDA 2019*e*, USDA 2019*f*, USDA 2019*g*, USDA 2020, USDA 2021, USDA 2022*a*, USDA 2022*b*, USDA 2022*c*, USDA 2023*a*, USDA 2023*b*, USDA 2023*c*, USDA 2023*d*, USDA 2023*e*). Based on the use patterns of methods available to address damage caused by birds, the use of non-chemical would comply with Executive Order 12898, Executive Order 13045, and Executive Order 13985.

Human presence

As discussed previously, human presence may consist of physical actions of people or the presence of people and/or a vehicle. If WS implements Alternative 1, WS activities would comply with relevant laws, regulations, policies, orders, and procedures. WS personnel would follow the safety and health guidelines required by WS directives (*e.g*., see WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635). Therefore, the physical actions of WS employees, including the presence of employees and vehicles would not pose threat to human health and safety.

Changes in cultural practices and exclusion methods

Based on their use profile for alleviating damage associated with wildlife, WS considers risks to human safety associated with changes in cultural practices and exclusion methods to be low. The use of fencing, surface coverings, overhead lines/wires, and netting to exclude birds would not pose risks to human health and safety. WS would not use electrified fencing in areas where risks to human safety would occur. For example, restricting the use of electrified fencing to agricultural areas where waterfowl are feeding on crops. Altering cultural practices would not pose a threat to human health and safety. Through a programmatic risk assessment, WS has determined the use of exclusionary methods to manage wildlife damage poses a low risk to human health and safety (USDA 2023*b*).

Auditory deterrents

Auditory deterrents that WS could use and/or recommend would include electronic hazing devices, pyrotechnics, and propane cannons. Risks to human health and safety would primarily occur from the noise produced by those methods, such as hearing loss from repeated and/or prolonged exposure to the noise produced by those methods. Other risks could include fire risks and bodily harm associated with the use of pyrotechnics and propane cannons. Although hazards to human safety from the use of auditory deterrents do occur, those methods are generally safe when used by trained individuals who have experience in their use. For example, although some risk of fire and bodily harm exists from the use of pyrotechnics, when used appropriately and in consideration of those risks, WS personnel can use those methods with a high degree of safety. WS employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.605. WS personnel who use pyrotechnics would follow the guidelines for using pyrotechnics in accordance with WS Directive 2.627. Through a programmatic risk assessment, WS has determined the use of pyrotechnics to manage wildlife damage poses a low risk to human health and safety (USDA 2023*c*).

Visual deterrents

Visual deterrents that WS personnel could use and/or recommend would include Mylar tape, eyespot balloons, flags, effigies, lasers, and lights. Lasers and lights would 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. Similarly, the use of mylar tape, eyespot balloons, flags and effigies would not pose risks to human safety.

Trained dogs

WS could use and/or recommend the use of trained dogs to disperse waterfowl in areas where they are causing damage or posing a threat of damage. The use of trained dogs would primarily occur at parks, airports, industrial complexes, and residential areas where waterfowl may congregate. WS would only use trained dogs that are responsive to their handler, which would minimize risks to the public.

High-pressure water spray

WS expects the use of high-pressure water spray to pose minimal risks to human health and safety. WS personnel would not direct water toward people and would be present on site to prevent people from access areas where WS personnel use this method.

Live-capture methods and translocation

Live-capture methods that would be available for WS personnel to use and/or recommend would include bow nets, hand nets, drop nets, mist nets, net guns, cannon nets, cage traps, nest box traps, raptor traps, corral traps, and modified padded foothold traps. Live-capture methods are typically set in situations where human activity would be minimal to ensure public safety. Traps rarely cause serious injury because live-capture traps available for birds are typically walk-in style traps where birds enter but are unable to exit or require a target bird species to trigger the trap. Therefore, human safety concerns associated with live traps used to capture birds require direct contact to cause bodily harm. If left undisturbed, risks to human safety would be minimal. In addition, WS personnel would be on site during the use of modified padded foothold traps and would monitor the traps. Other live-capture devices, such as cannon nets, pose minor safety hazards to the public because activation of the device occurs by trained personnel that are present on site and personnel would only activate the method after they observe target species in the capture area of the net. Personnel employing nets are present at the site during application to ensure the safety of the public and operators.

Although some fire and explosive hazards exist with cannon nets during ignition and storage of the explosive charges, safety precautions associated with the use of the method, when adhered to, pose minimal risks to human safety and primarily occur to the handler. WS would not use cannon nets in areas where public activity was high, which further reduces the risks to the public. WS would use nets in areas with restricted public access whenever possible to reduce risks to human safety. WS personnel employing hand nets would also be present at the site during application to ensure the safety of the public. Through programmatic risk assessments, WS has determined the use of cage traps (USDA 2019*c*), cable devices (USDA 2019*d*), foothold traps (USDA 2019*e*), nets (USDA 2020), and hand capture (USDA 2023*d*) to manage wildlife damage pose a low risk to human health and safety.

After using live-capture methods to capture birds, WS could translocate those birds to other areas. WS would primarily translocate raptor species when those species present an aircraft strike risk at airports. The translocation of birds would not pose a risk to the public. WS personnel would wear gloves and other personal protective equipment to minimize the risks associated with handling and transporting translocated birds. Therefore, the release of birds after live-capture would not pose a risk to human health and safety.

Nest destruction

WS could use nest destruction to discourage birds from nesting in areas by removing nesting material. Removal of nesting material by WS personnel would occur by hand, hand tools, and/or high-pressure water spray. Birds generally build nests using sticks, vegetation, and similar debris. The removal of nesting material by WS personnel would not pose risks to the public and would pose a very low risk to WS employees. Minor injuries could occur to WS employees related to bending to remove nesting material on the ground or from falling debris from removing nests in trees or other structures, such as bridges.

Unmanned Aerial Vehicles

When using UAVs, WS personnel would adhere to all federal, state, and local laws. All WS personnel who use UAVs are required to have a commercial Remote Pilot Certificate from the Federal Aviation Administration. To help ensure safe use and awareness, WS employees who use UAVs receive training from an approved UAV training course and to remain certified to use UAVs, WS employees must operate an UAV every 90 days to maintain proficiency. WS personnel who use UAVs are also required to follow the guidelines established in the WS Small Unmanned Aircraft System Flight Operations Procedures manual. When possible, there would be a minimum of two WS personnel present: a Pilot-in-Command, who is remotely controlling the UAV, and a Visual Observer, who alerts the Pilot-in-Command of any dangers while the UAV is being flown. The UAV must always remain in the visual line-of-sight of either the Pilot-in-Command and/or the Visual Observer. Additionally, UAVs are not operated over any person who is not directly involved with flight operations. By following the safety precautions outlined by the WS Small Unmanned Aircraft System Flight Operations Procedures manual, UAVs pose minimal risks to human safety.

Snap traps

WS personnel generally place snap traps in areas where damage is occurring to the side of a building or areas associated with cavity nesting birds, which are areas elevated above the ground. Like other traps, human safety concerns associated with snap traps used to capture birds require direct contact to cause bodily harm. If left undisturbed, risks to human safety would be minimal.

Sport hunting

The recommendation by WS that people harvest birds or allow other people to harvest birds during the annual hunting seasons would not increase risks to human safety above those risks already inherent with hunting birds. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce a localized bird population that could then reduce bird damage or threats would not increase risks to human safety. Safety requirements established by the GDNR for annual hunting seasons 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.

Aircraft

WS could also use fixed-winged aircraft and/or helicopters to monitor and survey birds in the state. For example, WS could use fixed-winged aircraft to locate and count the number of American white pelicans using aquaculture facilities in the state. WS could also use unmanned aircraft to survey and locate birds. A concern when using aircraft would be the potential risks to human safety associated with aircraft accidents, which would include risks to the pilot, crewmembers, and the public.

The use of aircraft by WS would be quite different from general aviation use. The environment in which WS would conduct aerial operations would be inherently a higher risk environment than that for general aviation. Low-level flights introduce hazards, such as power lines and trees, and the safety margin for error during maneuvers is higher when comparing the safety margins associated with high-level flights. WS has established an Aviation Training and Operations Center to support aerial activities and WS recognizes that an aggressive overall safety and training program is the best way to prevent accidents.

While the goal of the aviation program is to have no accidents, accidents may still occur. All WS personnel associated with aerial operations would follow the policies and directives set forth in WS Directive 2.620, the WS Aviation Operations and Safety Manual and its amendments, Title 14 CFR, and Federal Aviation Regulations, Part 43, 61, 91, 119, 133, 135, and 137. Because of the remote locations in which WS conducts aerial operations, the risk to the public from aviation operations or accidents would be minimal. WS aircraft-use policy helps ensure the use of aircraft occurs in a safe and environmentally sound manner in accordance with federal and state laws. Through a programmatic risk assessment, WS has determined the use of aircraft to manage wildlife damage poses a low risk to human health and safety (USDA 2019*f*).

Firearms

Certain safety issues can arise related to misusing firearms and the potential human hazards associated with the use of firearms to reduce damage and threats of damage. All WS personnel who use firearms would follow the guidelines in WS Directive 2.615. To help ensure safe use and awareness, WS employees who use firearms to conduct official duties receive training from an approved firearm safety-training course. 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 subject to the Lautenberg Domestic Confiscation Law and are required to inform their supervisor if they can no longer comply with the Lautenberg Domestic Confiscation Law (see WS Directive 2.615). Through programmatic risk assessments, WS has determined the use of firearms to manage wildlife damage poses a low risk to human health and safety (USDA 2019*g*).

WS would work closely with cooperators requesting assistance to ensure that WS personnel consider all safety issues before deeming the use of firearms to be appropriate. Whether a person contacted WS or consulted with WS, the use of firearms to alleviate bird damage would be available if WS implements any of the alternative approaches unless otherwise prohibited by the USFWS in a depredation permit, depredation order, or a control order, or when prohibited by the GDNR. People can use any methods legally available to remove those bird species afforded no protection from take under the MBTA, such as pigeons, starlings, and house sparrows. Because the use of firearms to alleviate bird damage would be available under any of the alternative approaches and the use of firearms by those persons experiencing bird damage could occur whether they contacted or consulted WS, the risks to human safety from the use of firearms would be similar among all the alternative approaches.

If WS personnel use firearms to remove birds lethally, WS would retrieve the carcasses to the extent possible. WS personnel would dispose of the carcasses retrieved in accordance with WS Directive 2.515 and would comply with requirements in depredation orders, control orders, depredation permits, and/or authorizations issued by the USFWS and/or the GDNR for activities associated with birds.

Egg destruction

Egg destruction would involve puncturing, breaking, shaking, or oiling an egg. Risks to human health and safety associated with egg destruction would be minimal. Egg oiling involves the use of corn oil to coat bird eggs in the nest, which renders the egg unviable. The oil prevents exchange of gases and causes asphyxiation of developing embryos and has been found to be 96 to 100% effective in reducing hatchability (Pochop et al. 1998*a*, Pochop et al. 1998*b*). WS personnel generally apply the corn oil by hand (rubbing oil over eggs), dipping eggs in corn oil, or spraying corn oil from a pump-type (non-aerosol) container. WS personnel use commercially available, food-grade corn oil when oiling eggs. Egg oiling is generally a method used to treat the eggs of bird species that nest on the ground, such as waterfowl. WS personnel coat each egg with a light to moderate amount of corn oil. WS only uses food-grade corn oil that people use every day when preparing food and uses a small amount of corn oil to treat each egg; therefore, risks to human safety associated with the use of corn oil to coat eggs would be extremely low (USDA 2022*b*).

Cervical Dislocation for Euthanasia

After WS live-captured a bird, WS could euthanize the bird by cervical dislocation. The American Veterinary Medical Association (AVMA) guidelines on euthanasia consider cervical dislocation as conditionally acceptable method of euthanasia for birds (AVMA 2020). Risks would primarily occur to the person handling the bird and primarily from the bird scratching or biting the handler. In general, WS personnel would perform cervical dislocation outside of public view, which would minimize risks to the public. WS would dispose of carcasses euthanized in accordance with WS Directive 2.515 and would comply with requirements in depredation orders, control orders, depredation permits, and/or authorizations issued by the USFWS and/or the GDNR for activities associated with birds.

SAFETY OF CHEMICAL METHODS EMPLOYED

In addition to non-chemical methods, chemical methods could be available for WS personnel to use (see Appendix B). Many of the chemical methods would only be available to target certain bird species and/or to manage damage or threats of damage in specific situations. Those chemical methods that WS could use as part of an integrated methods approach include nicarbazin (rock pigeons, European starlings, red-winged blackbirds, Brewer's blackbirds, boat-tailed grackles, common grackles, brown-headed cowbirds only), carbon dioxide for euthanasia, egg oiling, Avitrol (rock pigeons, red-winged blackbirds, Brewer's blackbirds, boat-tailed grackles, common grackles, brown-headed cowbirds, American crows, fish crows, European starlings, house sparrows only), the avicide DRC-1339 (rock pigeons, European starlings, red-winged blackbirds, Brewer's blackbirds, boat-tailed grackles, common grackles, brown-headed cowbirds, American crows, fish crows, Eurasian collared-doves, and certain gull species only), commercially available chemical repellents, and paintballs.

WS personnel would use the WS Decision Model to determine when chemical methods were appropriate to alleviate damage. WS personnel would adhere to WS directives when using chemical methods, including WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, and WS Directive 2.465. All WS personnel who handle and administer chemical methods would receive appropriate training to use those methods. WS would dispose of carcasses in accordance with WS Directive 2.515. Through a programmatic risk assessment, WS has determined the disposal of carcasses when conducting wildlife damage management activities poses a low risk to the environment and to human health and safety (USDA 2023*e*).

No adverse effects to human safety have occurred from WS use of chemical methods to alleviate bird damage in the state from FY 2017 through FY 2022. The risks to human safety from the use of chemical methods, when used appropriately and by trained personnel, would be low. Therefore, WS does not expect any direct, indirect, or cumulative effects to occur from WS use of those chemical methods discussed below and described further in Appendix B. Based on the use patterns of methods available to address damage caused by birds, the use of chemical methods would comply with Executive Order 12898, Executive Order 13045, and Executive Order 13985.

Nicarbazin

Nicarbazin is a general use pesticide that, when applied in accordance with its directions for use, would not generally cause unreasonable adverse effects on people or the environment. Use restrictions of nicarbazin for pigeons limit its use to rooftops or other flat paved or concrete surfaces and in secured areas with limited public access. In addition, applicators must ensure that children and pets do not come in contact with the bait and applicators cannot apply the product within 20 feet of any body of water, including lakes, ponds, or rivers. Commercial products containing the active ingredient nicarbazin were also available for Canada geese and domestic waterfowl in the past; however, those products are no longer available, and the manufacturer has not registered those products with the Georgia Department of Agriculture for use in Georgia.

Threats to human safety from the use of nicarbazin would likely be minimal if applicators follow label directions. The use pattern of nicarbazin would also ensure threats to public safety were minimal. The label requires an acclimation period, which assists with identifying risks. In addition, the label requires the presence of the applicator at the location until target birds consume all of the bait or requires the applicator to retrieve any unconsumed bait. The EPA has characterized nicarbazin as a moderate eye irritant. The United States Food and Drug Administration has established acceptable daily intake[16] levels and a tolerance[17] for nicarbazin residues. The acceptable daily intake level for nicarbazin is 200 micrograms per kilogram (0.2 parts per million) of body weight per day with tolerances for chicken livers of 52 parts per million (see 21 CFR 556.445). The EPA characterized the risks of human exposure as low when used to reduce egg hatch in Canada geese. The EPA also concluded that if human consumption occurred, people would have to eat a prohibitively large amount of nicarbazin to produce toxic effects (EPA 2005). Based on the use pattern of the nicarbazin and by following label instructions, risks to human safety would be low with the primary exposure occurring to those handling and applying the product. Safety procedures required by the label, when followed, would minimize risks to handlers and applicators.

Carbon Dioxide for Euthanasia

After target bird species were live-captured, WS could euthanize those birds by placing the birds into a sealed chamber and releasing compressed carbon dioxide inside the chamber. The AVMA (2020) guidelines on euthanasia list carbon dioxide as a conditionally acceptable method of euthanasia for free-ranging birds. As with many chemical methods, risks to human health and safety primarily occur to the applicator. The carbon dioxide released into the sealed chamber would diffuse into the atmosphere once WS personnel opened the chamber to dispose of the animal. The use of carbon dioxide for euthanasia would occur in ventilated areas where exposure of the applicator or the public to large concentrations of released carbon dioxide would not occur. Because WS would use carbon dioxide in sealed chambers to euthanize birds, the risks to human safety are extremely low.

Egg Oiling

Egg oiling involves the use of corn oil to coat the eggs in the nest of a target bird species, which renders the egg unviable. WS personnel generally apply the corn oil by hand (rubbing oil over eggs), dipping eggs in corn oil, or spraying corn oil from a pump-type (non-aerosol) container. WS personnel use

---

[16]The acceptable daily intake is defined as "…*the daily intake which, during up to an entire life of a human, appears to be without adverse effects or harm to the health of the consumer*" (see 21 CFR 556.3).
[17]Tolerance is defined as "…*the maximum concentration of a marker residue, or other residue indicated for monitoring, that can legally remain in a specific edible tissue of a treated animal*" (see 21 CFR 556.3).

commercially available, food-grade corn oil when oiling eggs. Egg oiling is generally a method used to treat the eggs of bird species that nest on the ground, such as Canada geese. WS personnel coat each egg with a light to moderate amount of corn oil. WS only uses food-grade corn oil that people use every day when preparing food and uses a small amount of corn oil to treat each egg; therefore, risks to human safety associated with the use of corn oil to coat eggs would be extremely low. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under the FIFRA.

4-Aminopyridine (Avitrol)

Several label requirements of Avitrol address threats to human health and safety risks associated with the use of the different formulations of Avitrol. For example, label requirements stipulate that applicators cannot place treated baits within a certain distance of water. Other requirements may stipulate that applicators must place treated bait on elevated sites in populated areas and areas open to the public or the applicator must continuously monitor the site during the entire application period and retrieve any unused bait. Applicators must pre-bait potential locations to monitor for target and non-target activity at the location, which allows applicators to monitor risks to human safety.

The half-life of 4-Aminopyridine under aerobic conditions ranges from three to 32 months (EPA 2007). However, based on the use pattern of 4-Aminopyridine, the EPA (2007) concluded that following the label requirements would reduce the ecological risks of exposure. When re-evaluating the registration of 4-Aminopyridine (*i.e.*, Avitrol) for use, the EPA (2007) stated, "*…long-term environmental exposure of* [4-Aminopyridine] *is expected to* [be] *minimal, and no drinking water exposure is expected.*" Further, the EPA (2007) stated, "*Because* [4-Aminopyridine] *is no longer registered on any food commodities, nor is exposure expected from drinking water sources, the* [EPA] *only assessed potential exposures in occupational and residential settings*".

When handling and applying Avitrol, WS personnel would follow label requirements for personal protective equipment to minimize their exposure to treated bait. The EPA (2007) further stated, "*Since all* [4-Aminopyridine] *products are restricted use products, no residential handler exposure scenario is expected*." However, the EPA (2007) also stated, "*Post-application residential exposures to* [4-Aminopyridine] *may result from application in residential settings*" but "*It is unlikely that adults will be exposed to the bait through dermal exposure, inhalation exposure, or through incidental oral exposure*." The primary concern of the EPA (2007) from the use of Avitrol in residential areas and public areas was the potential for children to encounter and accidentally ingest treated bait. Although children could accidentally ingest treated bait, the EPA (2007) "*…does not believe that children will be routinely exposed to* [4-Aminopyridine]". To minimize risks from children encountering and accidently ingesting treated bait, the EPA (2007) required several minimization measures as part of label requirements for products containing 4-Aminopyridine. Those requirements include:

- not applying treated bait in areas accessible to children
- in populated areas and areas open to the public, baiting must occur at elevated sites where feasible
- if baiting at elevated sites cannot be accomplished, the applicator must ensure children do not come in contact with treated bait and the applicator must not leave the site until all dead/dying birds and unused bait are retrieved from the site
- Products cannot be stored or temporarily placed in locations accessible to children

The EPA (2007) has required the applicator implement several minimization measures when handling and applying Avitrol to reduce risks to applicators and the public, including children. By following label requirements for Avitrol, risks to human health and safety associated with the use of Avitrol should be minimal. Through a programmatic risk assessment, WS has determined the use of Avitrol to manage bird damage poses a low risk to human health and safety (USDA 2023*a*).

DRC-1339

Risks to human safety from the use of DRC-1339 could occur either through direct exposure to the chemical (*e.g.*, handling treated bait) or exposure to the chemical from birds that have ingested treated bait and died. Depending on the label, WS can use a variety of bait types depending on the target bird species to alleviate damage or threats of damage.

For all uses, WS must mix technical DRC-1339 (powder) 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. After mixing, the handler allows the treated bait 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. WS personnel who prepare, mix, and handle technical DRC-1339 and treated bait would adhere to label requirements, including the use of personal protective equipment to ensure the safety of WS personnel. Therefore, risks to handlers and mixers who adhere to the personal protective equipment requirements of the label are low. Before application at bait locations, applicators would mix treated bait with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

WS personnel would determine where to potentially apply treated bait based on product label requirements (*e.g.*, distance from water, specific location restrictions). Other factors would also require consideration on appropriate locations to apply treated bait, such as the target bird species' use of the site (determined through pre-baiting), on non-target animal use of the area (areas with non-target animal activity are not used or abandoned), and based on human safety (*e.g.*, in areas restricted or inaccessible by the public). Once WS personnel determine a location to be appropriate to place treated baits, they would place bait in feeding stations, broadcast the bait using mechanical methods (ground-based equipment or hand spreaders), or distribute bait 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, WS personnel or people under the direct supervision would monitor locations for activity by non-target animals and to ensure the safety of the public.

WS personnel and persons under their direct supervision would follow the post-treatment clean-up requirements of an applicable label when using DRC-1339. For example, when using a bait dispenser, a label may require the retrieval of all baits. When broadcasting baits, a label may require the retrieval of as much bait as possible. For applications on bare ground, a label may require burying uneaten bait via mechanical methods (*e.g.*, discing under) or, if using manual methods (*e.g.*, shoveling under), burying uneaten bait under a minimum of two inches of soil. Through pre-baiting, applicators can acclimate target birds to feed at certain locations at certain times. By acclimating birds to a feeding schedule, baiting can occur at specific times to ensure that target birds quickly consume bait shortly after the applicator places the bait, especially when addressing large flocks of target species. For example, an applicator could condition target birds to feed at a specific location by placing pre-bait early each morning near a roost so as target birds leave the roost, they fly to the location knowing that food is available. Therefore, the acclimation period allows applicators to place treated bait at a location after conditioning the target birds to be present at the site at a certain time of day and provides a higher likelihood that target birds consume treated bait shortly after applicators place the bait. Conditioning target birds to feed at certain times and at certain locations minimizes the amount of time that treated bait is present at a location. For exposure to the bait to occur, someone would have to approach a bait site and handle treated bait. If target bird species had already consumed the bait or WS had already removed the bait from the location, then treated bait would no longer be available and public exposure to the bait could not occur. Therefore, direct exposure to treated bait during the baiting process would only occur if someone approached a bait site that contained bait and if treated bait was present, would have to handle treated bait.

Factors that minimize any risk to human health and safety from the use of DRC-1339 include:

- Its use is prohibited within 50 feet of standing water
- It 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 highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation. The half-life is about 25 hours; in general, DRC-1339 on treated bait material is almost completely broken down within a week if not consumed or retrieved
- The chemical is more than 90% metabolized in target birds within the first few hours after they consume the bait; therefore, little material is left in bird carcasses that may be found or retrieved by people
- Application rates are extremely low (EPA 1995)
- A person would need to ingest the internal organs of birds found dead from DRC-1339 to be exposed to the chemical
- Based on mutagenicity (the tendency to cause gene mutations in cells) studies, the EPA has concluded that DRC-1339 is not a mutagen or a carcinogen (*i.e.*, cancer-causing agent) (EPA 1995).

Of additional concern is the potential exposure of people to crows harvested during the regulated hunting season that have ingested DRC-1339 treated bait. During the development of this EA, the hunting season for crows in the state occurred from early November through the end of February the following calendar year with no daily take limit and no possession limit (GDNR 2023). If WS implements Alternative 1, baiting using DRC-1339 to reduce crow damage could occur in the state during the period when people could harvest crows. From FY 2018 through FY 2022, WS did not use the avicide DRC-1339 in Georgia and anticipates using the avicide infrequently in the future.

Although baiting could occur in rural areas of the state from November through February, most requests for assistance to manage crow damage during that period would likely occur in urban areas and would be 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 WS personnel have conditioned crows to feed by pre-baiting during the acclimation period. Crows, like other blackbirds, often stage (congregate) in an area prior to entering a roost location. The staging behavior exhibited by blackbirds occurs consistently and personnel can induce blackbirds, including crows, to stage consistently at a particular location by pre-baiting because blackbirds often feed prior to entering a roost location for the night. 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 personnel 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 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. Sensitive species quickly metabolize or excrete nearly all of the DRC-1339 ingested normally within a few hours. Researchers have found residues of DRC-1339 in the tissues of birds consuming DRC-1339 but generally only at very high dosage rates that exceed current acute lethal dosages achieved under the label requirements of DRC-1339. In addition, residues of DRC-1339 ingested by birds appear to be primarily located in the gastrointestinal tract of birds (see discussion on secondary hazards associated with DRC-1339 under Alternative 1 in Section 3.1.2).

As stated previously, to pose risks to human safety, a hunter would have to harvest a crow that ingested DRC-1339 treated bait and then, ingest the tissue of the crow that contains residue of DRC-1339. Very little information is available on the acute or chronic toxicity of DRC-1339 in people. However, based on the information available, WS expects risks to human safety would be extremely low because of several factors. First, a hunter would have to harvest a crow that had ingested DRC-1339 treated bait. As stated previously, the use of DRC-1339 primarily occurs to address damage associated with urban roosts. Most municipal areas prohibit hunting and discharging a firearm. Therefore, a crow would have to ingest treated bait and then travel to an area (typically outside of the city limit) where hunting can occur. WS would not recommend hunting as a damage management tool in those general areas where WS personnel or persons under their supervision were actively placing DRC-1339 treated baits. Second, to pose a risk to human safety, a person would have to consume the crow. Although no information is currently available on the number of people that might consume crows in Georgia, very few, if any, people are likely consuming crows harvested in the state or elsewhere. People primarily harvest crows for recreational purposes and to alleviate damage and are not likely harvesting crows for subsistence. Third, the tissue consumed would have to contain chemical residues of DRC-1339.

Current information indicates that target bird species metabolize or excrete the majority of the chemical within a few hours of ingestion. The highest concentration of chemical residue occurs in the gastrointestinal tract of the bird, which people are likely to discard and not consume. Although residues have been detected in the tissues that people might consume (*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, which would not be achievable under normal baiting procedures. In addition, WS anticipates using DRC-1339 to alleviate damage or threats of damage associated with crows in Georgia infrequently. From FY 2018 through FY 2022, no take of crows occurred by WS in Georgia using DRC-1339. Under the proposed action, the controlled and limited circumstances in which WS could use DRC-1339 would prevent any exposure of the public to DRC-1339. Based on current information, the human health risks from the use of DRC-1339 would be virtually nonexistent if WS implemented this alternative.

Commercially Available Repellents

The recommendation of commercially available repellents or the use of those repellents registered for use to disperse birds in the state could occur as part of an integrated approach to managing bird damage if WS implements this alternative. Several commercially available repellents could be available for use with the most common ingredients being anthraquinone and methyl anthranilate.

Methyl anthranilate, which has been classified by the United States Food and Drug Administration 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 United States Food and Drug Administration 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 adverse effects on human safety. The EPA (2015) stated, "*No harmful effects to humans are expected from using products containing* [methyl anthranilate] *as specified on the label*".

Additional repellents could contain the active ingredient anthraquinone (Dolbeer et al. 1998). 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 applicators use the required personal protective equipment, to be negligible (EPA 1998). Therefore, the EPA concluded that cumulative effects would not likely occur from any common routes of toxicity (EPA 1998). Based on the known use patterns and the conclusions of the EPA, WS does not expect any adverse effects on human safety to occur from WS use of anthraquinone or the recommendation of the use of anthraquinone. When used according to label requirements, the EPA (2015) determined the use of anthraquinone would have no harmful effects on people.

Commercially available repellents would be general use pesticides available to the public. A general use pesticide is a pesticide that, when applied in accordance with its directions for use, would not generally cause unreasonable adverse effects on people or the environment. When handling and applying commercially available repellents, WS personnel would follow the label requirements of those products and would recommend that people use those products according to label requirements. Therefore, WS does not expect any direct, indirect, or cumulative effects to occur from WS use of commercially available repellents or the recommendation of the use of those repellents.

Paintballs

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 pigskin, 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 Safety Data Sheets.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

Section 1.2.2 discusses the need to resolve threats to human safety associated with the bird species addressed in this EA. Threats to human safety associated with those bird species addressed in this EA are primarily associated with the risks of aircraft striking birds at airports in the state. Other risks to human safety can include the threats of disease transmission between birds and people or the aggressive behavior of certain bird species toward the public. If WS implements Alternative 1, those methods identified in Appendix B would be available for WS personnel to use when formulating a management strategy using the WS Decision Model. WS personnel would not necessarily use every method from Appendix B to address every request for assistance but would use the WS Decision Model to determine the most appropriate approach to address each request for assistance, which could include using additional methods from Appendix B if initial efforts did not adequately reduce threats to human safety.

Some methods discussed in Appendix B would only be available for use by WS personnel or persons under their direct supervision. DRC-1339 would be a method that would not be available for other entities to use. Therefore, implementation of Alternative 1 would provide the widest selection of methods to resolve requests for assistance. Restricting methods or limiting the availability of methods could lead to incidents where risks to human safety increase because the only available methods may not be effective enough to reduce risks to human safety adequately. In addition, implementation of Alternative 1 would provide another way for people to resolve threats to human safety because WS would be available to provide direct operational assistance and/or technical assistance. People experiencing threats to human safety could conduct activities themselves to alleviate threats, they could seek assistance from private businesses/entities, they could seek assistance from WS, they could seek assistance from other state or federal agencies, and/or they could take no further action. The mission of the national WS program is to provide federal leadership with managing conflicts with wildlife. In some cases, WS may be the only entity available to manage threats to human safety, such as in rural areas or at remote air facilities.

Overall, implementation of this alternative would likely result in a higher likelihood of successfully reducing threats to human safety because of the availability of WS and WS ability to use the widest range of available methods to reduce threats associated with those bird species addressed in this EA.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia using only non-lethal methods

Implementation of this alternative would require WS to only recommend and use non-lethal methods to manage and prevent damage caused by target bird species. WS would provide technical assistance and direct operational assistance under this alternative recommending and using only non-lethal methods. If WS implements Alternative 2, the non-lethal methods that would be available for WS to recommend and/or use would have the potential to threaten human safety.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

Alternative 1 discusses the threats to human safety associated with non-chemical methods that would be available if WS implements Alternative 2. If WS implements Alternative 2, the threats to human safety associated with non-chemical methods would be the same as those threats that would occur if WS implemented Alternative 1 because WS would use the same non-chemical methods that were also non-lethal methods. Non-chemical methods that WS could use and/or recommend if WS implements Alternative 2 include limited habitat modification, exclusionary methods, auditory deterrents, visual deterrents, live-capture methods, and inactive nest destruction.

No adverse effects to human safety have occurred from WS use of non-chemical methods to alleviate bird damage in the state from FY 2017 through FY 2022. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low (USDA 2019*c*, USDA 2019*d*, USDA 2019*e*, USDA 2019*f*, USDA 2019*g*, USDA 2020, USDA 2021, USDA 2022*b*, USDA 2022*c*, USDA 2022*d*, USDA 2023*b*, USDA 2023*c*, USDA 2023*d*, USDA 2023*e*). Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898, Executive Order 13045, and Executive Order 13985.

Other entities could and would likely continue to use non-chemical lethal methods, such as firearms, if WS implements this alternative approach. Many of the lethal methods available to manage bird damage would be available for use by other entities. This could result in less experienced persons implementing lethal methods, which could lead to greater risks to human safety. Other entities could use lethal methods where WS personnel may not because WS personnel would consider threats to human safety when formulating strategies to alleviating bird damage.

SAFETY OF CHEMICAL METHODS EMPLOYED

If WS implements Alternative 2, those non-lethal chemical methods that would be available for WS to use would include paintballs fired from paintball equipment, nicarbazin (primarily pigeons), and chemical repellents (primarily waterfowl). Those non-lethal chemical methods that WS could use would be identical to those non-lethal chemical methods available if WS implemented Alternative 1. To reduce redundancy, the safety of non-lethal methods occurs in the discussion for Alternative 1.

No adverse effects to human safety have occurred from WS use of chemical methods to alleviate bird damage in the state from FY 2017 through FY 2022. The risks to human safety from the use of chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898, Executive Order 13045, and Executive Order 13985.

Formulations of 4-Aminopyridine are restricted use pesticides; therefore, other entities with appropriate pesticide applicators licenses could continue to use some formulations of 4-Aminopyridine. If other entities use 4-Aminopyridine in accordance with label requirements, the risks to human safety associated with the use of 4-Aminopyridine would be similar to Alternative 1. If other entities use 4-Aminopyridine inconsistent with the label requirements, the risks to human health and safety could be higher.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

As discussed previously, using non-lethal methods can be effective at alleviating damage associated with birds. The use of non-lethal methods in an integrated approach can be effective at dispersing birds (*e.g.*, see Avery et al. 2008*a*, Chipman et al. 2008, Seamans and Gosser 2016). Section 1.2.2 discusses the need to resolve threats to human safety associated with the target bird species. Threats to human safety associated with birds are primarily associated with the risks of aircraft striking birds at airports in the state but can include threats of pathogen transmission where fecal droppings accumulate. Limiting the methods available could lead to higher risks to human health and safety. For example, vultures have the potential to cause severe damage to aircraft, which can threaten the safety of flight crews and passengers. Risks of aircraft strikes could increase if birds near airports and/or military facilities habituate to the use of non-lethal methods and no longer respond to the use of those methods.

Alternative 3 - WS would recommend an integrated methods approach to managing bird damage in Georgia through technical assistance only

If WS implements this alternative, WS personnel would only provide recommendations on methods the requester could use to alleviate bird damage themselves with no direct involvement by WS. On occasion, WS personnel could demonstrate the use of methods, but WS personnel would not conduct any direct operational activities to manage damage caused by birds. WS personnel would only recommend for use those methods that were legally available to the requester for use. If WS implements this alternative, the only method described in Appendix B that would not be available for use by other entities would be DRC-1339. WS would only provide technical assistance to those persons requesting assistance with bird damage and threats.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people requesting assistance from WS could conduct activities and use methods recommended by WS personnel, could implement other methods, could seek further assistance from other entities, or could take no further action. Therefore, the requester and/or other entities would be responsible for using those methods available, including methods recommended by WS. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance use non-chemical methods according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to those risks if WS personnel were using those methods. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use methods not recommended by WS, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. The extent of the increased risk would be unknown and variable. However, non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

SAFETY OF CHEMICAL METHODS EMPLOYED

Several chemical methods would continue to be available for use by the public if WS implements Alternative 3, which WS could recommend to people when providing technical assistance. Nicarbazin, carbon dioxide for euthanasia, egg oiling, paintballs, Avitrol, and commercially available repellents are chemical methods that would continue to be available to the public for use. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance from WS implement chemical methods appropriately and in consideration of human safety, including following label requirements, then the effects of implementing this alternative on human health and safety would be similar to those effects if WS implemented Alternative 1. If people implement chemical methods inappropriately, without regard for human safety, and/or use methods not recommended by WS, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

If WS implemented this alternative, the avicide DRC-1339 would not be a method that WS could recommend because DRC-1339 is currently only available for use by WS. A product with the same active ingredient as DRC-1339 has been commercially available to the public in the past and it is possible that other entities could seek to register the active ingredient of DRC-1339 as a restricted use pesticide in the state if WS implements this alternative. DRC-1339 can effectively reduce local populations of target bird species, which can reduce threats to human health and safety. For example, Boyd and Hall (1987) showed that a 25% reduction in a local crow roost using DRC-1339 resulted in reduced hazards to a nearby airport. However, DRC-1339 is only available to target certain bird species. The avicide DRC-1339 would only be available to target pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, and gulls.

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If people implement methods as intended at a similar level that would occur if WS personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If people attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the ability of those people to reduce threats to human health and safety would be lower than Alternative 1. This would likely occur on a case-by-case basis because one person may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be more effective at reducing threats to human health and safety than the implementation of Alternative 4 because WS would be available to provide technical assistance and demonstration to those persons seeking assistance.

Alternative 4 - WS would not provide any assistance with managing damage caused by birds in Georgia

If WS implements Alternative 4, WS would not provide assistance in Georgia with any aspect of managing damage caused by those target bird species addressed in this EA, including providing technical assistance. People could contact WS for assistance but WS would refer those people to other entities, such as the USFWS, GDNR, and/or private entities. Due to the lack of involvement in managing damage caused by those target bird species addressed in this EA, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities 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, when required, people could continue to take birds lethally when authorized by the USFWS and/or the GDNR.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people experiencing bird damage could conduct activities themselves, seek assistance from other entities, or take no action. The requester and/or other entities would be responsible for using available methods. Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Most non-chemical methods available to alleviate bird damage involve the live-capture or hazing of birds. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people implement non-chemical methods appropriately and in consideration of human safety, then the effects of using non-chemical methods would be similar to those effects if WS implemented Alternative 1. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use illegal methods, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. Although some risks to human safety are likely to occur with the use of pyrotechnics, propane cannons, exclusion devices, and firearms, those risks would likely be minimal when people use those methods appropriately and in consideration of human safety (USDA 2019*g*, USDA 2023*b*, USDA 2023*c*).

SAFETY OF CHEMICAL METHODS EMPLOYED

Similar to Alternative 3, several chemical methods would continue to be available for use by the public if WS implements Alternative 4. Nicarbazin, carbon dioxide for euthanasia, egg oiling, Avitrol, commercially available repellents, and paintballs are chemical methods that would continue to be available to the public for use. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people use chemical methods appropriately and in consideration of human safety, including follow label requirements, then the effects of implementing this alternative on human health and safety would be similar to those effects if WS implemented Alternative 1. If people implement chemical methods inappropriately, without regard for human safety, and/or use illegal methods, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

Similar to Alternative 3, the avicide DRC-1339 would not be available for the public to use if WS implements this alternative because DRC-1339 is currently only available for use by WS. A product with the same active ingredient as DRC-1339 has been commercially available to the public in the past and it is possible that other entities could seek to register the active ingredient of DRC-1339 as a restricted use pesticide in the state if WS implements this alternative.

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If people implement methods as intended at a similar level that would occur if WS personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If people attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the ability of those people to reduce threats to human health and safety would be lower than Alternative 1. This would likely occur on a case-by-case basis because one person may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be less effective at reducing threats to human health and safety than the implementation of Alternative 3 because WS would not be available to provide technical assistance and demonstration to those persons seeking assistance.

3.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised involves the humaneness and animal welfare concerns of methods available under the alternative approaches for resolving damage and threats. Discussion of humaneness and animal welfare concerns for those methods available under the alternative approaches occurs below.

Alternative 1 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia (Proposed Action/No Action)

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 people interpret 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."* The AVMA has previously described suffering 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…"* (AVMA 1987). 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 can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when people do not take action 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). Research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011). Therefore, the challenge in coping with this issue is how to achieve the least amount of animal suffering.

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 the use of AVMA accepted methods of euthanasia when killing all animals, including wild animals. However, the AVMA has previously stated, "*For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress-free death may not be possible*" (Beaver et al. 2001).

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. Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. Given 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, the challenge for agencies is to conduct activities and employing methods that people perceive 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 resolve requests for assistance to reduce damage and threats to human safety. WS would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some people and groups of people have stereotyped methods as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. Therefore, the goal would be to address requests for assistance effectively using methods in the most humane way possible that minimizes the stress and pain to the animal. When formulating a management strategy using the WS Decision Model, WS personnel would give preference to the use of non-lethal methods, when practical and effective, pursuant to WS Directive 2.101.

Although some issues of humaneness could occur from the use of non-lethal methods, when used appropriately and by trained personnel, those methods would not result in the inhumane treatment of birds. The non-lethal methods of primary concern would be the use of live-capture methods, such as nets and cage traps. Concerns from the use of those non-lethal methods would be from injuries to birds while those methods restrain birds and from the stress of the bird while being restrained or during the application of the method. However, WS personnel would be present on-site during capture events or personnel would check methods frequently to ensure WS addresses birds captured in a timely manner to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, WS could also use lethal methods to resolve requests for assistance to resolve or prevent bird damage and threats. Lethal methods would include firearms, DRC-1339, the recommendation that people harvest birds during regulated hunting seasons, egg destruction, and euthanasia after birds are live-captured. WS use of euthanasia methods under the proposed action would follow those required by WS Directive 2.505.

The euthanasia methods being considered for use under the proposed action for live-captured birds are cervical dislocation and carbon dioxide. The AVMA guideline on euthanasia lists cervical dislocation and carbon dioxide as conditionally acceptable methods of euthanasia for free-ranging birds, which can lead to a humane death (AVMA 2020). The use of cervical dislocation or carbon dioxide for euthanasia would occur after the animal has been live-captured and away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2020). WS personnel that employ firearms to address bird damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

Death from ingesting DRC-1339 occurs from nephrotoxicity (*i.e.*, causes damage to 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 ingested DRC-1339 slightly above the LD_{50} for starlings appeared normal for 20 to 30 hours, but water consumption doubled after 4 to 8 hours and decreased thereafter. Food consumption remained fairly constant until about 4 hours before death, at which time starlings refused food and water and became listless and inactive. The birds perched with feathers fluffed as in cold weather and appeared to doze but were responsive to external stimuli. As death nears, breathing increased slightly in rate and became more difficult; the birds no longer responded to external stimuli and became comatose. Death followed shortly thereafter without convulsions or spasms (DeCino et al. 1966).

Birds ingesting a lethal dose of DRC-1339 become listless and lethargic, and a quiet death normally occurs in 24 to 72 hours following ingestion. This method appears to result in a less stressful death than which probably occurs by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternative approaches. Certain formulations of DRC-1339 to manage damage caused by certain species of birds are only available to WS personnel for use.

The chemical repellent under the trade name Avitrol acts as a dispersing agent when birds ingest treated bait particles, which causes them to become hyperactive and elicits a flight response by other members of a flock. 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.

When WS personnel deem firearms to be an appropriate method to alleviate damage or threats of damage using the WS Decision Model, WS personnel would strive to minimize the distress and pain of target birds and to induce death as rapidly as possible. The use of carbon dioxide for euthanasia would occur after WS personnel live-capture a bird. WS personnel who use firearms and carbon dioxide would receive training in the proper use of the methods to ensure a timely and quick death. Egg destruction would involve puncturing, breaking, shaking, or oiling an egg. In general, egg destruction would represent a humane method of making an egg unviable. In accordance with WS Directive 2.505, when taking an animal's life, WS personnel would exhibit a high level of respect and professionalism toward the animal, regardless of method.

WS personnel would be experienced and professional in their use of management methods (see WS Directive 1.301). WS personnel would receive training in the latest and most humane devices/methods to manage damage associated with birds. Consequently, WS personnel would implement methods in the most humane manner possible. People experiencing damage or threats of damage associated with birds could use many of those methods discussed in Appendix B regardless of the alternative implemented by WS. The only method that would not be available for the public to use if WS implemented the other alternative approaches would be DRC-1339. Therefore, the issue of humaneness associated with methods would be similar across any of the alternative approaches because people could use those methods in the absence of WS involvement. 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 alternative approaches.

Alternative 2 - WS would continue the current integrated methods approach to managing damage caused by birds in Georgia using only non-lethal methods

If WS implemented this alternative, WS would only use non-lethal methods, which most people would generally regard as humane. WS would use non-lethal methods to live-capture, exclude, or disperse birds. The humaneness and animal welfare concerns of non-lethal methods would be identical to those described for Alternative 1 because those same non-lethal methods would be available for use if WS implemented this alternative. Although some issues of humaneness and animal welfare concerns could occur from the use of non-lethal methods, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of birds.

Alternative 3 - WS would recommend an integrated methods approach to managing bird damage in Georgia through technical assistance only

If WS implemented this alternative, the issue of method humaneness and animal welfare concerns would be similar to the humaneness and animal welfare concerns discussed for Alternative 1 because many of the same methods would be available for people to use. WS would not directly be involved with damage management activities if WS implemented Alternative 3. However, the entity receiving technical assistance from WS could employ those methods that WS recommends. Therefore, by recommending methods and, thus, a requester employing those methods, the issue of humaneness and animal welfare concerns would be similar to Alternative 1.

WS would instruct and demonstrate the proper use of methodologies to increase their effectiveness and to ensure people have the opportunity to use methods to minimize pain and suffering. However, the skill and knowledge of the person applying methods would determine the humane use of the methods the person was using despite WS demonstration. Therefore, a lack of understanding of the behavior of animals or improperly identifying the damage caused by animals along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of people perceiving those activities as inhumane. In those situations, people are likely to regard the pain and suffering to be greater than discussed for Alternative 1.

Those persons requesting assistance would be directly responsible for the use and placement of methods and if monitoring or checking of those methods does not occur in a timely manner, captured wildlife could experience suffering and if not 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 are not as diligent or timely in checking methods. It is difficult to evaluate the behavior of individual people. In addition, it is difficult to evaluate how those people will react under given circumstances. Therefore, this alternative can only evaluate the availability of WS assistance 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 people could apply those methods humanely 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 or animal welfare concerns, then the issue of method humaneness and animal welfare concerns would be of greater concern because the pain and distress of birds would likely be higher.

Alternative 4 – WS would not provide any assistance with managing damage caused by birds in Georgia

WS would not provide any assistance with managing bird damage in Georgia if WS implemented Alternative 4. Those people experiencing damage or threats associated with birds could continue to use those methods legally available. Those persons who consider methods inhumane would likely consider those methods inhumane under any alternative because people often label methods inhumane no matter the entity employing those methods. A lack of understanding regarding the behavior of birds 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 to use to resolve damage and threats caused by birds.

3.2 ISSUES NOT CONSIDERED FOR COMPARATIVE ANALYSIS

WS identified additional issues during the scoping process of this EA. WS considered those additional issues but a detailed analysis does not occur in Chapter 3. Discussion of those additional issues and the reasons for not analyzing those issues in detail occur below.

3.2.1 Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 2.4.1 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 described in Section 2.4.1 do not involve major ground disturbance, construction, or habitat alteration. Activities that WS could conduct during implementation of those alternative approaches discussed in Section 2.4.1 would not cause changes in the flow, quantity, or storage of water resources. The use and storage of methods by WS personnel would also follow WS directives, including WS Directive 2.210, WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, WS Directive 2.465, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635, and WS Directive 2.640. Through programmatic risk assessments, WS has determined the use of cage traps (USDA 2019*c*), cable devices (USDA 2019*d*), foothold traps (USDA 2019*e*), nets (USDA 2020), aircraft (USDA 2019*f*), firearms (USDA 2019*g*), lead (USDA 2022*c*), dog use (USDA 2021), egg addling (USDA 2022*b*), quick-kill traps (USDA 2022*d*), DRC-1339 (USDA 2022*e*), Avitrol (USDA 2023*a*), explosives (pyrotechnics) (USDA 2023*c*), hand capture (USDA 2023*d*), exclusion methods (USDA 2023*b*), and carcass disposal (USDA 2023*e*) to manage wildlife damage pose minimal risks to the environment.

Most methods available for use to manage damage caused by birds are mechanical methods. Mechanical methods would not cause contaminants to enter water bodies or result in bioaccumulation. For example, firearms are mechanical methods that WS could use to remove a target bird lethally and to reinforce the noise associated with non-lethal methods, such as pyrotechnics. Firearms would not enter bodies of water and would be securely stored off-site after each use; therefore, the firearm itself would not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials. Depredation permits issued by the USFWS require the use of non-toxic shot when using shotguns to target birds listed on the permit. Therefore, when conducting activities pursuant to a depredation permit issued by the USFWS and when using shotguns, WS personnel would only use non-toxic shot. WS would also use non-toxic ammunition when required by depredation/control orders. Occasionally, WS personnel could use lead ammunition in rifles, handguns, air rifles, and shotguns[18].

The deposition of lead into the environment from ammunition used in firearms to lethally remove birds is often a concern. 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 (see 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 21.100. The depredation order for blackbirds (see 50 CFR 21.150) includes the requirement for use of non-toxic shot, as defined under 50 CFR 20.21(j), as well as, non-toxic bullets. However, this prohibition on the use of lead bullets does not apply if an entity uses an air rifle or an air pistol to remove depredating blackbirds under the depredation order.

The take of target bird species by WS in the state would occur primarily from the use of shotguns. However, WS personnel could use rifles, air rifles, and handguns to disperse or remove target bird species in some situations when WS personnel determine their use to be safe. To reduce risks to human safety and property damage from bullets passing through a target bird, the use of rifles and air rifles would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to reduce the likelihood of the bullet passing through the target bird species. Birds that were removed using a firearm would often occur within areas where retrieval of all carcasses for proper disposal would be highly likely (*e.g.*, at roost sites). WS personnel would retrieve the carcasses of birds to the extent possible and would dispose of the carcasses in accordance with WS Directive 2.515. 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 lead contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a firearm, the projectile passed through a bird, if WS personnel missed the target, or if WS personnel were not able to retrieve the carcass. 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 generally stays within the top 20 cm (about eight 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 had 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 farther 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).

---

[18]Occasionally, WS could use shotguns using lead shot when targeting bird species that do not require a depredation permit from the USFWS to take those species, such as pigeons, house sparrows, and starlings.

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, which reduces the transport of lead across the landscape and 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 deposited and the concentrations that would occur from WS activities to reduce bird damage using firearms, as well as most other forms of hunting in general, lead contamination from such sources would be minimal to nonexistent (USDA 2022*c*).

Because the take of birds could occur by other entities when authorized by the USFWS and/or the GDNR, when required, WS assistance with removing target bird species 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. WS involvement in activities may result in lower amounts of lead being deposited into the environment 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 from projectiles passing through the carcass. The proficiency training received by WS employees in firearm use and accuracy increases the likelihood that WS personnel lethally remove a target bird humanely in situations that ensure accuracy and that misses occur infrequently, which would further reduce the potential for WS activities to deposit lead in the soil.

In addition, WS involvement in activities would ensure WS personnel made efforts 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 ammunition that WS activities could deposit into the environment due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination. WS would not use lead ammunition at a magnitude that activities would deposit a large amount of spent bullets or shot in such a limited area that would result in large accumulations of lead in the soil. As stated previously, when using shotguns to target those migratory bird species addressed in a depredation permit issued by the USFWS, only non-toxic shot (see 50 CFR 20.21(j)) would be used by WS. WS may utilize non-toxic ammunition in rifles, air rifles, and handguns as the technology improves and ammunition becomes more effective and available. In addition, when targeting birds pursuant to a depredation or control order, WS would use non-toxic ammunition if required by the order (*e.g*., the blackbird depredation order (see 50 CFR 21.150)).

WS could also use aircraft to survey, locate, and monitor birds. The use of a fixed-winged aircraft or helicopter for surveillance and monitoring activities, like any other flying, may result in an accident. WS would primarily use aircraft to conduct surveys of waterbirds in the state, such as American white pelicans or double-crested cormorants. WS pilots and crewmembers receive training and have experience to recognize the circumstances that lead to accidents. The national WS Aviation Program has a strong emphasis on safety, including funding for training, the establishment of a WS Flight Training Center, and annual recurring training for all pilots. In addition, WS has developed a comprehensive Aviation Operations and Safety Manual that provides guidance to WS personnel when conducting aerial operations. However, accidents may still occur. Nationwide, the WS program has been using aircraft during aerial operations for many years. During this time, no incidents of major ground fires associated with WS aircraft accidents have occurred; thus, the risk of catastrophic ground fires caused by an aircraft accident is exceedingly low.

Aviation fuel is extremely volatile and it will normally evaporate within a few hours or less to the point that even detecting its odor is difficult. The fuel capacity for aircraft used by WS varies. For fixed-winged aircraft, a 52-gallon capacity would generally be the maximum, while 91 gallons would generally be the maximum fuel capacity for helicopters. In some cases, little or none of the fuel would spill if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

With the size of aircraft used by WS, the quantities of oil (*e.g*., 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of spilling in any accident would be small with minimal chance of causing environmental damage. Aircraft used by WS would be single engine models, so the greatest amount of oil that could spill in one accident would be about eight quarts.

Petroleum products degrade through volatilization and bacterial action, particularly when exposed to oxygen (EPA 2000). Thus, small quantity oil spills on surface soils can biodegrade readily. Even in subsurface contamination situations involving underground storage facilities that generally involve larger quantities than would ever be involved in a small aircraft accident, the EPA guidelines provide for *"natural attenuation"* or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where the owner of the aircraft did not clean up oil spills in small aircraft accidents, the oil does not persist in the environment or persists in such small quantities that no adverse effects would likely occur. In addition, WS accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

For those reasons, the risk of ground fires or fuel/oil pollution from aviation accidents would be low. In addition, based on the history and experience of the program in aircraft accidents, it appears the risk of environmental damage from such accidents is exceedingly low.

Currently, the two principal types of fuel used in aviation today are aviation gasoline (commonly referred to as avgas) and jet fuel. According to the Federal Aviation Administration, aviation gasoline is the only transportation fuel that still contains a lead additive (Federal Aviation Administration 2018). Jet fuel does not contain a lead additive. The helicopters that WS could use to conduct monitoring and surveillance activities would use jet fuel, which does not contain lead. However, the airplanes that WS utilizes would use aviation gasoline, which does contain a lead additive. The Federal Aviation Administration (2018) stated, "[Aviation gasoline] *emissions have become the largest contributor to the relatively low levels of lead emissions produced in* [the United States]."

In consultation with the Federal Aviation Administration, the EPA has the authority to regulate aircraft emissions under the Clean Air Act, including lead emissions from the use of aviation gasoline. When the EPA sets standards for aircraft emissions, the Clean Air Act specifies that the EPA and the Federal Aviation Administration must consider the time needed to develop required technology, consider cost, and must not adversely affect aircraft safety or noise (Federal Aviation Administration 2018).

In 2006, an environmental advocacy organization petitioned the EPA to find that lead emissions from airplanes using aviation gasoline containing lead additives contribute to lead air pollution that may endanger public health or welfare. The same environmental advocacy organization petitioned the EPA again in 2014 and urged the EPA to make an endangerment finding regarding lead emissions from aviation gasoline. Despite the petitions, the EPA continues to indicate a need for more data and findings to make a judgment on whether lead emissions from aviation gasoline are a danger to public health. Pursuant to Section 231 of the Clean Air Act, the EPA is currently conducting proceedings regarding whether lead emissions from piston-engine general aviation aircraft that use aviation gasoline cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. In addition, the Federal Aviation Administration is supporting research of alternative fuels to replace aviation gasoline that contain lead additives (Federal Aviation Administration 2018). The Federal Aviation Administration is committed to developing an alternative fuel or fuels for use in airplanes and the EPA continues to proceed with investigations regarding whether lead emissions from airplanes using aviation gasoline cause or contribute to air pollution that may endanger the public. When the EPA and the Federal Aviation Administration approve the general use of an alternative fuel or fuels and the fuel or fuels become readily available for use, WS would use the alternative fuel or fuels.

The use of chemical immobilization and euthanizing agents by WS employees would occur pursuant to WS Directive 2.430. WS employees would follow WS Directive 2.401, which provides for the safe and effective storage, disposal, recordkeeping, and use of pesticides. When using pesticides, WS employees would follow product labels to minimize risks of environmental hazards. For example, label requirements of the avicide DRC-1339 may include not placing treated bait directly in water, not using treated bait within 50 feet of permanent manmade or natural bodies of water, not applying treated bait when runoff is likely to occur, and not contaminating water when cleaning equipment or disposing of waste. Similarly, label requirements for 4-Aminopyridine (Avitrol) may include not placing treated bait directly in water, not using treated bait within 25 feet of permanent bodies of water, and not contaminating water when cleaning of equipment or disposing of waste.

When conducting activities using lethal methods, WS personnel would retrieve carcasses to the extent possible for disposal. WS personnel would dispose of retrieved carcasses in accordance with WS Directive 2.510 and WS Directive 2.515. When applicable, WS personnel would also dispose of carcasses pursuant to requirements in authorizations issued by the USFWS and/or authorizations provided by the GDNR. In addition, WS personnel would follow the requirements of labels and use guidelines when using pesticides and when using chemical immobilization and euthanizing agents.

Consequently, WS does not expect that implementing any of the alternative approaches discussed in Section 2.4.1 would significantly change the environmental status quo with respect to soils, geology, minerals, water quality, water quantity, floodplains, wetlands, other aquatic resources, air quality, prime and unique farmlands, timber, and range. WS has received no reports or documented any effects associated with soil, water, or air quality from previous activities associated with managing damage caused by birds in the state that WS conducted. Therefore, the EA will not analyze those elements further.

3.2.2 Greenhouse Gas Emissions by WS

The ten warmest years on record have occurred since 2010 and 2022 was the sixth warmest year on record based on National Oceanic and Atmospheric Administration data (Lindsey and Dahlman 2023). Increases in global climate temperature pose substantial challenges for ecosystems, human and animal health and safety, food and water supplies, emergency response, invasive species management, facilities and infrastructure and other facets of the human environment (Hauser et al. 2009, Blunden and Arndt 2020, Blunden and Boyer 2022). Observed increases in global average surface temperature are often attributable to human-caused increases in greenhouse gas concentrations and other human-caused factors (Intergovernmental Panel on Climate Change 2022). Greenhouse gases are components of the atmosphere that trap heat relatively near the surface of the earth, and therefore contribute to the greenhouse effect and global warming. Most greenhouse gases occur naturally in the atmosphere but increases in their concentration can result from human activities such as the burning of fossil fuels. Global temperatures are likely to continue rising as human activities continue to add carbon dioxide, methane, nitrous oxide, and other greenhouse (heat-trapping) gases to the atmosphere.

The Intergovernmental Panel on Climate Change (2022) report states that climate change impacts are strongest and most comprehensive for natural systems, causing changes in precipitation levels, timing, and extremity; water quality, quantity, and timing; seasonal timing of life cycle activities, migration patterns, geographic ranges abundance, and interactions of terrestrial, aquatic, and marine species; ocean acidification; temperature extremes; and increases in high sea levels. Continued emissions of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems.

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*b*). The analysis estimated effects of vehicle, aircraft, office, and all-terrain vehicle use by WS nationwide for 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 between 10,350 and 12,254 metric tons or less per year (see pages 266 and 267 in USDA 2015*b*), which was below the reference point of 25,000 metric tons per year recommended by Council on Environmental Quality at that time for actions requiring detailed review of impacts on greenhouse gas emissions.

In Georgia, activities to manage bird damage could include working in an office, travel from office to field locations, travel at field locations (vehicles or all-terrain vehicles), and from other work-related travel (*e.g*., attending meetings). Activities to manage damage caused by birds in Georgia by WS would be responsible for only a small percentage of the greenhouse gas emissions of the national WS program.

Agencies have a responsibility to work to reduce greenhouse gas contributions even if their overall emissions are low relative to other sources. WS' facilities and vehicles in Georgia are managed and acquired through the General Services Administration and are part of the General Services Administration Climate Action and Sustainability Initiatives (General Services Administration 2023). Through participation in these initiatives, WS anticipates that the overall contribution of WS' activities to greenhouse gas emissions will decrease with time.

There is insufficient data to make quantitative comparisons amongst the alternative approaches in Carbon Dioxide Equivalents generated because decreases in trips to implement one type of method (*e.g*., lethal methods) are likely to be replaced with trips to implement other types of methods or replaced with trips by entities that can manage damage without any involvement by WS. Additionally, the choice of methods used and the associated impact on Carbon Dioxide Equivalents, as reflected in vehicle trips to implement and monitor the methods, is highly dependent upon site-specific circumstances that are also difficult to predict. Given the variability and the likelihood that shifts in vehicle use by WS would likely result in compensatory shifts in activities by other entities, the differences amongst the alternative approaches are likely to be low or difficult to detect. Therefore, WS has concluded that detailed comparative analysis of this issue amongst the alternative approaches would not provide substantive information to guide a selection amongst the alternative approaches. Consequently, WS did not advance this issue for detailed analysis amongst the alternative approaches in Section 3.1.

3.2.3 WS Actions Would Result in Irreversible and Irretrievable Commitments of Resources

Other than relatively minor uses of fuels for vehicles/aircraft, electricity for office operations and UAVs, carbon dioxide for euthanasia, applied chemical methods, and some components associated with ammunition (*e.g*., gun powder, shot) and pyrotechnics (*e.g*., black powder, cardboard), no irreversible or irretrievable commitments of resources result from WS activities.

3.2.4 Impacts on Cultural, Archaeological, Historic, and Tribal Resources and Unique Characteristics of Geographic Areas

A number of different types of federal and state lands occur within the analysis area, such as national wildlife refuges, national forests, and wildlife management areas. WS recognizes that some persons interested in those areas may feel that any activities that could occur in those areas would adversely affect the esthetic value and natural qualities of the area. Similarly, WS activities could occur within areas with cultural, archaeological, historic, and/or tribal resources. WS would only provide direct operational assistance in the state if WS implements Alternative 1 or Alternative 2 (see Section 2.4.1). WS would provide no assistance with managing damage caused by birds if WS implements Alternative 4 and WS would only provide technical assistance if WS implements Alternative 3.

If WS implements Alternative 1 or Alternative 2, the methods that WS could employ would not cause major ground disturbance and would not cause any physical destruction or damage to property. In addition, the methods available 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, implementation of Alternative 1 or Alternative 2 would not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of properties. Therefore, if WS implemented Alternative 1 or Alternative 2, the methods would not have the potential to affect the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources. If WS implements Alternative 1 or Alternative 2 and WS planned an individual activity with the potential to affect historic resources, WS and/or the entity requesting assistance would conduct the site-specific consultation, as required by Section 106 of the National Historic Preservation Act, as necessary.

Conducting activities at or in close proximity to historic or cultural sites for the purposes of alleviating damage caused by birds would have the potential for audible effects on the use and enjoyment of the historic property. For example, WS could use pyrotechnics to disperse birds. However, WS would only use such methods at a historic site after the property owner or manager signed a work initiation document allowing WS to conduct activities on their property. A built-in minimization factor for this issue is that nearly 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.

In addition, WS 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. WS would also adhere to the Native American Graves Protection and Repatriation Act. If WS personnel located Native American cultural items while conducting activities on federal or tribal lands, WS would notify the land manager and would discontinue work at the site until authorized by the managing entity.

WS would abide by federal and state laws, regulations, work plans, Memorandums of Understanding, and policies to minimize any effects and would abide by any restrictions imposed by the land management agency on activities conducted by WS. The implementation of those alternative approaches discussed in Section 2.4.1 by WS would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources.

3.2.5 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 dispersal of the roost occurs, 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 hazing methods including pyrotechnics, propane cannons, effigies, and electronic distress calls (Avery et al. 2008*a*, Chipman et al. 2008, Seamans and Gosser 2016). A similar conflict could develop when making minor habitat alterations (*e.g.*, trimming tree branches) to disperse a bird roost. This could be a concern in 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 alternative approaches 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 are 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 WS and/or other entities to address roosts that relocated to other areas effectively and often times, before roosts become well established. Section 2.2.1 further discusses a community-based decision-making approach to bird damage management in urban areas. Therefore, WS did not consider this issue further.

3.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Based on the best available information, the analyses in Section 3.1.1 and the information discussed in Appendix E indicate the direct, indirect, and cumulative effects on target bird populations associated with implementing Alternative 1 would be of low magnitude. The cumulative lethal removal of target bird species from all known sources of mortality would not reach a threshold that would cause a decline in their respective populations. The implementation of Alternative 2, Alternative 3, or Alternative 4 would likely have similar effects on target bird populations to implementing Alternative 1 because the same or similar activities would occur by other entities. The USFWS has issued depredation permits and authorizations for other entities to take many of the bird species addressed in this EA and the lethal take of birds in Georgia has occurred by entities other than WS. The USFWS could continue to issue depredation permits and authorizations to entities experiencing damage or threats of damage caused by birds in the state despite WS only providing technical assistance if WS implemented Alternative 3 or provided no assistance if WS implemented Alternative 4.

If WS implemented Alternative 1, those methods that WS could use to alleviate damage would essentially be selective for target bird species because WS personnel would consider the methods available and their potential to disperse, capture, or kill non-target animals based on the use pattern of the method. WS personnel would have experience with managing animal damage and would receive training in the use of methods, which would allow WS employees to use the WS Decision Model to select the most appropriate methods to address damage caused by birds and to reduce the risks to non-target animals. No take of non-target animals has occurred by WS during prior activities to manage bird damage in the state.

If WS implemented Alternative 3, the knowledge and skill of those persons implementing recommended methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in non-target animal removal when compared to the non-target animal removal that could occur by WS under Alternative 1. Similarly, if WS implemented Alternative 4, the knowledge and skill of those persons implementing methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from implementing Alternative 4 could be greater than Alternative 1.

The risks to human health and safety from the use of available methods, when used appropriately and by trained personnel, would be low. No adverse effects to human safety have occurred from WS use of methods to alleviate bird damage in the state from FY 2018 through FY 2022. Based on the use patterns of methods available to address damage caused by birds, implementation of Alternative 1 would comply with Executive Order 12898, Executive Order 13045, and Executive Order 13985. Other entities have and could continue to conduct activities to manage bird damage in the state. If people implemented methods appropriately and in consideration of human safety, threats to human health and safety would be minimal. If people implemented methods inappropriately, without regard for human safety, and/or used illegal methods, risks to human health and safety would increase.

People experiencing damage or threats of damage associated with birds could use many of those methods discussed in Appendix B regardless of the alternative implemented by WS. If WS implemented Alternative 2, Alternative 3, or Alternative 4, the only method that would not be available for use by the public would be the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, gulls only). Therefore, the issue of humaneness associated with methods would be similar across any of the alternative approaches because people could use those methods in the absence of WS involvement. 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 alternative approaches. In addition, many "*humane*" methods can be inhumane if not used appropriately. For example, people may view a live trap as a humane method because the trap captures an animal alive. Yet, without proper care, people can treat a bird captured in a live trap inhumanely if they do not attend to the bird appropriately.

CHAPTER 4: LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

4.1 LIST OF PREPARERS

Odin Stephens, State Director	USDA-APHIS-Wildlife Services
Ryan Wimberly, Environmental Coordinator	USDA-APHIS-Wildlife Services
Colleen Marron, Wildlife Specialist	USDA-APHIS-Wildlife Services

4.2 LIST OF PERSONS CONSULTED AND REVIEWERS

Kelly Baxter, NEPA Specialist	TVA
Elizabeth Hamrick, Biologist/Zoologist	TVA
RJ Moore, Senior Specialist – Natural Resources Management	TVA
Todd Schneider, Wildlife Biologist	GDNR

APPENDIX A
LITERATURE CITED

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.

Air National Guard. 1997. Final environmental impact statement for the Colorado Airspace Initiative, Vol. 1. Impact Analyses. National Guard Bureau, Andrews Air Force Base, Maryland.

Albers, P. H. 1984. Effects of oil and dispersants on birds. Pp. 101-110 *in* Region 9 Oil Dispersants Workshop, 7-9 February 1984, Santa Barbara, Holiday Inn. Sponsored by Region 9 Regional Response Team, in cooperation with U.S. Coast Guard, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, et al. 207 pp.

Albers, P. H. 1991. Oil spills and living organisms. Texas Agricultural Extension Service, College Station, Texas. 9 pp.

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

Alge, T. L. 1999. Airport bird threat in North America from large flocking birds (geese) (as viewed by an engine manufacturer). Pages 11-22 *in* Proceedings of the 1st Joint Birdstrike Committee – USA/Canada meeting. Vancouver, British Columbia, Canada.

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.

Allan, J. R. 2002. The costs of bird strikes and bird strike prevention. Pp. 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, 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. 2020. AVMA Guidelines for the Euthanasia of Animals: 2020 Edition. American Veterinary Medical Association. https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf. Accessed June 14, 2021.

Ames, D. R., and L. A. Arehart. 1972. Physiological response of lambs to auditory stimuli. Journal of Animal Science 34:997-998.

Andersen, D. E., O. J. Rongstad, and W. R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. Condor 91:296-299.

Andres, B. A., P. A. Smith, R. I. G. Morrison, C. L. Gratto-Trevor, S. C. Brown, and C. A. Friis. 2012. Population estimates of North American shorebirds, 2012. Wader Study Group Bulletin 119:178-192.

Ankney, C. D. 1996. An embarrassment of riches: too many geese. Journal of Wildlife Management 60:217-223.

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

Archer, J. 1999. The nature of grief: the evolution and psychology of reactions to loss. Taylor & Francis/Routledge, Florence, Kentucky.

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 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? Animal Behaviour 48:1371-1378.

Avery, M. L. 2020. Rusty Blackbird (*Euphagus carolinus*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.rusbla.01.

Avery, M. L., and M. Lowney. 2016. Vultures. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 17 pp.

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., 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. W. Nelson, and M. A. Cone. 1991. Survey of bird damage to blueberries in North America. Proceedings of the Eastern Wildlife Damage Control Conference 5:105-110.

Avery, M. L., J. S. Humphrey, E. A. Tillman, K. O. Phares, and J. E. Hatcher. 2002. Dispersing vulture roosts on communication towers. Journal of Raptor Research 36:45–50.

Avery, M. L., K. L. Keacher, and E. A. Tillman. 2006. Development of nicarbazin bait for managing rock pigeon populations. Pp. 116-120 in R.M. Timm and J. M. O'Brien eds. Proceedings of the 22nd Vertebrate Pest Conference. University of California-Davis, Davis California 95616.

Avery, M. L., K. L. Keacher, and E. A. Tillman. 2008*b*. Nicarbazin bait reduces reproduction by pigeons (*Columba livia*). Wildlife Research 35:80-85.

Awbrey, F. T., and A. E. Bowles. 1990. The effects of aircraft noise and sonic booms on raptors: A preliminary model and a synthesis of the literature on disturbance. Noise and Sonic Boom Impact Technology, Technical Operating Report 12. Wright-Patterson Air Force Base, Ohio.

Barnard, W. H., C. Mettke-Hofmann, and S. M. Matsuoka. 2010. Prevalence of hematozoa infections among breeding and wintering Rusty Blackbirds. Condor 112:849-853.

Barnes, T. G. 1991. Eastern bluebirds: Nesting structure design and placement. College of Agriculture Extension Publication FOR-52. University of Kentucky, Lexington, Kentucky. 4 pp.

Barras, S. C. 2004. Double-crested Cormorants in Alabama. Alabama Wildlife 68:28–29. Available online at https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1075&context=icwdm_usdanwrc. Accessed January 12, 2023.

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. Francis-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. Pp. 155–162 in D. M. Bird, D. E. Varland, and J. J. Negro, editors. Raptors in human landscapes: Adaptations to built and cultivated environments. Academic Press, San Diego, California, USA.

Bedard, J., A. Nadeau, and M. Lepage. 1995. Double-crested cormorant culling in the St. Lawrence River Estuary. Colonial Waterbirds 18 (Special Publication 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, technical coordinator. Symposium on Double-crested Cormorants: Population status and management issues in the Midwest, Technical Bulletin 1879. United States Department of Agriculture, Animal and Plant Health Inspection Service, Washington, D.C., USA.

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

Belanger, L., and J. Bedard. 1989. Responses of staging greater snow geese to disturbance. Journal of Wildlife Management 53:713-719.

Belanger, L., and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. Journal of Wildlife Management 54:36-41.

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. American Birds 47:220-224.

Belant, J. L., S. K. Ickes, and T. W. Seamans. 1998. Importance of landfills to urban-nesting herring and ring-billed gulls. Landscape and Urban Planning 43:11-19.

Belant, J. L., T. W. Seamans, 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.

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.

Berryman, J. H. 1991. Animal damage management: Responsibilities of various agencies and the need for coordination and support. Proceeding of the Eastern Wildlife Damage Control Conference 5:12-14.

Besser, J. F. 1964. Baiting starlings with DRC-1339 at a large cattle feedlot, Ogden, Utah, January 21 – February 1, 1964. Supplemental Technical Report Work Unit F9.2. U.S. Department of the Interior, Fish and Wildlife Service, Denver Wildlife Research Center, Colorado, USA.

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. Department of the Interior, Fish and Wildlife Service, Denver Wildlife Research Center, 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.

Bevins, S. N., R. J. Dusek, C. L. White, T. Gidlewski, B. Bodenstein, K.G. Mansfield, P. DeBruyn, D. Kraege, E. Rowan, C. Gillin, B. Thomas, S. Chandler, J. Baroch, B. Schmit, M. J. Grady, R. S. Miller, M. L. Drew, S. Stopak, B. Zscheile, J. Bennett, J. Sengl, C. Brady, H. S. Ip, E. Spackman, M. L. Kilian, M. K. Torchetti, J. M. Sleeman, and T. J. Deliberto. 2016. Widespread detection of highly pathogenic H5 influenza viruses in wild birds from the Pacific Flyway of the United States. Scientific Reports 6:28980 | DOI: 10.1038/srep28980.

Bierregaard, R. O., A. F. Poole, M. S. Martell, P. Pyle, and M. A. Patten. 2020. Osprey (*Pandion haliaetus*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.osprey.01.

BirdLife International. 2016. *Charadrius vociferus*. The IUCN Red List of Threatened Species 2016: e.T22693777A93422319. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693777A93422319.en. Accessed March 10, 2022.

BirdLife International. 2018. *Larus delawarensis*. The IUCN Red List of Threatened Species 2018: e.T22694317A132541912. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22694317A132541912.en.

BirdLife International. 2019. *Ardea alba* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22697043A155465940. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22697043A155465940.en. Accessed on March 10, 2022.

BirdLife International. 2020. *Sturnella magna*. The IUCN Red List of Threatened Species 2020: e.T22735434A179984605. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22735434A179984605.en. Accessed on July 26, 2023.

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.

Blankespoor, H. D., and R. L. Reimink. 1991. The control of swimmer's itch in Michigan: past, present and future. Michigan Academy of Science, Arts, and Letters 24:7–23.

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 W. C. Scharf. 1991. The ring-billed gull in the Great Lakes of North America. Proceedings of the International Ornithological Congress 20:2372–2377.

Bloom, P. H., W. S. Clark, and J. W. Kidd. 2007. Capture techniques. Pp. 193 – 219 *in* D. M. Bird and K. L. Bildstein, eds., Raptor research and management techniques. Hancock House, Blaine, Washington.

Blunden, J., and D. S. Arndt, Eds., 2020. State of the Climate in 2019. Bulletin of the American Meteorological Society 101:Si–S429.

Blunden, J., and T. Boyer, Eds. 2022. State of the climate in 2021. Bulletin of the American Meteorological Society 103:Si-S465.

Bodenchuk, M. J., and D. L. Bergman. 2020. Grackles. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 16 pp.

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

Borg, E. 1979. Physiological aspects of the effects of sound on man and animals. Acta Oto-laryn-gologica, Supplement 360:80-85.

Boyce, P. S. 1998. The social construction of bereavement: an application to pet loss. Thesis, University of New York.

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.

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., M. B. Brown, P. Pyle, and M. A. Patten. 2020. Cliff Swallow (*Petrochelidon pyrrhonota*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.cliswa.01.

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, M. B., and C. R. Brown. 2020. Barn Swallow (*Hirundo rustica*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.barswa.01.

Brown, S., C. Hickey, B. Harrington, and R. Gill, editors. 2001. The United States Shorebird Conservation Plan, 2nd edition. Manomet Center for Conservation Sciences, Manomet, Massachusetts, USA.

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.

Buckley, N. J., B. M. Kluever, R. Driver, and S. A. Rush. 2022. Black Vulture (*Coragyps atratus*), version 2.0. In Birds of the World (P. G. Rodewald and B. K. Keeney, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.blkvul.02.

Burger, J. 1978. Competition between Cattle Egrets and native North American herons, egrets, and ibises. Condor 80: 15–23.

Burr, P. C., S. Samiappan, L. A. Hathcock, R. J. Moorhead, and B. S. Dorr. 2019. Estimating waterbird abundance on catfish aquaculture ponds using an unmanned aerial system. Human-Wildlife Interactions 13:317-330.

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. 2020. European Starling (*Sturnus vulgaris*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.eursta.01.

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. Public Report 2007-8: Nicarbazin. 6 pp.

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., G. M. Linz, L. R. Ballweber, S. A. Elmore, S. E. Pettit, A. B. Franklin. 2011*a*. 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*b*. 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.

Carlson, J. C., A. B. Franklin, D. R. Hyatt, S. E. Pettit, and G. M. Linz. 2010. The role of starlings in the spread of *Salmonella* within concentrated animal feeding operations. Journal of Applied Ecology 48:479-486.

Carlson, J. C., J. W. Ellis, S. K. Tupper, A. B. Franklin, and G. M. Linz. 2012. The effect of European starlings and ambient air temperature on *Salmonella enterica* contamination within cattle feed bunks. Human-Wildlife Interactions 6:64-71.

Carlson, J. C., R. S. Stahl, J. J. Wagner, T. E. Engle, S. T. DeLiberto, D. A. Reid, and S. J. Werner. 2018*a*. Nutritional depletion of total mixed rations by red-winged blackbirds and projected impacts on dairy cow performance. Journal of Dairy Research 85:273-276.

Carlson, J. C., R. S. Stahl, S. T. DeLiberto, J. J. Wagner, T. E. Engle, R. M. Engeman, C. S. Olson, J. W. Ellis, and S. J. Werner. 2018*b*. Nutritional depletion of total mixed rations by European starlings: Projected effects on dairy cow performance and potential intervention strategies to mitigate damage. Journal of Dairy Science 101:1777-1784.

Castelli, P. M., and S. E. Sleggs. 2000. The efficacy of border collies for nuisance goose control. Wildlife Society Bulletin 28:385-293.

Centers for Disease Control and Prevention. 2015. Outbreaks of avian influenza A (H5N2), (H5N8), and (H5N1) among birds – United States, December 2014-January 2015. Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report 64:111.

Centers for Disease Control and Prevention. 2022. Avian influenza in birds. Centers for Disease Control and Prevention website. https://www.cdc.gov/flu/avianflu/avian-in-birds.htm. Accessed March 10, 2022.

Centers for Disease Control and Prevention. 2023. H5N1 bird flu: Current situation summary. Centers for Disease Control and Prevention website: https://www.cdc.gov/flu/avianflu/avian-flu-summary.htm. Accessed July 24, 2023.

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.

Ciaranca, M. A., C. C. Allin, and G. S. Jones. 2020. Mute Swan (*Cygnus olor*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.mutswa.01.

Clark, L. 2003. A review of pathogens of agricultural and human health interest found in Canada geese. Pages 326-334 in K. A. Fagerstone and G. W. Witmer, eds. Proceedings of the 10th Wildlife Damage Management Conference. 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.

Clements, S. A., B. S. Dorr, J. B. Davis, L. A. Roy, C. R. Engle, K. C. Hanson-Dorr, and A. M. Kelly. 2020. Distribution and abundance of scaup using baitfish and sportfish farms in eastern Arkansas. Journal of the World Aquaculture Society 52:347-361.

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.

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. 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. Proceedings of the Vertebrate Pest Conference 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 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., and R. A. Dolbeer. 1989. Reflecting tapes fail to reduce blackbird damage to ripening cornfields. Wildlife Society Bulletin 17:441-443.

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. 1998. The potential for managing urban Canada Geese by modifying habitat. Proceedings of the Eighteenth Vertebrate Pest Conference 18:18-25.

Cooper, J. A., and T. Keefe. 1997. Urban Canada Goose management: Policies and procedures. Transactions of the North American Wildlife and Natural Resources Conference 62:412-430.

Costanzo, G. R., R. A. Williamson, and D. E. Hayes. 1995. An efficient method for capturing flightless geese. Wildlife Society Bulletin 23:201-203.

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.

Council on Environmental Quality. 2007. A citizen's guide to the NEPA: Having your voice heard. Council on Environmental Quality, Executive Office of the President. 55 pp.

Cox, R. R., and A. D. Afton. 1994. Portable platforms for setting rocket nets in open-water habitats. Journal of Field Ornithology 65:551-555.

Craig, E. C., D. T. King, J. P. Sparks, and P. D. Curtis. 2016. Aquaculture depredation by double-crested cormorants breeding in Eastern North America. Journal of Wildlife Management 80:57-62.

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., campylobacter 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.

Cunningham, F. L., M. M. Jubirt, K. C. Hanson-Dorr, L. Ford, P. Fioranelli, and L. A. Hanson. 2018. Potential of double-crested cormorants (*Phalacrocorax auritus*), American white pelicans (*Pelecanus erythrorhynchos*), and wood storks (*Mycteria americana*) to transmit a hypervirulent strain of *Aeromonas hydrophila* between Channel Catfish culture ponds. Journal of Wildlife Diseases 54:548-552.

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.

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.

Decker, D. J., and T. L. Brown. 2001. Understanding your stakeholders. Pages 109-132 in D.J. Decker, T. L. Brown, and W.F. Siemer, eds. Human Dimensions of Wildlife Management in North America. The Wildlife Society, Bethesda, Maryland, USA.

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.

De Grazio, J. W., J. F. Besser, T. J. DeCino, J. L. Guarino, and R. I. Starr. 1971. Use of 4-Aminopyridine to protect ripening corn from blackbirds. Journal of Wildlife Management 35:565-569.

De Grazio, J. W., J. F. Besser, T. J. DeCino, J. L. Guarino, and E. W. Schafer, Jr. 1972. Protecting ripening corn from blackbirds by broadcasting 4-Aminopyridine baits. Journal of Wildlife Management 36:1316-1320.

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

Delaney, D. K., T. G. Grubb, P. Beier, L. L. Pater, and M. H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63:60-76.

DeLeon, E. E. 2012. Ecology of rusty blackbird wintering in Louisiana: seasonal trends, flock composition and habitat associations. Thesis. Louisiana State University. 115 pp.

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., and B. E. Washburn. 2013. Identification and management of wildlife food resources at airports. Pp. 79-90 in T. L. DeVault, B. F. Blackwell, and J. L. Belant, eds. Wildlife in Airport Environments: Preventing Animal-Aircraft Collisions through Science-based Management. Johns Hopkins University Press, Baltimore, Maryland.

DeVault, T. L., B. F. Blackwell, J. L. Belant, and M. J. Begier. 2017. Wildlife at airports. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 19 pp.

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 W. H. Thornberry. 1950. A cannon-projected net trap for capturing waterfowl. Journal of Wildlife Management 14:132-137.

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. 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., and G. M. Linz. 2016. Blackbirds. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 16 pp.

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

Dolbeer, R. A., and J. L. Seubert. 2006. Canada goose populations and strikes with civil aircraft: Positive trends for aviation industry. Abstracts of the Proceedings of the 8th Annual Bird Strike Committee USA/Canada Meeting. 21-24 August 2006, St. Louis, Missouri, USA.

Dolbeer, R. A., D. F. Mott, and J. L. Belant. 1997. Blackbirds and starlings killed at winter roosts from PA-14 applications, 1974-1992: Implications for regional population management. Proceedings of the Eastern Wildlife Damage Management Conference 7:77-86.

Dolbeer, R. A., J. L. Belant, and L. Clark. 1993. 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., 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. J. Begier, P. R. Miller, J. R. Weller, and A. L. Anderson. 2022. Wildlife strikes to civil aircraft in the United States, 1990–2021. Federal Aviation Administration, National

Wildlife Strike Database, Office of Airport Safety and Standards, Washington, D.C., USA. Serial Report Number 28.

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, and E. C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. Wildlife Society Bulleting 28:372-378.

Dolbeer, R. A., S. E. Wright, J. Weller, and M. J. Begier. 2009. Wildlife strikes to civil aircraft in the United States, 1990-2008, Serial Report 15. Federal Aviation Administration, National Wildlife Strike Database, Office of Airport Safety and Standards, Washington, D.C., USA.

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.

Donaldson, C. W. 2003. Paintball toxicosis in dogs. Veterinary Medicine 98(12): 995-997.

Dorr, B. S., J. J. Hatch, and D. V. Weseloh. 2021. Double-crested Cormorant (*Nannopterum auritum*), version 1.1. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.doccor.01.1.

Dorr, B. S., K. L. Sullivan, P. D. Curtis, R. B. Chipman, and R. D. McCullough. 2016. Double-crested cormorants. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 17 pp.

Dorr, B. S., L. W. Burger, S. C. Barras, and K. C. Godwin. 2012. Economic impact of double-crested cormorant, *Phalacrocorax auritus*, depredation on Channel Catfish, *Ictalurus punctatus*, aquaculture in Mississippi, USA. Journal of the World Aquaculture Society 43:502-513.

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. 2020. Mallard (*Anas platyrhynchos*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.mallar3.01.

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.

Egan, C. C., B. F. Blackwell, E. Fernandez-Juricic, and P. E. Klug. 2020. Testing a key assumption of using drones as frightening devices: Do birds perceive wildlife-monitoring drones as risky? Condor 122:1-15.

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 Wildlife Research Center, Fort Collins, Colorado.

Ellis, D. H. 1981. Responses of Raptorial Birds to low level military jets and sonic booms: Results of the 1980-1981 Joint U.S. Air Force-U.S. Fish and Wildlife Service Study. Prepared by the Institute for Raptor Studies for USAF and USFWS. NTIS No. ADA 108-778.

Elser, J. L., A. L. Adams Progar, K. M. M. Steensma, T. P. Caskin, S. R. Kerr, and S. A. Shwiff. 2019*a*. Economic and livestock health impacts of birds on dairies: Evidence from a survey of Washington dairy operators. PLoS ONE 14:e0222398. https://doi.org/10.1371/journal.pone.0222398.

Elser, J. L., C. A. Lindell, K. M. M. Steensma, P. D. Curtis, D. K. Leigh, W. F. Siemer, J. R. Boulanger, and S. A. Shwiff. 2019*b*. Measuring bird damage to three fruit crops: A comparison of growner and field estimates. Crop Protection 123:1-4.

Emlen, J. T., Jr. 1940. The midwinter distribution of the crow in California. Condor. 42: 287-294.

Engle, C. R., S. Clements, B. S. Dorr, J. B. Davis, L. A. Roy, and A. M. Kelly. 2020. Economic effects of predation by scaup on baitfish and sportfish farms. Journal of the World Aquaculture Society 52:329-349.

EPA. 1982. Avian single-dose oral LD50 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 January 25, 2022.

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 January 25, 2022.

EPA. 2000. Introduction to phytoremediation. EPA/600/R-99/107, Office of Research and Development, Washington, D.C., USA.

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

EPA. 2007. Reregistration eligibility decision for 4-Aminopyridine. United States Environmental Protection Agency, Prevention, Pesticides, and Toxic Substances. 75 pp.

EPA. 2015. Selected Mammal and Bird Repellents: 9, 10-Anthraquinone (122701), 1-Butanethiol (1-Butylmercaptan) (125001), Fish Oil (122401), Meat Meal (100628), Methyl Anthranilate

(128725), Red Pepper (Chile Pepper) (070703) Fact Sheet. United States Environmental Protection Agency, Ombudsman, Biopesticides, and Pollution Division, Office of Pesticide Programs, Washington, D.C. 2 pp.

EPA. 2016. Climate change on ecosystems. https://www.epa.gov/climate-impacts/climate-impacts-ecosystems. Accessed January 25, 2022.

EPA. 2020. Testing guidelines for pesticide data requirement. United States Environmental Protection Agency website. https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/test-guidelines-pesticide-data-requirements#:~:text=The%20Up%2Dand%2DDown%20Procedure,by%20using%20sequential%20dosing%20steps.&text=It%20replaces%20the%20traditional%20acute,%2C%20pesticides%2C%20and%20their%20mixtures. Accessed January 25, 2022.

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. 1989. 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.

Faanes, C.A., and D. Bystrak. 1981. The role of observer bias in the North American breeding bird survey. Pp. 353-359 *in* C. J. Ralph and J. M. Scott, eds., Estimating the numbers of terrestrial birds. Studies in Avian Biology 6.

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.

Farraway, A., K. Thomas, and 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.

Federal Aviation Administration. 2018. Aviation gasoline - About aviation gasoline. Federal Aviation Administration website. https://www.faa.gov/about/initiatives/avgas/. Accessed April 2, 2019.

Federal Aviation Administration. 2023. National Wildlife Strike Database. http://wildlife.faa.gov/default.aspx. Accessed July 26, 2023.

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

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.

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.

Flickinger, E. L. 1981. Wildlife mortality at petroleum pits in Texas. Journal of Wildlife Management 45:560-564.

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, Gainesville, Florida, USA.

Franklin, A. B., A. M. Ramey, K. T. Bentler, N. L. Barrett, L. M. McCurdy, C. A. Ahlstrom, J. Bonnedahl, S. A. Shriner, and J. C. Chandler. 2020. Gulls as sources of environmental contamination by colistin-resistant bacteria. Scientific Reports 10:4408. doi: 10.1038/s41598-020-61318-2.

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.

Fraser, J. D., L. D. Frenzel, and J. E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49:585-592.

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.

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.

Fuller, M. R., and J. A. Mosher. 1987. Raptor survey techniques. Pages 37-65 *in* B. A. Giron Pendleton, B.A Millsap, K. W. Cline, and D. M. Bird, editors. Raptor management techniques manual. National Wildlife Federation, Washington, D.C., USA.

Gabig, P. J. 2000. Large Canada geese in the Central Flyway: Management of depredation, nuisance and human health and safety issues. Central Flyway Council. 53 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.

General Services Administration. 2023. Climate action and sustainability. General Services Administration website. https://www.gsa.gov/governmentwide-initiatives/climate-action-and-sustainability. Accessed February 15, 2023.

GDNR. 2015. Georgia State Wildlife Action Plan. Georgia Department of Natural Resources, Social Circle, Georgia.

GDNR. 2022*a*. Species Management and Conservation Programs, Georgia Department of Natural Resources, Wildlife Resources Division website. https://georgiawildlife.com/about/what-we-do. Accessed January 31, 2022.

GDNR. 2022*b*. Wild turkey program FY 2021 harvest report. Georgia Department of Natural Resources, Wildlife Resources Division, Social Circle, Georgia. 2 pp.

GDNR. 2023. Hunting regulations 2023-2024. Georgia Department of Natural Resources, Social Circle, Georgia. 76 pp.

Gerwolls, M. K., and S. M. Labott. 1994. Adjustment to the death of a companion animal. Anthrozoos 7:172-187.

Gilmer, D. S., L. M. Cowardin, R. L. Duval, L. M. Mechlin, C. W. Shaiffer, and V. B. Kuechle. 1981. Procedures for the use of aircraft in wildlife biotelemetry studies. U.S. Fish and Wildlife Service Resource Publication 140.

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.

Gladwin, D. N., D. A. Asherin, and K. M. Manci. 1988. Effects of aircraft noise and sonic booms on fish and wildlife. U.S. Fish and Wildlife Service National Ecology Research Center Report 88/30.

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., D. S. Reinhold, and P. Smith. 1999. Wading bird depredations on channel catfish *Ictalurus punctatus* in northwest Mississippi. Journal of the World Aquaculture Society 30:107-114.

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., 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 starlings at a southeastern livestock farm: implications for damage control. Proceedings of the Eastern Wildlife Damage Control Conference 3:194-203.

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.

Goodwin, A. E. 2002. First report of Spring Viremia of Carp Virus (SVCV) in North America. Journal of Aquatic Animal Health 14:161-164.

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*a*. Characteristics of American crow urban roosts in California. Journal of Wildlife Management 59:638-645.

Gorenzel, W. P., and T. P. Salmon. 1994*b*. Swallows. Pages E121–E128 in S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. The Handbook: Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA.

Gorenzel, W. P., T. P. Salmon, G. D. Simmons, B. Barkhouse, and M. P. Quisenberry. 2000. Urban crow roosts – a nation¬wide 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, Utah, USA.

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.

Greenberg, R., and S. Droege. 1999. On the decline of the rusty blackbird and the use of ornithological literature to document long-term population trends. Conservation Biology 13:553-559.

Greenberg, R., and S. M. Matsuoka. 2010. Rusty blackbird: Mysteries of a species in decline-*Euphagus carolinus*. The Condor 112:770-777.

Greenberg, R., D. W. Demarest, S. M. Matsuoka, C. Mettke-Hofmann, D. Evers, P. B. Hamel, J. Lucier, L. L. Powell, M. L. Avery, K. A. Hobson, P. J. Blancher, and D. K. Niven. 2011. Understanding declines in rusty blackbirds. Pp 107-125 *in* J. V. Wells, ed., Boreal birds of North America: A hemispheric view of their conservation links and significance. University of California Press, Berkeley, California, USA.

Gross, D. 2012. Osprey (*Pandion haliaetus*), fact sheet. Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA.

Grubb, T. G., D. K. Delaney, W.W. Bowerman, and M. R. Wierda. 2010. Golden eagle indifference to heli-skiing and military helicopters in Northern Utah. Journal of Wildlife Management 74:1275–1285.

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.

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.

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(Special Publication 1):8-24.

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

Hauser, R., S. Archer, P. Backlund, J. Hatfield, A. Janetos, D. Lettenmaier, M. G. Ryan, D. Schimel, and M. Walsh. 2009. The effects of climate change on U.S. ecosystems. Synthesis and Assessment Product 4.3. United States Global Change Research Program. 28 pp.

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, J. A., P. C. Frederick, J. A. Kushlan, and K. L. Bildstein. 2020. White Ibis (*Eudocimus albus*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.whiibi.01.

Hebert, C. E., J. Duffe, D. V. C. Weseloh, E. M. T. Senese, and G. D. Haffner. 2005. Unique island habitats may be threatened by double-crested cormorants. Journal of Wildlife Management 69:68-76.

Heinrich, J. W., and S. R. Craven. 1990. Evaluation of three damage abatement techniques for Canada geese. Wildlife Society Bulletin 18:405-410.

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.

Hogrefe, T. C., R. H. Yahner, and N. H. Piergallini. 1998. Depredation of artificial ground nests in a suburban versus a rural landscape. Journal of the Pennsylvania Academy of Science 72:3-6.

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.

Holthuijzen, A. M. A., W. G. Eastland, A. R. Ansell, M. N. Kochert, R. D. Williams, and L. S. Young. 1990. Effects of blasting on behavior and productivity of nesting prairie falcons. Wildlife Society Bulletin 18:270-281.

Homan, H. J., R. S. Stahl, and G. M. Linz. 2011. Comparing a bioenergetics model with feeding rates of caged European starlings. Journal of Wildlife Management 75:126-131.

Homan, H. J., R. S. Stahl, and G. M. Linz. 2013. Comparison of two models for estimating mortality from baitings with compound DRC-1339 concentrate avicide. Crop Protection 45:71-75.

Homan, H. J., R. J. Johnson, J. R. Thiele, and G. M. Linz. 2017. European starlings. Wildlife Damage Management Technical Series. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Service. 26 pp.

Homan, H. J., R. S. Stahl, J. J. Johnston, and G. M. Linz. 2005. Estimating DRC-1339 mortality using bioenergetics: A case study of the European starling. Proceedings of the Wildlife Damage Management Conference 11:202–208.

Hothem, R. L., B. E. Brussee, W. E. Davis Jr., A. Martínez-Vilalta, A. Motis, and G. M. Kirwan. 2020. Black-crowned Night-Heron (*Nycticorax nycticorax*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.bcnher.01.

Hoy, M. D. 2017. Herons and egrets. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 12 pp.

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.

Ingold, D. J. 1994. Influence of nest site competition between European starlings and woodpeckers. Wilson Bulletin 1106:227-241.

Intergovernmental Panel on Climate Change. 2022. Climate change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

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, 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.

Jackson, B. J., and J. A. Jackson. 2020. Killdeer (*Charadrius vociferus*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.killde.01.

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, technical coordinator. Symposium on Double-crested Cormorants: Population status and management issues in the Midwest, Technical Bulletin 1879. United States Department of Agriculture, Animal and Plant Health Inspection Service, Washington, D.C., USA.

Jaster, L. A., W. E. Jensen, W. E. Lanyon, and S. G. Mlodinow. 2022. Eastern Meadowlark (*Sturnella magna*), version 1.1. In Birds of the World (P. Pyle and N. D. Sly, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.easmea.01.1.

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.

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.

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.

Kaiser, B. A. 2019. Chemical repellents for reducing blackbird damage: the importance of plant structure and avian behavior in field applications. Environmental and Conservation Sciences (Biological Sciences). Fargo, ND USA, North Dakota State University. MS Biology: 97.

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.

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.

Kendall, R. J., T. E. Lacher, Jr., C. Bunck, B. Daniel, C. Driver, C. E. Grue, F. Leighton, W. Stansley, P.G. Watanabe, and M. Whitworth. 1996. An ecological risk assessment of lead shot exposure in non-waterfowl avian species: Upland game birds and raptors. Environ. Toxicol. and Chem. 15:4-20.

Kerpez, T. A., and N. S. Smith. 1990. Competition between European starlings and native woodpeckers for nest cavities in saguaros. Auk. 107:367-375.

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

King, D. T. 1997. American White Pelicans: The latest avian problem for catfish producers. Proceedings of the Seventh Eastern Wildlife Damage Management Conference 7:31-35.

King, D. T. 2005. Interactions between the American white pelican and aquaculture in the southeastern United States: an overview. Waterbirds 28 (Special Publication 1):3-86.

King, T. 2019. American white pelicans. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Service, Wildlife Damage Management Technical Series. 14 pp.

Kirk, D. A., and M. J. Mossman. 2020. Turkey Vulture (*Cathartes aura*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.turvul.01.

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. Limnology and Oceanography 44:828-836.

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.

Klimstra, J. D., and P. I. Padding. 2012. Harvest distribution and derivation of Atlantic Flyway Canada geese. Journal of Fish and Wildlife Management 3:43-55.

Kluever, B. M., M. B. Pfeiffer, S. C. Barras, B. G. Dunlap, and L. A. Humberg. 2020. Black vulture conflict and management in the United States: damage trends, management overview, and research needs. Human – Wildlife Interactions 14(3):376-389.

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.

Koh, L. P., and S. A. Wich. 2012. Dawn of drone ecology: low-cost autonomous aerial vehicles for conservation. Tropical Conservation Science 5:121-132.

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. 1997. Review of the population status and management of double-crested cormorants in Ontario. Pp. 131–145 *in* M. E. Tobin, technical coordinator. Symposium on Double-crested Cormorants: Population status and management issues in the Midwest, Technical Bulletin 1879. United States Department of Agriculture, Animal and Plant Health Inspection Service, Washington, D.C., USA.

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

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. 1979. Effects of helicopter censuses on wading bird colonies. Journal of Wildlife Management 43:756-760.

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.

Lafferty, D. J., K. C. Hanson-Dorr, A. M. Prisock, and B. S. Dorr. 2016. Biotic and abiotic impacts of Double-crested Cormorant breeding colonies on forested islands in the southeastern United States. Forest Ecology and Management 369:10–19.

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.

Lamp, R. E. 1989. Monitoring of the effect of military air operations at naval air station Fallon on the biota of Nevada. Nevada Department of Wildlife, Reno, Nevada.

Lancia, R. A., C. S. Rosenberry, and M. C. Conner. 2000. Population parameters and their estimation. Pages 64-83 *in* S. Demaris and P. R. Krausman, editors. Ecology and management of large mammals in North America. Prentice-Hall Incorporated, Upper Saddle River, New Jersey.

Lefrancois, G. R. 1999. The Lifespan. Sixth edition. Wadsworth Publishing Company, Belmont, California, USA.

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. Bugbee, 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. Dissertation, Cornell University, Ithaca, New York, USA.

Lindsey, R., and L. Dahlman. 2023. Climate change: Global Temperature. National Oceanic and Atmospheric Administration website. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature. Accessed February 15, 2023.

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.

Linnell, M. A., M. R. Conover, and T. J. Ohashi. 1999. Biases in bird strike statistics based on pilot reports. Journal of Wildlife Management 63:997–1003.

Linz, G. M., D. A. Schaaf, R. L. Wimberly, H. J. Homan, T. L. Pugh, B. D. Peer, P. Mastrangelo, and W. J. Bleier. 2000. Efficacy and potential nontarget impacts of DRC-1339 avicide use in ripening sunflower fields: 1999 progress report. Pp. 162-169 in L. Kroh, ed.Proceedings of the 22nd Sunflower Research Workshop. (January 18-19, 2000, Fargo, North Dakota). National Sunflower Association, Bismarck, North Dakota.

Lipnick, R., J. A. Cotrouvo, R. N. Hill, R. D. Bruce, D. A. Stitzel, A. P. Walker, I. Chu, M. Goddard, L. Segal, J. A. Springer, and R. C. Meyers. 1995. Comparison of the Up-and-Down, conventional LD50, and Fixed-Dose Acute Toxicity procedure. Food Chemistry and Toxicology 33:223-331.

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.

Lowe, S., M. Browne, S. Boudjelas, and M. De Poorter. 2000. 100 of the world’s worst invasive alien species: A selection from the global invasive species database. The Invasive Species Specialist Group, Auckland, New Zealand. <http://www.issg.org/booklet.pdf>. Accessed August 27, 2016.

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.

Lowney, M. S., S. F. Beckerman, S. C. Barras, T. W. Seamans. 2018. Gulls. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 16 pp.

Lowery, G. H. 1981. Louisiana Birds. Louisiana State University Press. 651 pp.

Lowther, P. E. 2020. Brown-headed Cowbird (*Molothrus ater*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.bnhcow.01.

Lowther, P. E., and C. L. Cink. 2020. House Sparrow (*Passer domesticus*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.houspa.01.

Lowther, P. E., and R. F. Johnston. 2020. Rock Pigeon (*Columba livia*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.rocpig.01.

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.

Luscier, J. D., S. E. Lehnen, and K. G. Smith. 2010. Habitat occupancy by rusty blackbirds wintering in the Lower Mississippi Alluvial Valley. The Condor 112:841-848.

Lyons, M., K. Brandis, C. Callaghan, J. McCann, C. Mills, S. Ryall, and R. Kingsford. 2017. Bird interactions with drones, from individuals to large colonies. BioRxiv website. https://www.biorxiv.org/content/10.1101/109926v3.

MacDonald, J. W. and P. D. Brown. 1974. Salmonella infection in wild birds in Britain. Veterinary Record 94: 21-322.

MacKinnon, B., R. Sowden, and S. Dudley, editors. 2004. Sharing the skies: an aviation guide to the management of wildlife hazards. Transport Canada, Aviation Publishing Division, AARA, 5th Floor, Tower C, 330 Sparks Street, Ottawa, Ontario, K1A 0N8, Canada. 316 pp.

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.

Manci, K. M., D. N. Gladwin, R. Villella, and M. G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: A literature synthesis. Fort Collins, Colorado/ Kearneysville, West Virginia: U.S. Fish and Wildlife Service and National Ecology Research Center.

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. Hydrobiologia 279/280:121- 132.

Marks, S. G., J. E. Koepke, and C. L. Bradley. 1994. Pet attachment and generativity among young adults. Journal of Psychology 128:641-650.

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, 2019.

Martin, J., H. H. Edwards, M. A. Burgess, H. F. Percival, D. E. Fagan, B. E. Gardner, J. G. Ortega-Ortiz, P. G. Ifju, B. S Evers, T. J. Rambo. 2012. Estimating distribution of hidden objects with drones: From tennis balls to manatees. Plos 1 7:e38882. 8 pp.

Marzluff, J. M, R. B. Boone, and G. W. Cox. 1994. Native pest bird species in the West: why have they succeeded where so many have failed? Studies in Avian Biology. 15: 202-220.

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.

Massei, G., R. J. Quy, J. Gurney, and D. P. Cowan. 2010. Can translocations be used to mitigate human-wildlife conflicts? Wildlife Research 37:428-439.

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.

McAlister, M. A., C. S. DePerno, J. C. Fuller, D. L. Howell, and C. E. Moorman. 2017. A comparison of field methods to estimate Canada Goose abundance. Wildlife Society Bulletin 41:685-690.

McCrimmon Jr., D. A., J. C. Ogden, G. T. Bancroft, A. Martínez-Vilalta, A. Motis, G. M. Kirwan, and P. F. D. Boesman. 2020. Great Egret (*Ardea alba*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.greegr.01.

McGilvrey, F. B., and F. M. Uhler. 1971. A starling-deterrent wood duck nest box. Journal of Wildlife Management 35:793-797.

McRoberts, J. T., M. C. Wallace, and S. W. Eaton. 2020. Wild Turkey (*Meleagris gallopavo*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.wiltur.01.

Meanley, B. 1971. Blackbirds and the southern rice crop. United States Fish and Wildlife Service Resource Publication 100. 64 pp.

Meanley, B., J. S. Webb, and D. P. Frankhauser. 1966. Migration and movements of blackbirds and starlings. U.S. Bureau of Sport Fisheries and Wildlife, Patuxent Wildlife Research Center, Laurel, Maryland, USA.

Meehan, T. D., G. S. LeBaron, K. Dale, A. Krump, N. L. Michel, and C. B. Wilsey. 2020. Abundance trends of birds wintering in the USA and Canada, from Audubon Christmas Bird Counts, 1966-2019, version 3.0. National Audubon Society, New York, New York, USA.

Mengak, M. T. 2018. Wildlife translocation. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 15 pp.

Meyers, B. 2000. Anticipatory mourning and the human-animal bond. Pp 537-564 in T. A. Rando, ed. Clinical dimensions of anticipatory mourning: theory and practice in working with the dying, their loved ones, and their caregivers. Research Press, Champaign, Illinois, 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.

Miller, J. W. 1975. Much ado about European starlings. Natural History 84:38-45.

Miller, J. E. 2018. Wild turkeys. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 12 pp.

Miller, R. S., M. L. Farnsworth, J. L. Malmberg. 2013. Diseases at the livestock-wildlife interface: Status, challenges, and opportunities in the United States. Preventive Veterinary Medicine 110:119-132.

Milleson, M. P., S. A. Shwiff, and M. L. Avery. 2006. Vulture-cattle interactions – A survey of Florida ranchers. Proc. Vertebrate Pest Conference 22:231-238.

Mississippi Flyway Council Technical Section. 1996. Mississippi Flyway Giant Canada Goose Management Plan. Mississippi Flyway Council, Mississippi Flyway Technical Section, Giant Canada Goose Committee. 66 pp.

Mississippi Flyway Council Technical Section. 2017. A management plan for Mississippi Flyway Canada geese. Mississippi Flyway Council Technical Section Canada Goose Committee. 83 pp.

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.

Morrison, J. L., M. Terry, and P. L. Kennedy. 2006. Potential factors influencing nest defense in diurnal North American raptors. Journal of Raptor Research 40(2):98-110.

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. 15 pp.

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.

Mowbray, T. B., C. R. Ely, J. S. Sedinger, and R. E. Trost. 2020*a*. Canada Goose (*Branta canadensis*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.cangoo.01.

Mowbray, T. B., C. R. Ely, J. S. Sedinger, and R. E. Trost. 2020*b*. Cackling Goose (*Branta hutchinsii*), version 1.0. In Birds of the World (P. G. Rodewald and B. K. Keeney, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.cacgoo1.01.

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.

Munro, R. E., and C. F. Kimball. 1982. Population ecology of the Mallard: VII. Distribution and derivation of the harvest. United States Department of the Interior, Fish and Wildlife Service. Resource Publication 147. Washington, D.C.

National Audubon Society. 2020. The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org. Accessed June 7, 2021.

National Park Service. 1995. Report of effects of aircraft overflights on the National Park System. USDI-NPS D-1062, July 1995.

National Wild Turkey Federation. 2022*a*. Learn about the wild turkey subspecies. National Wild Turkey Federation website. https://www.nwtf.org/hunt/article/wild-turkey-subspecies. Accessed March 31, 2022.

National Wild Turkey Federation. 2022*b*. 4 facts about declining turkey populations. National Wild Turkey Federation website. https://www.nwtf.org/hunt/article/4-wild-turkey-populations#:~:text=After 40 years of effort, 6 and 6.2 million birds. Accessed March 31, 2022.

Neff, J. A., and B. Meanley. 1952. Experiences in banding blackbirds in Eastern Arkansas. Bird-Banding 23:154-157.

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.

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. 333 pp.

Norton, R. L. 1986. Case of botulism in laughing gulls at a landfill in the Virgin Islands, Greater Antilles. Florida Field Naturalist 14:97-98.

Olesen, N. J., and P. E. Vestergard-Jorgensen. 1982. Can and do herons serve as vectors for Egtved virus? Bulletin of European Association of Fish Pathologists 2:48.

Organ, J. F., S. P. Mahoney, and V. Geist. 2010. Born in the hands of hunters, the North American model of wildlife conservation. The Wildlife Professional 4:22-27.

Organ, J. F., V. Geist, S. P. Mahoney, S. Williams, P. R. Krausman, G. R. Batcheller, T. A. Decker, R. Carmichael, P. Nanjappa, R. Regan, R.A. Medellin, R. Cantu, R. E. McCabe, S. Craven, G. M. Vecellio, and D. J. Decker. 2012. The North American Model of Wildlife Conservation. The Wildlife Society Technical Review 12-04. The Wildlife Society, Bethesda, Maryland, USA.

Otis, D. L., J. H. Schulz, D. Miller, R. E. Mirarchi, and T. S. Baskett. 2020. Mourning Dove (*Zenaida macroura*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.moudov.01.

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.

Padding, P. I. and J. A. Royle. 2012. Assessment of bias in US waterfowl harvest estimates. Wildlife Research 39:336–342.

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, and 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.

Parsons, K. C., and T. L. Master. 2020. Snowy Egret (*Egretta thula*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.snoegr.01.

Partners in Flight. 2020. Population Estimates Database, version 3.1. Available at http://pif.birdconservancy.org/PopEstimates. Accessed on February 1, 2022.

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.

Pedersen, K., J. A. Baroch, D. L. Nolte, T. Gidlewski, and T. J. Deliberto. 2012. The role of the National Wildlife Disease Program in wildlife disease surveillance and emergency response. Proceedings of the 14th Annual Wildlife Damage Management Conference 14:74-79.

Peer, B. D., and E. K. Bollinger. 2020. Common Grackle (*Quiscalus quiscula*), version 1.0. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.comgra.01.

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., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52:273–288.

Pochop, P. A., J. L. Cummings, J. E. Steuber, and C. A. Yoder. 1998*a*. Effectiveness of several oils to reduce hatchability of chicken eggs. Journal of Wildlife Management 62:395-398.

Pochop, P. A., J. L. Cummings, C. A. Yoder, and J. E. Steuber. 1998*b*. Comparison of white mineral oil and corn oil to reduce hatchability of Ring-billed Gull eggs. Proceedings of the 18th Vertebrate Pest Conference 18:411-413.

Pollet, I. L., D. Shutler, J. W. Chardine, and J. P. Ryder. 2020. Ring-billed Gull (*Larus delawarensis*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.ribgul.01.

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. 2020. Boat-tailed Grackle (*Quiscalus major*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.botgra.01.

Powell, L. A., M. J. Conroy, G. D. Balkcom, and J. N. Caudell. 2004. Urban Canada Geese in Georgia: Assessing a golf course survey and a nuisance relocation program. Pages 145-149 *in* T. J. Moser, R. D. Lien, K. C. VerCauteren, K. F. Abraham, D. E. Andersen, J. G. Bruggink, J. M. Coluccy, D. A. Graber, J. O. Leafloor, D. R. Luukkonen, and R. E. Trost, editors. Proceedings of the 2003 International Canada Goose Symposium, 19–21 March 2003, Madison, Wisconsin, USA.

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., and M. D. Decker. 1989. Black and turkey vultures expand their ranges northward. The Eyas. 12:11-15.

Raftovich, R.V., K. K. Fleming, S. C. Chandler, and C. M. Cain. 2021. Migratory bird hunting activity and harvest during the 2019–20 and 2020-21 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.

Reidinger, R. F., and J. E. Miller. 2013. Wildlife damage management, prevention, problem solving and conflict resolution. The Johns Hopkins Press, Baltimore. 243 pp.

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.

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/

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. Ornithological Monographs 14:3-9.

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.

Rocke, T. E. 1999. Oil. Pp. 309-315 *in* M. Friend and J. C. Franson, eds., Field Manual of Wildlife Diseases: General Field Procedures and Diseases of Birds. Biological Resources Division Information and Technology Report 1999-2001.

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.

Romagosa, C. M., and S. G. Mlodinow. 2022. Eurasian Collared-Dove (*Streptopelia decaocto*), version 1.1. In Birds of the World (P. Pyle, P. G. Rodewald, and S. M. Billerman, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.eucdov.01.1.

Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River valley. University of Arizona Press, Tucson, Arizona, USA.

Ross, C. B., and J. Baron-Sorensen. 1998. Pet loss and human emotion: guiding clients through grief. Accelerated Development, Incorporation, Philadelphia, Pennsylvania, USA.

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.

Rusch, D. H., R. E. Malecki, and R. E. Trost. 1995. Canada Geese in North America. Pages 26-28 in E. T. LaRoe, 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. National Biological Service, Washington, D.C., USA.

Rush, S. A., S. Verkoeyen, T. Dobbie, S. Dobbyn, C. E. Hebert, J. Gagnon, and A. T. Fisk. 2011. Influence of increasing populations of Double-crested Cormorants on soil nutrient characteristics of nesting islands in western Lake Erie. Journal of Great Lakes Research 37:305–309.

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.

Samuel, M. D., and M. R. Fuller. 1996. Wildlife radiotelemetry. Pp 370-417 *in* Research and management techniques for wildlife and habitats, T. A. Bookhout, ed. Allan Press, Inc., Lawrence, Kansas.

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. 2019. The North American Breeding Bird Survey, Results and Analysis 1966 - 2019. Version 2.07.2019 USGS Patuxent Wildlife Research Center, Laurel, Maryland.

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

Schafer, E. W., Jr. 1981. Bird control chemicals - nature, modes of action, and toxicity. Pp. 129-139 in CRC handbook of pest management in agriculture. Vol. 3. CRC Press, Cleveland, 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., and L. L. Marking. 1975. Long-term effects of 4-Aminopyridine exposure to birds and fish. Journal of Wildlife Management 39:807-811.

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.

Schafer, L. M., J. L. Cummings, J. A. Yunger, and K. E. Gustad. 2002. Efficacy of Translocation of Red-tailed Hawks from Airports. 2002 Bird Strike Committee-USA/Canada, 4th Annual Meeting, Sacramento, California. 38.

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.

Schorger, A. 1952. Introduction of the domestic pigeon. Auk 69:462-463.

Seamans, T. W. 2004. Response of roosting turkey vultures to a vulture effigy. Ohio Journal of Science 104:136–138.

Seamans, M. E. 2021. Mourning dove population status, 2021. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, Maryland.

Seamans, T. W., and A. Gosser. 2016. Bird dispersal techniques. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Wildlife Damage Management Technical Series. 12 pp.

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.

Sharp, T., and G. Saunders. 2008. A model for assessing the relative humaneness of pest animal control methods. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Sharp, T., and G. Saunders. 2011. A model for assessing the relatives humaneness of pest animal control methods. 2nd Edition. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Sheikh, P. A., M. L. Corn, J. A. Leggett, and P. Folger. 2007. Global climate change and wildlife. Congressional Research Service Report for Congress. 6 pp.

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. 1997. Colonial waterbird nesting on West Sister Island National Wildlife Refuge and the arrival of double-crested cormorants. Pp. 115–119 *in* M. E. Tobin, technical coordinator. Symposium on Double-crested Cormorants: Population status and management issues in the Midwest, Technical Bulletin 1879. United States Department of Agriculture, Animal and Plant Health Inspection Service, Washington, D.C., USA.

Shirota, Y. M., and S. Masake. 1983. Eyespotted balloons are a device to scare gray European starlings. Appl. Ent. Zool. 18:545-549.

Shwiff, S., K. Kirkpatrick, and T. DeVault. 2009. The economic impact of double-crested cormorants to Central New York. National Wildlife Research Center, USDA/APHIS/WS, Fort Collins, Colorado, USA.

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.

Smith, A. E. 1996. Movement and harvest of Mississippi Flyway Canada Geese. Thesis, University of Wisconsin-Madison, Madison, Wisconsin, USA.

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.

Somer, J. D., F. F. Gilbert, D. E. Joyner, R. J. Brooks, and R. G. Gartshore. 1981. Use of 4-Aminopyridine in cornfields under high foraging stress. Journal of Wildlife Management 45:702-709.

Speich, S. 1986. Colonial waterbirds. Pages 387-405 *in* A. Y. Cooperrider, R. J. Boyd, and H. R. Stuart, editors. Inventory and monitoring of wildlife habitat. USDI, Bureau of Land Management Service Center, Denver, Colorado, USA.

Stahl, R. S., N. Borchert, C. Heuser, R. Woodruff, and M. Tobin. 2016. The USDA APHIS WS unified model for estimating DRC-1339 bait application take estimates as effected by French fry bait size. Pp. 240-243 *in* R. A. Timm and R. A. Baldwin, eds., Proceedings of the 27th Vertebrate Pest Conference.

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.

Stanton, J. C., P. Blancher, K. V. Rosenberg, A. O. Panjabi, and W. E. Thogmartin. 2019. Estimating uncertainty of North American landbird population sizes. Avian Conservation and Ecology 14:4.

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.

Stickley, Jr., A. R. 1987. Albinistic rusty blackbird in Kentucky. Kentucky Warbler 63:42-43.

Stickley, A. R., and K. J. Andrews. 1989. Survey of Mississippi catfish farmers on means, effort, and costs to repel fish-eating birds from ponds. Fourth Eastern Wildlife Damage Control Conference 4:105-108.

Stickley, A. R., Jr., R. T. Mitchell, J. L. Seuburt, C. R. Ingram, and M. I. Dyer. 1976. Large-scale evaluation of blackbird frightening agent 4-Aminopyridine in corn. Journal of Wildlife Management 40:126-131.

Stickley, A. R., Jr., J. F. Glahn, J. O. King, and D. T. King. 1995. Impact of great blue heron depredations on channel catfish farms. Journal of the World Aquaculture Society 26:194-199.

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.

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.

Szaro, R. C. 1977. Effects of petroleum on birds. Transactions of the North American Wildlife and Natural Resources Conference 42:374-381.

Taylor, II, J. D., and B. Dorr. 2003. Double-crested cormorant impacts to commercial and natural Resources. K. Fagerstone and G. Witmer Eds., Tenth Wildlife Damage Management Conference Proceedings, Hot Springs, Arkansas, USA, 2003.

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. 2020. Cattle Egret (*Bubulcus ibis*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.categr.01.

TVA. 2020*a*. Update of TVA's Natural Resource Plan Final Supplemental Environmental Impact Statement. Tennessee Valley Authority, Knoxville, Tennessee, USA.

TVA. 2020*b*. Tennessee Valley Authority Natural Resource Plan. Tennessee Valley Authority, Knoxville, Tennessee, USA.

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

Thackston, R., T. Holbrook, W. Abler, J. Bearden, D. Carlock, D. Forster, N. Nicholson, and R. Simpson. 1991. The wild turkey in Georgia: History, biology, and management. Georgia Department of Natural Resources, Game and Fish Division, Game Management Section. 18 pp.

The Wildlife Society. 2017. Standing position statement: Wildlife damage management. The Wildlife Society, Bethesda, Maryland, USA.

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.

Tizard, I. 2004. Salmonellosis in wild birds. Seminars in Avian and Exotic Pet Medicine 13:50–66.

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.

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. 2015*a*. 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.

USDA. 2015*b*. Final Environmental Impact Statement: Feral swine damage management: A national approach. USDA/APHIS/WS, Riverdale, Maryland, USA.

USDA. 2016. Final report for the 2014-2015 outbreak of highly pathogenic avian influenza (HPAI) in the United States. United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Riverdale, Maryland, USA.

USDA. 2017. Death loss in U.S. cattle and calves due to predator and nonpredator causes, 2015. Report #745.1217. United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, National Animal Health Monitoring System, Fort Collins, Colorado, USA.

USDA. 2019*a*. Wildlife Services Strategic Plan: FY 2020-2024. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. 30 pp.

USDA. 2019*b*. 2017 census of agriculture: Georgia State and County Data. United States Department of Agriculture, National Agricultural Statistics Service. Volume 1, Geographic Area Series Part 10, AC-17-A-10. 1350 pp.

USDA. 2019*c*. Chapter II: The use of cage traps in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/2-cage-trap-peer-reviewed.pdf. Accessed July 27, 2023.

USDA 2019*d*. Chapter III: The use of cable devices in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/3-cable-devices-peer-reviewed.pdf. Accessed July 27, 2023.

USDA. 2019*e*. Chapter IV. The use of foothold traps in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by

United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/4-foothold-trap-peer-reviewed.pdf. Accessed July 27, 2023.

USDA. 2019*f*. Chapter V. The use of aircraft in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/ 5-aircraft-use-peer-reveiwed.pdf. Accessed July 27, 2023.

USDA. 2019*g*. Chapter VI: The use of firearms in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/6-firearms-use-peer-reviewed.pdf. Accessed July 27, 2023.

USDA. 2020. Chapter XIII: The use of nets in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/13-nets.pdf. Accessed July 27, 2023.

USDA. 2021. Chapter XV: The use of dogs and other animals in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/15-dog-use.pdf. Accessed July 27, 2023.

USDA. 2022*a*. 2020 state agriculture overview. United States Department of Agriculture, National Agricultural Statistics Service. https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=GEORGIA. Accessed January 31, 2022.

USDA. 2022*b*. Chapter XVI: The use of egg addling in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/16-egg-addling.pdf. Accessed February 8, 2023.

USDA. 2022*c*. Chapter XII: The use of lead in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/12-lead.pdf. Accessed February 8, 2023.

USDA. 2022*d* Chapter XIV: The use of quick-kill traps in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/14-quick-kill-traps.pdf. Accessed February 8, 2023.

USDA. 2022*e*. Chapter XVII: The use of DRC-1339 in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/17-drc-1339.pdf. Accessed February 8, 2023.

USDA. 2023*a*. Chapter XXV: Use of 4-aminopyridine in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/25-aminopyridine-avitrol.pdf. Accessed October 4, 2023.

USDA. 2023*b*. Chapter XXII: Use of exclusion in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/22-exclusion.pdf. Accessed October 4, 2023.

USDA. 2023*c*. Chapter XXI: The use of explosive materials in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/21-explosives.pdf. Accessed July 27, 2023.

USDA. 2023*d*. Chapter XVIII: The use of hand capture and biological sampling in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/18-hand-capture.pdf. Accessed July 27, 2023.

USDA. 2023*e*. Chapter XXIII: Carcass disposal in wildlife damage management. Human Health and Ecological Risk Assessment for the Use of Wildlife Damage Management Methods by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. https://www.aphis.usda.gov/wildlife_damage/nepa/risk_assessment/23-carcass-disposal.pdf. Accessed July 27, 2023.

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.

USFWS. 2007*a*. Final environmental impact statement: light goose management. United States Department of the Interior, Washington, D.C., USA.

USFWS. 2007*b*. National bald eagle management guidelines. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

USFWS. 2016. Programmatic Environmental Impact Statement for the Eagle Rule Revision. United States Department of the Interior, Washington, D.C., USA.

USFWS. 2018. North American Waterfowl Management Plan Update. U. S. Department of the Interior, Washington, D.C., USA. 46 pp.

USFWS. 2020*a*. Final Environmental Impact Statement: Management of conflicts associated with double-crested cormorants. United States Department of the Interior, United States Fish and Wildlife Service, Falls Church, Virginia. 249 pp.

USFWS. 2020*b*. Species status assessment report for the *Scutellaria ocmulgee* (Ocmulgee skullcap), Version 1.2. United States Fish and Wildlife Service, South Atlantic-Gulf Coast and Mississippi Basin Regions. Atlanta, Georgia. 81 pp.

USFWS. 2022. Waterfowl population status, 2022. United States Department of the Interior, Washington, D.C., USA. 76 pp.

USFWS. 2023. United States Fish and Wildlife Service website. https://www.fws.gov. Accessed January 13, 2023.

USFWS and the United States Department of Commerce. 2011. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. 172 pp.

United States Food and Drug Administration. 2003. Bird poisoning of federally protected birds. Office of Criminal Investigations. Enforcement Story 2003.

United States Forest Service. 1992. Overview, Report to Congress, Potential Impacts of Aircraft Overflights of National Forest System Wilderness. Report to Congress. Prepared pursuant to Section 5, Public Law 100-91, National Park Overflights Act of 1987.

United States Geological Survey. 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 July 14, 2021.

United States Geological Survey. 2015. Highly pathogenic avian influenza detected for the first time in wild birds in North America. GeoHealth Newsletter Volume 12, Number 1.

United States Geological Survey. 2018. Avian influenza. United States Geological Survey website. https://www.usgs.gov/centers/nwhc/science/avian-influenza?qt-science_center_objects=0#qt-science_center_objects. Accessed January 24, 2022.

United States Shorebird Conservation Plan Partnership. 2016. Shorebirds of conservation concern in the United States of America – 2016. http://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds/. Accessed July 26, 2023.

Vanderhoff, N., P. Pyle, M. A. Patten, R. Sallabanks, and F. C. James. 2020. American Robin (*Turdus migratorius*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.amerob.01.

Vennesland, R. G., and R. W. Butler. 2020. Great Blue Heron (*Ardea herodias*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.grbher3.01.

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. 2021. American Crow (*Corvus brachyrhynchos*), version 1.1. In Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.amecro.01.1.

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.

Veum, L. M., B. S. Dorr, K. C. Hanson-Dorr, R. J. Moore, and S. A. Rush. 2019. Double-crested cormorant colony effects on soil chemistry, vegetation structure and avian diversity. Forest Ecology and Management 453: 117588. doi: 10.1016/j.foreco.2019.117588.

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.

Wandrie, L. J., P. E. Klug, and M. E. Clark. 2019. Evaluation of two unmanned aircraft systems as tools for protecting crops from blackbird damage. Crop Protection 117:15-19.

Wang, Z., A. S. Griffin, A. Lucas, and K. C. Wong. 2019. Psychological warfare in vineyard: Using drones and bird psychology to control bird damage to wine grapes. Crop Protection 120:163-170.

Washburn, B. E. 2016. Hawks and Owls. Wildlife Damage Management Technical Series. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Service. 17 pp.

Watts, A. C., J. H. Perry, S. E. Smith, M. A. Burgess, B. E. Wilkinson, Z. Szantoi, P. G. Ifju, and H. F. Percival. 2010. Small unmanned aircraft systems for low-altitude aerial surveys. Journal of Wildlife Management 74:1614-1619.

Watts, B. D. 2020. Yellow-crowned Night-Heron (*Nyctanassa violacea*), version 1.0. In Birds of the World (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.ycnher.01.

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.

Weisman, A. D. 1991. Bereavement and companion animals. Omega: Journal of Death and Dying 22: 241-248.

Weitzel, N. H. 1988. Nest site competition between the European starling and native breeding birds in northwestern Nevada. Condor 90:515-517.

Welty, J. C. 1982. The life of birds. Third edition. Saunders College Publishing. New York, New York, USA.

Werner, S. J., M. Gottlob, C. D. Dieter, and J. D. Stafford. 2019. Application strategy for an anthraquinone-based repellent and the protection of soybeans from Canada goose depredation. Human-Wildlife Interactions 13:308-316.

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, Canada.

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., C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten. 2020. Herring Gull (*Larus argentatus*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.hergul.01.

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. 2022. Waterbird Population Estimates. wpe.wetlands.org. Accessed March 30, 2022.

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.

White, C. M., and S. K. Sherrod. 1973. Advantages and disadvantages of the use of rotor-winged aircraft in raptor surveys. Raptor Research 7:97-104.

White, C. M., and T. L. Thurow. 1985. Reproduction of Ferruginous Hawks exposed to controlled disturbance. Condor 87:14-22.

White, S. B., R. A. Dolbeer, and T. A. Bookhout. 1985. Ecology, bioenergetics, and agricultural impacts of a winter-roosting population of blackbirds and starlings. Wildlife Monographs 93:3-42.

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.

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.

Will, T., J. C. Stanton, K. V. Rosenberg, A. O. Panjabi, A. F. Camfield, A. E. Shaw, W. E. Thogmartin, and P. J. Blancher. 2020. Handbook to the Partners in Flight Population Estimates Database, Version 3.1. PIF Technical Series No 7.1. pif.birdconservancy.org/popest.handbook.pdf.

Willcox, A. S., and W. M. Giuliano. 2012. The Canada Goose in Florida, WEC 211. Wildlife Ecology and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, USA.

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/.

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.

Wilmers, T. J. 1987. Competition between European starlings and kestrels for nest boxes: a review. Raptor Res. Rep. No. 6 pp. 156-159.

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.

Wires, L. R., S. J. Lewis, G. J. Soulliere, S. W. Matteson, D. V. Weseloh, R. P. Russell, and F. J. Cuthbert. 2010. Upper Mississippi Valley/Great Lakes Waterbird Conservation Plan. A plan associated with the Waterbird Conservation for the Americas Initiative. Final Report submitted to United States Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

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.

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.

World Health Organization. 2022. Assessment of risk associated with recent influenza A(H5N1) clade 2.3.4.4b viruses. World Health Organization website: https://cdn.who.int/media/docs/default-source/influenza/avian-and-other-zoonotic-influenza/h5-risk-assessment-dec-2022.pdf?sfvrsn=a496333a_1&download=true. Accessed July 24, 2023.

World Health Organization. 2023. Ongoing avian influenza outbreaks in animals pose risk to humans. World Health Organization website: https://www.who.int/news/item/12-07-2023-ongoing-avian-influenza-outbreaks-in-animals-pose-risk-to-humans. Accessed July 24, 2023.

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.

Wright, S. 2010. Some significant wildlife strikes to civil aircraft in the United States, January 1990-November 2009. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Sandusky, Ohio, USA.

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. 2020. Red-winged Blackbird (*Agelaius phoeniceus*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bow.rewbla.01.

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.

Zasloff, R. L. 1996. Human-animal interactions. Special Issue. Applied Animal Behaviour Science. 47: 43-48.

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 TO MANAGE BIRD DAMAGE

WS is evaluating the use of an adaptive approach to managing damage associated with birds, when requested, through the implementation and integration of safe and practical methods based on local problem analyses and the informed decisions of trained WS personnel. WS personnel would formulate integrated method approaches using the WS Decision Model (Slate et al. 1992; see WS Directive 2.201). An integrated approach to resolving requests for assistance using the Decision Model would allow WS personnel greater flexibility and more opportunity to develop an effective damage management strategy for each request for assistance, such as considerations for threatened, endangered, or candidate species, that could be present in an area.

When selecting damage management techniques for specific damage situations, WS personnel would consider the species involved along with the magnitude, geographic extent, duration, frequency, and likelihood of further damage. WS personnel would also consider the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, humaneness of methods, animal welfare concerns, 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. WS personnel would evaluate those factors when formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to WS 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. WS could recommend or use the following methods in Georgia. Many of the methods described would also be available to other entities in the absence of any involvement by WS.

I. NON-LETHAL METHODS

Non-lethal methods consist primarily of tools or devices used to disperse, exclude, or capture a particular bird or a local population of birds to alleviate damage and conflicts. When evaluating management methods and formulating a management strategy, WS personnel would give preference to non-lethal methods when they determine those methods to be practical and effective (see WS Directive 2.101). Most of the non-lethal methods available to WS would also be available to other entities within the state and other entities could employ those methods to alleviate bird damage.

Human presence: Human presence may consist of physical actions of people, such as clapping, waving, or shouting, or the presence of people and/or a vehicle at a location where damage or threats of damage are occurring. For example, birds may associate a vehicle with previous hazing activities and approaching an area in that vehicle or a similar vehicle may disperse target bird species from an area. Similarly, making a person’s presence known to target bird species by clapping, waving, or shouting can often disperse birds from an area. When birds begin to associate people with hazing and/or shooting activities, the presence of people can disperse those birds when they see people approach. Human activities can also enhance the effectiveness of effigies, such as human effigies, because they associate people with hazing or shooting activities.

Modifying cultural practices: WS personnel could make recommendations to people on where to locate facilities, the design of facilities, modifications of existing facilities, and fisheries management to reduce the threat of bird damage. WS personnel could make recommendations on facility design or modifications to existing facilities to minimize the attractiveness of the facilities to birds, such as removing or altering areas where birds can perch and loaf. WS personnel could also make recommendations on operations management, such as areas to locate vulnerable fish stock, stocking rates, and the timing of releasing vulnerable fish stock.

Recommendations could include modifying the behavior of people that may be attracting or contributing to the damage 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. Recommendations may include altering planting dates so that crops are less vulnerable to damage when birds may be present. 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. For example, Carlson et al. (2018*a*) found that red-winged blackbirds preferred flaked corn over ground corn in livestock feed. Similarly, Carlson et al. (2018*b*) found that pelleted feed of 0.95 centimeters diameter or larger inhibited starling consumption by more than 79%. WS could make recommendations on changes to animal husbandry practices, such as feeding animals at night, feeding animals indoors, removing spilled grain or standing water, and use of bird proof feeders.

In situations where the presence of birds at or near airports results in threats to human safety and cannot be resolved by other means, WS personnel could recommend airports or military facilities alter aircraft flight patterns or schedules to avoid risks of striking birds. However, altering operations at airports to decrease the potential for strike hazards involving birds 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 can 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 that attract other waterfowl. Domestic waterfowl could also carry diseases, which can threaten wild populations.

Limited habitat modification: In most cases, the resource or property owner would be responsible for implementing habitat modifications, and WS would only provide recommendations 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. Management of vegetation and water from areas adjacent to aircraft runways can minimize many bird problems on airport properties. WS could also recommend limited habitat modification in urban areas. 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 in urban areas. Selectively thinning trees or pruning trees can greatly reduce bird activity at a roost location. Modifying habitat can include planting 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*).

Supplemental feeding and lure crops: Supplemental feeding and lure crops are food resources planted or provided to attract wildlife away from more valuable resources (*e.g*., crops). The intent is to provide a more attractive food source so that the animals causing damage would consume it rather than a more valuable resource. In feeding programs, an alternative food source with a higher appeal is offered to target birds 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 often continuous. The resource owner would be limited in implementing this method contingent upon ownership of or ability to manage the property.

Fencing: WS could recommend and implement fencing to alleviate bird damage; however, fencing has limited application for birds. WS personnel would primarily use and recommend fencing when addressing requests for assistance associated with waterfowl. Similar to other exclusion methods, the intent of fencing is to prevent waterfowl from accessing an area. For example, WS could place fencing between a crop and a pond that waterfowl use. The fencing would act as a barrier to prevent waterfowl from leaving the pond and walking to feed on the crop. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993). In addition, limits to the use of fencing arise where there are multiple landowners, the size of the area, and its proximity to bodies of water used by waterfowl. 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. Fencing can also be effective during molts (Gosser et al. 1997). Birds that are capable of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing.

Fencing could include the use and recommendation of electrified fencing. Cooper and Keefe (1997) found people viewed the use of electric fencing as highly effective. The application of electrified fencing would be limited to rural settings, due to the possibility/likelihood of interaction with people and pets in populated areas. 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.

Surface coverings: WS could recommend or use surface coverings to discourage birds from using areas. For example, covering the surface of a pond with plastic balls that float on the surface of the water can prevent access by waterfowl and gulls. However, a "*ball blanket*" would render a pond unusable for boating, swimming, fishing, and other recreational activities. It would also make it difficult to harvest fish from the pond. In addition, this method can be very expensive depending on the area covered, which often restricts its applicability to small water retention ponds.

Overhead wire grids: Overhead lines and wires consist of a line (*e.g*., fishing line) or wire (*e.g*., high-tensile galvanized or stainless steel wire) 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 and a lowering of the esthetic value of the neighborhood when used in residential areas or public areas. Wire grids can render an area unusable by people.

Netting: In some limited situations, WS could recommend or use netting to exclude birds. Similar to overhead wire grids, netting is not likely practical in most situations because the size of the area requiring netting would be too large, such as fields used for commercial agriculture. In addition, as they attempt to access resources, birds may entangle themselves in nets causing injuries or death.

Visual scaring techniques: Visual scaring techniques that WS may use and/or recommend include Mylar tape, eyespot balloons, flags, effigies, lasers, and lights. Visual scaring techniques can act as novel stimuli that birds act to avoid. WS personnel would use those methods to scare and disperse target bird species, such as at roosting locations or areas where target birds nest.

Mylar tape has a highly reflective surface that produces flashes of light as sunlight reflects off the surface, which can startle birds. In addition, the metallic rattle and quick movement of Mylar tape as it moves in the wind can startle birds. WS personnel would attach Mylar tape to a stake and then insert the stake into the ground so the Mylar tape was visible and could move in the wind. In addition, WS personnel could tie Mylar tape to structures in a similar manner to using a stake. 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, Tobin et al. 1988, Conover and Dolbeer 1989). Flagging often works similar to Mylar tape, which often creates quick movements when they blow in the wind.

Eyespot balloons are large balloons that people can hang inside buildings to disperse birds. When inflated, the balloons appear to have a large eye or eyes that apparently give birds a visual cue that a large predator is present.

Scarecrows and effigies are models or silhouettes that often depict predator animals (*e.g.*, alligators, owls), people (*e.g.*, scarecrows), or mimic distressed target species (*e.g.*, dead geese, dead vultures) that applicators can place in areas where birds cause damage or pose a threat of damage. Scarecrows and effigies may elicit a flight response from target birds, which disperses those birds from the area. Avery et al. (2002) 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. Effigies and scarecrows that pop-up into the air and/or have moving parts are often more effective at dispersing birds. Scarecrows and effigies would be most effective when they were moved frequently, alternated with other methods, and were well maintained. However, scarecrows and effigies tend to lose effectiveness over time and become less effective as populations increase (Smith et al. 1999).

WS personnel could use lasers and lights to disperse birds when low-light conditions exist (Glahn et al. 2000, Blackwell et al. 2002). Lasers and lights may be novel stimuli that birds act to avoid. Lasers and lights have advantages over other dispersal methods because they are silent and WS personnel can use those methods directly at birds. Therefore, WS personnel can use those methods is areas where disturbing other wildlife is a concern.

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 be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser may be 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). Similarly, lasers were ineffective at dispersing starlings and cowbirds (Blackwell et al. 2002). Lasers were found to be only moderately effective for hazing geese, with a reduction in night roosting, but little to no reduction in diurnal activity at the site pre- and post-use (Sherman and Barras 2004).

Lights would primarily consist of high-powered spotlights. 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).

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 esthetic appearance presented on the properties where those methods are used.

Trained Dogs: The use of trained dogs can be effective at hazing waterfowl to keep 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 is less than two acres in size (Swift and Felegy 2009). WS would recommend and encourage the use of dogs where appropriate. Swift and Felegy (2009) have reported that when hazing with dogs ceases, the number of geese returns to pre-treatment numbers.

Electronic Hazing Devices: WS could recommend and/or use 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). However, the effectiveness of alarm or distress calls can be reduced as birds become accustomed to the sounds and learn to ignore them (Seamans and Gosser 2016).

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. Birds can habituate to hazing techniques (Zucchi and Bergman 1975, Summers 1985, Aubin 1990, Seamans and Gosser 2016). 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. 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. 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.

The use of electronic hazing devices can have some drawbacks. For example, 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 geese become more accustomed to human activity*". 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.

Paintballs: WS personnel may use paintballs and recreational paintball equipment to supplement other hazing 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 carbon dioxide to propel paintballs an average of 280 feet per second but 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 hazing techniques. Although paintballs break easily and velocity rapidly decreases with distance, firing at close range is discouraged to avoid harming birds. The use of paintballs may be restricted in some areas by local ordinances.

Pyrotechnics: The term "*pyrotechnic*" encompasses several commercially available devices that produce a loud noise after firing the device. People may refer to some of the common individual devices as "*bird bombs*", "*screamers*", "*bangers*", "*shell crackers*", or "*CAPA*". The most common pyrotechnics are pyrotechnics that people fire from a pyrotechnic launcher or from a shotgun. Those pyrotechnics fired from a launcher or from a shotgun travel approximately 200 to 300 feet downrange. Some types of pyrotechnics emit a loud whistle as they travel while some travel downrange and then explode with a bang. Pyrotechnics that whistle as they travel and those that explode with a bang after travelling downrange generally emit a 100-decibel report that can startle target animals. A long-range pyrotechnic that is commercially available can travel approximately 1,000 feet downrange and produce a 150-decibel report. Pyrotechnics are one of the primary methods that WS personnel use to disperse birds.

Williams (1983) reported an approximate 50% reduction in blackbirds at two south Texas feedlots because of pyrotechnics and propane cannon use. Aguilera et al. (1991) found 15 mm screamer shells effective at reducing resident and migrant Canada geese use of areas in Colorado. 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 et al. 1983, Schmidt and Johnson 1983, Mott 1985, Bomford 1990). 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.

Propane cannons: These small cannons operate using propane gas and when fired, produce a noise similar to a firearm. The user attaches the cannon to a propane tank using a hose. Opening the valve on the propane tank releases propane gas into a bladder system on the propane cannon, which begins to fill with propane gas. Once the bladder system fills, it releases the propane gas into the chamber of the cannon and simultaneously, a striking mechanism produces a spark that ignites the gas causing a loud explosion similar to the sound of a firearm firing. Propane cannons use a timing mechanism that people can adjust to vary how often the cannon fires. For example, propane cannons may be set to fire every five minutes. Some models are capable of being set to produce multiple blasts. For example, the user can set the propane cannon to produce a random series of single, double, or triple blasts. In addition, attachments to propane cannons can allow the user to control when the cannon operates during a 24-hour period. For example, the user may set the cannon to begin firing in the morning and then shut off in the evening. The user can also fit cannons with mechanisms that allow the cannon to rotate so that each firing occurs from a different direction.

High-pressure water spray: WS could use high-pressure water to scare birds from a location (*e.g.*, areas where birds loaf or roost) and/or to clean surfaces (*e.g.*, remove fecal droppings, remove inactive nests). 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. For example, WS could use this method when rousing crows or other gregarious bird species from a roost. Using high-pressure water may be more acceptable than using loud noises or chemicals in some areas, such as urban areas. WS could also use high-pressure water to remove inactive nests to discourage nesting. Logistical issues with using this method arise due to the size of the equipment needed and access to water.

Bow nets: Bow nets are suitcase or basket-type traps that people use to primarily live-capture raptors. Bow nets consist of two semi-circular bows as a frame with loose netting strung between the bows that the user places on the ground. Hinges and springs connect the two semi-circular bows at their bases with one bow fixed to the ground. The other semi-circular frame is folded and held together with the staked portion of the bow net that are held together by a trigger or release mechanism (Bloom et al. 2007). The user typically places an attractant near the center of the circle. For example, WS could use a mouse inside a small cage or a tethered rock pigeon in the center of the bow net to attract raptors. For other bird species, WS could place the bow net to envelope a nest on the ground. Therefore, the nest would act as the attractant. When a target bird approaches the nest, the user activates the bow net by a line or electronic mechanism that the user pulls or that personnel trigger while monitoring the trap. When activated, the net envelopes the bird. WS personnel would be present on site during the use of bow nets to address birds live-captured in the net.

Cage traps: Cage traps often consist of wire mesh or netting and are available in a variety of styles to live-capture birds. Cage traps allow target bird species to enter inside the trap through a one-way door or opening but prevent the target bird from exiting the trap. When using cage traps, WS personnel would place a visual attractant or bait inside the trap to attract target bird species. Visual attractants usually consist of a decoy bird or birds of the same species as the target birds. The feeding behavior and calls of the decoy birds attract other birds to the trap. WS could also place cage traps over nests where the nest acts as the attractant. Target bird species enter the trap through one-way doors or openings to access the bait or attractant but are then unable to exit. People often refer to cage traps that use a visual attractant as decoy traps. WS personnel could use decoy traps for a variety of species, such as European starlings (Homan et al. 2017), blackbirds (Dolbeer and Linz 2016), crows (Johnson 1994), and rock pigeons (Williams and Corrigan 1994). When using live decoy birds in traps, WS personnel would ensure the birds have sufficient food, water, and shelter to assure their survival. WS personnel may also configure perches within the trap to allow birds to roost and perch above the ground. WS personnel would monitor decoy traps appropriately (*e.g.*, daily) to remove target bird species and to replenish food and water.

Nest box traps: Nest box traps are similar to cage traps; however, nest box traps resemble a nest box used by cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976). When birds enter inside the box trap, they trigger a mechanism that closes the opening to the box. WS would place nest box traps on the side of a building or on a tree in an area where the target birds are active.

Raptor traps: There are a variety of traps available designed to capture raptors. WS would primarily use raptor traps at airports to live-capture raptors that pose a risk of an aircraft strike. The bal-chatri trap, dho-gaza trap, the phai hoop trap, and the Swedish goshawk traps are some of the more common raptor traps. The designs of several raptor traps are similar to the use of nets (*e.g.*, dho-gaza trap) and the use of cage traps (*e.g.*, Swedish goshawk trap). Raptor traps use a prey animal (*e.g.*, mouse, pigeon) to attract raptors to the traps.

Bal-chatri traps consist of a small cage made from mesh wire. The small cage is often in a conical, half cylinder, or rectangle shape and holds the prey animal. To capture raptors, the user attaches one end of short pieces of monofilament line to the exposed areas of the cage trap and creates a noose with the other end of the monofilament line. As a raptor attempts to grab the prey item in the cage with their foot or feet, the noose tightens around the raptor's foot or feet, which holds the raptor at the location. WS personnel place weights on or anchor Bal-chatri traps to prevent the raptor from flying off with the trap attached to their foot or feet. Phai hoop traps function in a similar way to the bal-chatri trap. Phai hoop traps consist of a circular hoop with upright nooses placed along the length of the hoop with the lure animal placed inside the hoop. As a raptor attempts to grab the prey animal, the nooses close on their feet and/or legs. Similar to bal-chatri traps, personnel would place weights on the trap or anchor the hoop to the ground to prevent raptors from flying off with the trap.

Dho-gaza traps function similar to mist nets. Personnel attach the four corners of a small net to a pole frame. WS personnel attach the net to the pole frame is such a way as to allow the net to easily detach from the pole frame, such as attaching the net to the pole frame using paper clips. A cinch-line string runs through the mesh along all four sides of the net with the ends of the cinch-line string securely attached to the pole frame. WS personnel place the net in front of a lure animal that acts to attract the target raptor. Personnel place the net and frame perpendicular to the anticipated approach of the raptor to the lure animal. As the raptor swoops in to grab the attractant, the raptor hits the net, which causes the net to detach from the pole frame and the cinch-line string to close the net behind the raptor. The closing net forms a net bag around the raptor.

The Swedish goshawk trap consists of two parts. The base consists of a cage made from wire mesh that holds a prey animal while the upper portion contains the trap. The trap portion attaches to the top of the cage containing the prey animal. A trigger stick holds the top part of the trap open. As a raptor attempts to land on the trigger stick to investigate the prey animal, the trigger stick falls away causing springs to close the doors of the trap quickly. Once shut, the raptor is unable to exit the trap.

Corral traps: WS could use corral traps to live capture waterfowl or other birds that are unable to fly. WS personnel can slowly guide birds unable to fly into corral traps. Corral traps as described by Costanzo et al. (1995) are lightweight, portable panels (approximate size 4' x 10') that WS could use to surround and slowly guide target birds into a moveable catch pen. Catch pens consist of panels erected and attached to form a "U" shape. WS personnel would guide a target bird or birds through the open end of the "U" using handheld panels. As the bird or birds enter the "U", the handheld panels are brought together to close the catch pen and prevent birds from exiting. Once WS personnel confine a target bird or birds inside the catch pen, employees can live-capture the bird or birds.

Hand nets: The hand nets WS personnel could use would be similar to those used during fishing, such as a dip net or hand-thrown net. Generally, dip nets have netting at one end of a long pole that a user uses to scoop up a target animal. A hand-thrown net would be a net that a WS employee throws over a target bird. Hand-thrown nets typical have weights on the edges of the net.

Cannon nets: The term cannon net refers to net deployment systems that use rockets, cannons, or compressed air to propel a net over a target area. Rocket nets and cannon nets are projectile-type net traps comprised of three to five rockets or cannons and a large net (*e.g.*, 33 x 57 foot with 2-inch square nylon mesh) (Dill and Thornberry 1950, Cox and Afton 1994). The user would anchor the rear of the net to 5- or 10-pound boat anchors or would tie the rear of the net with inner tubes to stakes driven into the ground. Smokeless powder or black powder charges propel the rockets or projectiles in the cannons that a user would ignite with an electric squib inside the charge. The user would place the charges inside the rockets or cannon tubes and test with a galvanometer for electrical continuity. The user would unspool at least 200 to 350 feet of 18 or larger gauge wire and connect one end to the charges and the other end to a blasting machine. When an adequate number of birds gather in front of the net, the user would charge the blasting machine and fire the net. Firing the blasting machine sends an electrical charge down the wire and ignites the charges in the rockets or cannon tubes, which discharge the net. Pneumatic cannon nets deploy under similar methodology as the cannon or rocket nets but do not use smokeless powder or black powder charges to deploy the net. Pneumatic cannons utilize compressed air to deploy the net. The user also remotely discharges the pneumatic air cannon through push button controls wired to a mechanism that releases the compressed air. WS personnel would primarily use cannon nets in areas where birds routinely congregate or loaf. In most cases, WS personnel would use an attractant (*e.g.*, food source) to acclimate target birds to feeding at the location and to position the birds in an area that ensures the net envelopes the target birds.

Drop nets: Although not a commonly used method for birds, WS could occasionally use drop nets to capture target bird species. The use of drop nets is similar to cannon nets; however, instead of propelling the net outward when fired, WS personnel would drop the net on top of target birds. WS personnel could manually drop the net onto target birds or remotely trigger the net to drop onto target birds. When dropped, the net would envelope target birds. WS personnel would use attractants to ensure target birds were using the location and to ensure the net envelopes target birds. Attractants could include a food source or decoy birds.

Net guns: Net guns are another method that WS does not frequently use to live-capture birds. Net guns are similar to cannon nets except the nets are smaller and the nets are propelled from a hand-held launcher similar to a gun. The hand-held gun launches a weighted net over a target bird or birds using a firearm blank or compressed air. Similar to the use of cannon nets and drop nets, the use of net guns is often associated with the use of an attractant. WS may use net guns to capture individual birds or a small number of birds that WS is unable to capture using other methods.

Mist nets: Mist nets consist of a fine black silk or nylon net that are generally three to 10 feet wide and 25 to 35 feet long. Users of mist nets generally suspend the net between two poles anchored into the ground. Mist nets contain overlapping pockets that extend the length of the net. As a bird flies into the net, the bird falls into the pocket and becomes entangled in the net. In general, WS would use mist nets to capture small birds, such as sparrows, blackbirds, and starlings. However, WS could occasionally use mist nets to catch larger bird species, such as raptors and waterfowl. When in use, WS personnel would monitor mist nets to address birds captured in the net. WS may use decoys and/or electronic calls to enhance the effectiveness of mist nets.

Modified padded foothold traps: Another live-capture method that WS personnel could consider is a modified foothold trap with padded jaws. WS personnel would modify padded foothold traps by removing or weakening springs on the trap so that when the jaws snap shut on the leg of a bird, the jaws do not injure the bird. WS personnel would primarily use modified padded foothold traps at airports where WS personnel would place the trap atop poles (*i.e.*, pole traps). Pole traps live-capture raptors as they land atop a pole to perch. When landing atop the pole, the raptor triggers the modified padded foothold trap, which closes around the foot or leg of the bird. WS personnel would attach the modified padded foothold trap 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. WS could occasionally place modified padded foothold traps on the ground or submerge the trap in shallow water to live-capture larger bird species, such as white pelicans.

Nest destruction: The destruction of nests involves the removal of nesting materials during the construction phase of the nesting cycle or the removal of an inactive nest. Nest destruction could also occur after destroying eggs in the nests or after euthanizing nestlings in the nest. WS could destroy nests by hand, using hand tools, and/or using high-pressure water.

Live-capture and translocation: WS personnel could use live-capture methods to capture birds and then translocate those birds to other areas. Once live-captured, WS personnel would place the birds in appropriately sized containers (*e.g.*, pet carriers) for transport to a release site. Translocation would only occur when authorized by the USFWS and/or the GDNR. WS personnel would only release birds on properties where the appropriate property owner or manager agrees to allow the release of those birds. WS would primarily translocate raptor species and primarily when those species present an aircraft strike risk at airports. WS often uses translocation when damage or threats of damage occur during the migratory periods when many bird species do not have well defined territories as birds migrate to and/or through the state.

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. 2004). In areas where interest in hunting is high, the potential exists for moving nuisance geese to areas more accessible by hunters.

Aircraft: Surveying wildlife from an aircraft is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of wildlife. WS could use fixed-winged aircraft and/or helicopters to conduct surveys to locate and/or estimate the number of birds in areas of the state. For example, WS could use fixed-winged aircraft to identify locations where American white pelicans roost or conduct surveys to estimate the number of American white pelicans near aquaculture facilities. Low-level flights would primarily occur in the fall and during the winter when the number of individuals from certain species increase in the state. Surveying could involve circling an area as an observer counts the number of birds present in an area.

WS could also use fixed-winged aircraft and/or helicopters to identify movement patterns of birds. For example, WS personnel could place radio-transmitting collars on American white pelicans and then monitor their movements over a specified period. WS personnel would then attempt to locate the research subject using a hand-held antennae and radio receiver from the ground; however, occasionally birds could travel long distances that would prevent biologists from locating the bird from the ground. In those situations, WS may utilize either fixed wing aircraft or helicopters and elevation to conduct aerial telemetry and locate the specific bird wherever it has moved to.

Unmanned Aerial Vehicles: UAVs have several applications to prevent or reduce damage caused by birds. UAVs are receiving increasing attention as a wildlife management tool (Watts et al. 2010, Koh and Wich 2012, Martin et al. 2012, Lyons et al. 2017, Wandrie et al. 2019, Wang et al. 2019). WS personnel could use UAVs to locate nuisance birds, haze birds, and monitor bird nests for the presence of eggs or chicks. Wandrie et al. (2019) found that red-winged blackbirds showed behavioral responses to UAVs when flown within 30 meters of the ground, which could reduce damage occurring to sunflower fields. Egan et al. (2020) also noted that drones with predatory characteristics exhibited greater alarm responses in blackbirds than other common drone models. Unmanned aircraft generally produce less noise, use less fuel, and are generally less expensive to operate than manned aircraft (Watts et al. 2010). Burr et al. (2019) used UAVs to estimate waterbird abundance on aquaculture ponds. When using UAVs, WS would adhere to all federal, state, and local laws. WS would also follow the guidelines established in the WS Small Unmanned Aircraft System Flight Operations Procedures manual.

Nicarbazin: Commercial products are available that contain the active ingredient nicarbazin that, when ingested by target bird species, can reduce the hatchability of eggs laid. Nicarbazin is the only reproductive inhibitor currently registered with the EPA for birds and the only reproductive inhibitor approved for use in Georgia by the Georgia Department of Agriculture. In Georgia, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons, European starlings, red-winged blackbirds, boat-tailed grackles, common grackles, and brown-headed cowbirds[19]. Nicarbazin is available as a general use commercial product available to the public under the trade name OvoControl® P (Innolytics, LLC, La Quinta, California).

When consumed by birds, nicarbazin is broken down into the two base components of DNC and HDP, which are then rapidly excreted. In addition, nicarbazin is only effective in reducing the hatchability of eggs when blood levels of DNC are sufficiently elevated in a bird species. To maintain the high blood levels required to reduce egg hatch, birds must consume nicarbazin daily at a sufficient dosage that appears to be variable depending on the bird species (Yoder et al. 2005, Avery et al. 2006). For example, to reduce egg hatch in Canada geese, geese must consume nicarbazin at 2,500 ppm compared to 5,000 ppm required to reduce egg hatch in pigeons (Avery et al. 2006, Avery et al. 2008*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).

Anthraquinone: Anthraquinone is a taste repellent that is commercially available for the public to purchase and use. Anthraquinone is available to discourage geese from feeding on turf and to discourage pheasants, blackbirds, crows, grackles, cowbirds, starlings, and Sandhill cranes from feeding on planted corn and rice seed. Anthraquinone has shown effectiveness in protecting rice seed from red-winged blackbirds and boat-tailed grackles (Avery et al. 1997) and Canada geese from feeding on emerging soybeans (Werner et al. 2019). However, Kaiser (2019) found anthraquinone relatively ineffective at reducing avian consumption of sunflowers. Like other taste repellents, products containing anthraquinone require the user to apply the products directly to resources they are protecting so the target bird species ingest the product and results can vary depending on the specific circumstances. Anthraquinone is a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism. WS would very rarely use products containing anthraquinone operationally but could recommend the use of products through technical assistance. Therefore, the entity receiving technical assistance would be responsible for using the product.

Methyl anthranilate: Methyl anthranilate naturally occurs in grapes and often occurs as a flavor additive in food, candy, and soft drinks (Dolbeer et al. 1992). Methyl anthranilate is the active ingredient in repellents commercially available to disperse several bird species, primarily geese and blackbirds. Products containing methyl anthranilate are either taste repellents or olfactory repellents. Products containing methyl anthranilate are often liquids that people apply directly to susceptible resources and require target bird species to ingest the product. Applying products containing methyl anthranilate to a food source, such as turf, can make the food source unpalatable to a target bird species, such as waterfowl (Dolbeer et al. 1993). Some commercially available products allow the use of methyl anthranilate in fogging applications that act as an olfactory repellent. The use of methyl anthranilate in fogging applications can disperse target bird species in areas where they congregate in large numbers, such as a blackbird roost at an industrial company (Vogt 1997). When inhaled, the methyl anthranilate fog acts as a mild irritant to birds. Taste and olfactory repellents containing methyl anthranilate are commercially available and available for use by the public.

Cummings et al. (1995) found the effectiveness of methyl anthranilate declined 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. Mason et al. (1984, 1989) evaluated methyl anthranilate as a livestock feed additive; however, formulations of methyl anthranilate are not available for use on livestock feed. Like anthraquinone, WS would infrequently use products containing methyl anthranilate but could recommend the use of products through technical assistance.

[19]Although the label allows for the use of products containing nicarbazin to inhibit egg hatching in local breeding populations of Brewer's blackbirds, Brewer's blackbirds do not nest in Georgia.

II. LETHAL METHODS

In addition to the use of non-lethal methods, WS personnel could use lethal methods. The lethal removal of birds by WS would only occur when authorized by the USFWS and/or the GDNR (when required) and only at levels authorized. In addition, WS would only use those lethal methods authorized by the USFWS and/or the GDNR.

Egg destruction: WS personnel could make eggs of target birds unviable in several different ways. Egg destruction would involve puncturing an egg, breaking an egg, shaking an egg, or oiling an egg. When puncturing an egg, a person holds the egg securely in a hand that they brace against the ground and then inserts a long, thin metal probe into the pointed end of the egg with slow steady pressure. The person inserts the probe all of the way through the egg until the tip of the probe hits against the inside of the shell at the opposite side of entry. While the person has the probe inserted into the egg, the egg is swirled in a circular motion to emulsify the yolk sac, ensuring the embryo is unviable. After removing the metal probe from the egg, a person can seal the puncture hole with a small amount of glue to prevent the contents of the egg from leaking out of the egg. WS personnel can then place the egg back in the nest so that birds continue to incubate the egg.

WS personnel could destroy eggs by manually gathering the eggs and breaking them open or by vigorously shaking an egg numerous times, which causes the embryo to detach from the egg sac. Egg oiling involves spraying a small quantity of food grade corn oil on eggs in a nest. The oil prevents exchange of gases through the eggshell and causes asphyxiation of developing embryos. Puncturing eggs, shaking eggs, or oiling eggs often has advantages over breaking an egg open because the adults may continue to incubate the egg and do not re-nest. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under the FIFRA.

Firearm: WS personnel could use firearms to lethally remove and/or haze target bird species. Firearms are mechanical methods that WS could use to remove birds lethally and to reinforce the noise associated with non-lethal methods, such as pyrotechnics or propane cannons. In addition, the noise associated with discharging a firearm can disperse birds. As appropriate, WS personnel could use suppressed firearms to minimize noise impacts. Pursuant to the standard conditions included with the current depredation permit issued to WS, when using a shotgun, WS personnel would not use shotguns larger than 10-gauge. In addition, when using shotguns to take migratory birds pursuant to the current depredation permit, WS would use non-toxic shot listed in 50 CFR 20.21(j). When using rifles, WS could use ammunition that contains lead. WS personnel would retrieve the carcasses of birds to the extent possible and would dispose of the carcasses in accordance with WS Directive 2.515. As noted for pyrotechnics, some commercially available pyrotechnics require the use of a shotgun to fire the pyrotechnic. WS firearm use and safety would comply with WS Directive 2.615.

Sport hunting: In limited situations, WS personnel could recommend that a person allow sport hunting on their property when people can legally harvest the target species during a hunting season, such as allowing hunters to harvest waterfowl during the appropriate hunting season for waterfowl.

Cervical dislocation: WS personnel could use cervical dislocation 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 (2020) 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. Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (AVMA 2020).

Carbon dioxide: Carbon dioxide is another method that WS personnel may use to euthanize birds after personnel live-capture those birds using other methods. After capture, WS personnel would place a bird or birds into a container or chamber that personnel seal shut. WS personnel would then slowly release carbon dioxide gas into the container or chamber. The carbon dioxide gas would begin to displace oxygen in the container or chamber. At high concentrations, inhaling carbon dioxide can induce anesthesia initially followed by loss of consciousness in bird species.

Snap traps: Snap traps are common household traps used for rats or mice. WS could occasionally use modified snap traps to target bird species that use cavities, such as European starlings. Snap traps are available in many designs and shapes but generally consist of a rectangular wooden or plastic base, a spring, a hammer, a catch, and a holding bar. The spring holds the hammer down on the base when closed; however, setting or opening the hammer applies tension on the spring. The holding bar, which the user places over the hammer to prevent the hammer from closing, attaches to the catch. The catch holds the bar in place while the spring is under tension. WS could use the modified rat snap traps inside nest boxes so the target bird would trigger the trap once the bird enters the trap. In some situations, WS personnel would bait the catch with peanut butter or other food attractants. As the target bird attempts to feed on the bait, they trip the catch causing the holding bar to release and allowing the spring to close the hammer forcibly onto the target bird. WS personnel would place snap traps near the damage area and in areas where the target bird is active.

4-Aminopyridine (Avitrol): Avitrol is a flock dispersal method available for public use to manage damage associated with some bird species. The active ingredient of Avitrol is 4-Aminopyridine. 4-Aminopyridine is available to manage damage associated with house sparrows, red-winged blackbirds, Brewer's blackbirds, boat-tailed grackles, common grackles, brown-headed cowbirds, European starlings, rock pigeons, American crows, and fish crows.

Avitrol acts as a flock-dispersing method because, when a target bird species ingests a treated bait particle, the bird becomes hyperactive, produces distress vocalizations, and displays abnormal flying behavior, which can elicit a flight response by other members of a flock. The distress calls and erratic behavior by a bird that ingests a treated particle can alarm the other birds in a flock causing them to leave the site. Only a small number of birds need to show erratic behavior and/or produce distress vocalizations to cause alarm in the rest of the flock. Although Avitrol is a flock dispersing method, birds that ingest a treated particle often die.

The EPA has approved the public use of several Avitrol formulations as restricted use pesticides. The different formulations involve the use of different bait types, such as chopped corn, whole corn, and mixed grains, which may be more palatable to the bird species the applicator is targeting when using Avitrol. Additionally, formulations may differ in the concentration of active ingredient. In Georgia, the Georgia Department of Agriculture has approved the use of several Avitrol formulations by people with the appropriate applicators license within the state.

DRC-1339: DRC-1339 is an avicide available to manage damage associated with pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, and gulls in certain locations (*e.g.*, feedlots, blackbird staging areas) using certain bait types (*e.g.*, cracked corn, brown rice). The active ingredient of DRC-1339 is 3-chloro-p-toluidine hydrochloride. 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, Eisemann et al. 2003). Birds ingesting a lethal dose of DRC-1339 usually die in one to three days.

The EPA has approved the use of DRC-1339 as a restricted use pesticide that only WS' personnel and people under their direct supervision can use. The national WS program has registered two formulations of DRC-1339 with the EPA. Those formulations restrict the use of DRC-1339 to certain areas where target bird species are causing damage or posing a threat of damage. However, WS has not registered either formulation of DRC-1339 with the Georgia Department of Agriculture for use in Georgia. A formulation of DRC-1339 that WS could register for use in Georgia would be available to manage damage caused by Brewer's blackbirds, red-winged blackbirds, common grackles, boat-tailed grackles, brown-headed cowbirds, European starlings, American crows, fish crows, rock pigeons, and Eurasian collared-doves at commercial animal operations and staging areas along with gulls at gull colonies and gull feeding or loafing sites (Compound DRC-1339 Concentrate – Bird Control; EPA Reg. #56228-63). WS would not use the Compound DRC-1339 Concentrate – Bird Control formulation unless the Georgia Department of Agriculture has approved of its use in the state. WS anticipates using the Compound DRC-1339 Concentrate – Bird Control formulation of DRC-1339 infrequently in the future.

WS has not registered the Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder Depredations formulation (EPA Reg. #56228-29) for use in the state. Therefore, WS would not use the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 (EPA Reg. #56228-29) until WS submitted an application to the Georgia Department of Agriculture to register the formulation in the state and the Georgia Department of Agriculture approves the formulation for use by WS. WS anticipates using the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 infrequently in the future.

For all uses, WS must mix technical DRC-1339 (powder) 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. After mixing, the handler allows the treated bait to air dry. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Before application at bait locations, applicators would mix treated bait with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

WS personnel would determine potential locations to apply treated bait based on product label requirements (*e.g.*, distance from water, specific location restrictions). Other factors would also require consideration of appropriate locations to apply treated bait, such as the target bird species use of the site (determined through pre-baiting), on non-target animal use of the area (areas with non-target animal activity are not used or abandoned), and based on human safety (*e.g.*, in areas restricted or inaccessible by the public). Once WS personnel determine a location to be appropriate to place treated baits, they or people under their direct supervision would distribute treated bait per label requirements and would monitor locations for activity by non-target animals and to ensure the safety of the public.

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

Table C-1: List of threatened or endangered species in Georgia and WS' effects determination

Common Name	Scientific Name	Status†	Determination‡
ANIMALS			
Clams			
Alabama Moccasinshell	*Medionidus acutissimus*	T	MANLAA
Altamaha Spinymussel	*Elliptio spinosa*	E	MANLAA
Coosa Moccasinshell	*Mesionidus parvulus*	E	MANLAA
Fat Threeridge	*Amblema neislerii*	E	MANLAA
Finelined Pocketbook	*Lampsilis altilis*	T	MANLAA
Georgia Pigtoe	*Pleurobema hanleyianum*	E	MANLAA
Gulf Moccasinshell	*Medionidus penicillatus*	E	MANLAA
Longsolid	*Fusconaia subrotunda*	T	MANLAA
Ochlockonee Moccasinshell	*Medionidus simpsonianus*	E	MANLAA
Oval Pigtoe	*Pluerobema pyriforme*	E	MANLAA
Ovate Clubshell	*Pleurobema perovatum*	E	MANLAA
Pink Mucket	*Lampsilis abrupta*	E	MANLAA
Purple Bankclimber	*Elliptoideus sloatianus*	T	MANLAA
Shinyrayed Pocketbook	*Lampsilis subangulata*	E	MANLAA
Southern Clubshell	*Pleurobema decisum*	E	MANLAA
Southern Pigtoe	*Pleurobema georgianum*	E	MANLAA
Suwannee Moccasinshell	*Medionidus walkeri*	T	MANLAA
Triangular Kidneyshell	*Ptychobranchus greenii*	E	MANLAA
Snails			
Interrupted (=Georgia) Rocksnail	*Leptoxis foremani*	E	MANLAA
Insects			
Monarch Butterfly	*Danaus plexippus*	C	NJ
Amphibians			
Frosted Flatwoods Salamander	*Ambystoma cingulatum*	T	MANLAA
Reticulated Flatwoods Salamander	*Ambystoma bishopi*	E	MANLAA
Reptiles			
Alligator Snapping Turtle	*Macrochelys temminckii*	PT	NJ
Bog Turtle	*Glyptemys muhlenbergii*	SAT	MANLAA
Eastern Indigo Snake	*Drymarchon corais couperi*	T	MANLAA
Green Sea Turtle	*Chelonia mydas*	T	MANLAA
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	MANLAA
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	MANLAA
Leatherback Sea Turtle	*Dermochelys coracea*	E	MANLAA
Loggerhead Sea Turtle	*Caretta caretta*	T	MANLAA
Suwannee Alligator Snapping Turtle	*Macrochelys suwanniensis*	PT	NJ
Fish			
Amber Darter	*Percina antesella*	E	MANLAA
Blue Shiner	*Cyprinella caerulea*	T	MANLAA
Cherokee Darter	*Etheostoma scotti*	T	MANLAA
Conasauga Logperch	*Percina jenkinsi*	E	MANLAA

Etowah Darter	*Etheostoma Etowahae*	E	MANLAA
Frecklebelly Madtom	*Noturus munitus*	T	MANLAA
Goldline Darter	*Percina aurolineata*	T	MANLAA
Trispot Darter	*Etheostoma trisella*	T	MANLAA
Birds			
Eastern Black Rail	*Laterallus jamaicensis ssp. jamaicensis*	T	MANLAA
Piping Plover	*Charadrius melodus*	T	MANLAA
Red Knot	*Calidris canutus rufa*	T	MANLAA
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Whooping Crane	*Grus americana*	EXP	NJ
Wood Stork	*Mycteria americana*	T	MANLAA
Mammals			
Gray Bat	*Myotis grisescens*	E	MANLAA
Indiana Bat	*Myotis sodalist*	E	MANLAA
Northern Long-eared Bat	*Myotis septentrionalis*	E	MANLAA
West Indian Manatee	*Tricheus manatus*	T	MANLAA
PLANTS			
Flowering Plants			
Alabama Leather Flower	*Clematis socialis*	E	NE
American Chaffseed	*Schwalbea americana*	E	NE
Canby's Dropwort	*Oxypolis canbyi*	E	NE
Cooley's Meadowrue	*Thalictrum cooleyi*	E	NE
Fringed Campion	*Silene polypetala*	E	NE
Georgia Rockcress	*Arabis georgiana*	T	NE
Green Pitcher-plant	*Sarracenia oreophila*	E	NE
Hairy Rattleweed	*Baptisia arachnifera*	E	NE
Harperella	*Ptilimnium nodosum*	E	NE
Kral's Water-plantain	*Sagittaria secundifolia*	T	NE
Large-flowered Skullcap	*Scutellaria montana*	T	NE
Little Amphianthus	*Amphianthus pusillus*	T	NE
Michaux's Sumac	*Rhus michauxii*	E	NE
Mohr's Barbara's Buttons	*Marshallia mohrii*	T	NE
Morefield's Leather Flower	*Clematis morefieldii*	E	NE
Ocmulgee Skullcap	*Scutellaria Ocmulgee*	PT	NJ
Persistent Trillium	*Trillium persistens*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
Relict Trillium	*Trillium reliquum*	E	NE
Small Whorled Pogonia	*Isotria medeolides*	T	NE
Smooth Coneflower	*Echinacea laevigata*	T	NE
Swamp Pink	*Helonias bullata*	T	NE
Tennessee Yellow-eyed Grass	*Xyris tennesseensis*	E	NE
Virginia Spiraea	*Spiraea virginiana*	T	NE
White Fringless Orchid	*Plantanthera integrilabia*	T	NE
Whorled Sunflower	*Helianthus verticillatus*	E	NE
Conifers and Cycads			
Florida Torreya	*Torreya taxifolia*	E	NE
Ferns and Allies			
American Hart's-tongue Fern	*Asplenium scolopendrium var. americanum*	T	NE
Black Spored Quillwort	*Isoetes melanospora*	E	NE

Mat-forming Quillwort	*Isoetes tegetiformans*	E	NE
Lichens			
Rock Gnome Lichen	*Gymnoderma lineare*	E	NE

†T=Threatened; E=Endangered; EXP=Experimental Population, Non-essential; C=Candidate; PT=Proposed Threatened; SAT=Threatened due to Similarity of Appearance

‡NE=No effect; MANLAA=May affect, not likely to adversely affect; NJ=No Jeopardy

Table C-2: Critical habitats designated in Georgia

Common Name	Scientific Name	Status†	Determination‡
ANIMALS			
Clams			
Alabama Moccasinshell	*Medionidus acutissimus*	CH	NE
Altamaha Spinymussel	*Elliptio spinosa*	CH	NE
Coosa Moccasinshell	*Mesionidus parvulus*	CH	NE
Fat Threeridge	*Amblema neislerii*	CH	NE
Finelined Pocketbook	*Lampsilis altilis*	CH	NE
Georgia Pigtoe	*Pleurobema hanleyianum*	CH	NE
Gulf Moccasinshell	*Medionidus penicillatus*	CH	NE
Ochlockonee Moccasinshell	*Medionidus simpsonianus*	CH	NE
Oval Pigtoe	*Pluerobema pyriforme*	CH	NE
Ovate Clubshell	*Pleurobema perovatum*	CH	NE
Purple Bankclimber	*Elliptoideus sloatianus*	CH	NE
Shinyrayed Pocketbook	*Lampsilis subangulata*	CH	NE
Southern Acornshell	*Epioblasma othcaloogensis*	CH	NE
Southern Clubshell	*Pleurobema decisum*	CH	NE
Southern Pigtoe	*Pleurobema georgianum*	CH	NE
Suwannee Moccasinshell	*Medionidus walkeri*	CH	NE
Triangular Kidneyshell	*Ptychobranchus greenii*	CH	NE
Upland Combshell	*Epioblasma metastriata*	CH	NE
Snails			
Interrupted (=Georgia) Rocksnail	*Leptoxis foremani*	CH	NE
Amphibians			
Reticulated Flatwoods Salamander	*Ambystoma bishopi*	CH	NE
Reptiles			
Loggerhead Sea Turtle	*Caretta caretta*	CH	NE
Fish			
Amber Darter	*Percina antesella*	CH	NE
Conasauga Logperch	*Percina jenkinsi*	CH	NE
Frecklebelly Madtom	*Noturus munitus*	CH	NE
Spotfin Chub	*Erimonax monachus*	CH	NE
Trispot Darter	*Etheostoma trisella*	CH	NE
Birds			
Piping Plover	*Charadrius melodus*	CH	NE
Mammals			
West Indian Manatee	*Tricheus manatus*	CH	NE
PLANTS			
Flowering Plants			
Georgia Rockcress	*Arabis georgiana*	CH	NE
Ocmulgee Skullcap	*Scutellaria ocmulgee*	PCH	NE

Whorled Sunflower	*Helianthus verticillatus*	CH	NE

†CH=Critical Habitat; PCH=Proposed Critical Habitat
‡NE=No Effect, no adverse modification

APPENDIX D

STATE LISTED THREATENED AND ENDANGERED SPECIES IN GEORGIA

TAXA	SPECIES	COMMON NAME	STATUS
Amphibians	*Ambystoma cingulatum*	Frosted Flatwoods Salamander	T
	Ambystoma bishop	Reticulated Flatwoods Salamander	T
	Amphiuma pholeter	One-toed Amphiuma	R
	Aneides aeneus	Green Salamander	R
	Cryptobranchus alleganiensis	Hellbender	T
	Gyrinophilus palleucus	Tennessee Cave Salamander	T
	Haideotriton wallacei	Georgia Blind Salamander	T
	Notophthalmus perstriatus	Striped Newt	T
	Plethodon petraeus	Pigeon Mountain Salamander	R
	Lithobates capito	Gopher Frog	R
Birds	*Aimophila aestivalis*	Bachman's Sparrow	E
	Ammodramus henslowii	Henslow's Sparrow	R
	Calidris canutus	Red Knot	R
	Campephilus principalis	Ivory-billed Woodpecker	E
	Charadrius melodus	Piping Plover	T
	Charadrius wilsonia	Wilson's Plover	T
	Corvus corax	Common Raven	R
	Setophaga cerulean	Cerulean Warbler	R
	Setophaga kirtlandii	Kirtland's Warbler	E
	Elanoides forficatus	Swallow-tailed Kite	R
	Falco peregrinus	Peregrine Falcon	R
	Falco sparverius paulus	Southeastern American Kestrel	R
	Haematopus palliatus	American Oystercatcher	R
	Haliaeetus leucocephalus	Bald Eagle	T
	Laterallus jamaicensis ssp. Jamaicensis	Eastern Black Rail	T
	Mycteria americana	Wood Stork	E
	Picoides borealis	Red-cockaded Woodpecker	E
	Rynchops niger	Black Skimmer	R
	Sterna antillarum	Least Tern	R
	Gelochelidon nilotica	Gull-billed Tern	T
	Vermivora chrysoptera	Golden-winged Warbler	E
Invertebrates	*Alasmindonta arcula*	Altamaha Arcmussel	T
	Alasmindonta triangulate	Southern Elktoe	E
	Amblema neislerii	Fat Threeridge	E
	Anodonta heardi	Apalachicola Floater	R
	Anodontoides radiatus	Rayed Creekshell	T
	Cambarus coosawattae	Coosawattee Crayfish	E
	Cambarus cryptodytes	Dougherty Plain Cave Crayfish	T
	Cambarus cymatilis	Conasauga Blue Burrower	E
	Cambarus doughertyensis	Dougherty Burrowing Crayfish	E
	Cambarus englishi	Tallapoosa Crayfish	R
	Cambarus extraneus	Chickamauga Crayfish	T

	Cambarus fasciatus	Etowah Crayfish	T
	Cambarus georgiae	Little Tennessee Crayfish	E
	Cambarus harti	Piedmont Blue Burrower	E
	Cambarus howardi	Chattahoochee Crayfish	T
	Cambarus parrishi	Hiwassee Headwaters Crayfish	E
	Cambarus scotti	Chattooga River Crayfish	T
	Cambarus speciosius	Beautiful Crayfish	E
	Cambarus strigosus	Lean Crayfish	T
	Cambarus truncatus	Oconee Burrowing Crayfish	T
	Cambarus unestami	Blackbarred Crayfish	T
	Cordulegaster sayi	Say's Spiketail	T
	Distocambarus devexus	Broad River Burrowing Crayfish	T
	Elliptio arca	Alabama Spike	E
	Elliptio arctata	Delicate Spike	E
	Elliptio purpurella	Inflated Spike	T
	Elliptio spinosa	Altamaha Spinymussel	E
	Elliptoideus sloatianus	Purple Bankclimber	T
	Epioblasma metastriata	Upland Combshell	E
	Epioblasma othcaloogensis	Southern Acornshell	E
	Fusconaia masoni	Atlantic Pigtoe Mussel	E
	Gomphus cansanguis	Cherokee Clubtail	T
	Hamiota altilis	Fine-lined Pocketbook	T
	Hamiota subangulata	Shinyrayed Pocketbook	E
	Lampilis abrupta		
	Leptoxis foremani	Interrupted Rocksnail	E
	Medionidus acutissimus	Alabama Moccasinshell	T
	Medionidus parvulus	Coosa Moccasinshell	E
	Medionidus penicillatus	Gulf Moccasinshell	E
	Medionidus simpsonianus	Ochlockonee Moccasinshell	E
	Nicrophorus americanus	American Burying Beetle	E
	Ophiogomphus edmundo	Edmund's Snaketail	E
	Pleurobema decisum	Southern Clubshell	E
	Pleurobema georgianum	Southern Pigtoe	E
	Pleurobema hanleyianum	Georgia Pigtoe	E
	Pleurobema perovatum	Ovate Clubshell	E
	Pleurobema pyriforme	Oval Pigtoe	E
	Procambarus gibbus	Muckalee Crayfish	T
	Procambarus verrucosus	Grainy Crayfish	R
	Procambarus versutus	Sly Crayfish	R
	Ptychobranchus foremanianus	Rayed Kidneyshell	E
	Strophitus connasaugaensis	Alabama Creekmussel	E
	Toxolasma pullus	Savannah Lilliput	T
Fishes	*Acipenser brevirostrum*	Shortnose Sturgeon	E
	Acipenser oxyrinchus	Atlantic Sturgeon	E
	Alosa alabamae	Alabama Shad	T
	Ameiurus serracanthus	Spotted Bullhead	R
	Chrosomus tennesseensis	Tennessee Dace	E
	Cyprinella caerulea	Blue Shiner	E
	Cyprinella callitaenia	Bluestripe Shiner	T
	Cyprinella xaenura	Altamaha Shiner	T

Ellasoma okatie	Bluebarred Pygmy Sunfish	E
Enneacanthus chaetodon	Blackbanded Sunfish	E
Erimystax insignis	Blotched Chub	E
Etheostoma brevirostrum	Holiday Darter	E
Etheostoma chlorobranchium	Greenfin Darter	T
Etheostoma chuckwachatte	Lipstick Darter	E
Etheostoma ditrema	Coldwater Darter	E
Etheostoma duryi Blackside	Snubnose Darter	R
Etheostoma etowahae	Etowah Darter	E
Etheostoma parvipinne	Goldstripe Darter	R
Etheostoma rupestre	Rock Darter	R
Etheostoma scotti	Cherokee Darter	T
Etheostoma tallapoosae	Tallapoosa Darter	R
Etheostoma trisella	Trispot Darter	E
Etheostoma vulneratum	Wounded Darter	E
Fundulus bifax	Stippled Studfish	E
Fundulus catenatus	Northern Studfish	R
Hemitremia flammea	Flame Chub	E
Hybopsis lineapunctata	Lined Chub	R
Ichthyomyzon bdellium	Ohio Lamprey	R
Lucania goodei	Bluefin Killifish	R
Macrhybopsis sp.	Coosa Chub	E
Micropterus notius	Suwannee Bass	R
Moxostoma carinatum	River Redhorse	R
Moxostoma robustum	Robust Redhorse	E
Moxostoma sp.	Sicklefin Redhorse	E
Notropis ariommus	Popeye Shiner	E
Notropis asperifrons	Burrhead Shiner	T
Notropis hypsilepis	Highscale Shiner	R
Notropis photogenis	Silver Shiner	E
Notropis scepticus	Sandbar Shiner	R
Noturus eleutherus	Mountain Madtom	E
Noturus munitus	Frecklebelly Madtom	E
Percina antesella	Amber Darter	E
Percina aurantiaca	Tangerine Darter	E
Percina aurolineata	Goldline Darter	E
Percina jenkinsi	Conasauga Logperch	E
Percina lenticula	Freckled Darter	E
Percina sciera	Dusky Darter	R
Percina shumardi	River Darter	E
Percina crypta	Halloween Darter	T
Percina sp. cf. macrocephela	Muscadine Darter	R
Percina kusha	Bridled Darter	E
Percina squamata	Olive Darter	E
Percina tanasi	Snail Darter	E
Phenacobius crassilabrum	Fatlips Minnow	E
Phenacobius uranops	Stargazing Minnow	T
Pteronotropis euryzonus	Broadstripe Shiner	R
Pteronotropis welaka	Bluenose Shiner	T
Typhlichthys subterraneus	Southern Cavefish	E

Mammals	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat	R
	Eubalaena glacialis	Northern Atlantic Right Whale	E
	Geomys pinetis	Southeastern Pocket Gopher	T
	Megaptera novaeangliae	Humpback Whale	E
	Myotis grisescens	Gray Bat	E
	Myotis septentrionalis	Northern Bat	T
	Myotis sodalis	Indiana Bat	E
	Neofiber alleni	Round-tailed Muskrat	T
	Puma concolor coryi	Florida Panther	E
	Sylvilagus obscurus	Appalachian Cottontail	R
	Trichechus manatus	West Indian Manatee	E
Reptiles	*Caretta caretta*	Loggerhead Sea Turtle	E
	Chelonia mydas	Green Sea Turtle	T
	Clemmys guttata	Spotted Turtle	U
	Dermochelys coriacea	Leatherback Sea Turtle	E
	Drymarchon couperi	Eastern Indigo Snake	T
	Eretmochelys imbricata	Hawksbill Sea Turtle	E
	Glyptemys muhlenbergii	Bog Turtle	E
	Gopherus polyphemus	Gopher Tortoise	T
	Graptemys barbouri	Barbour's Map Turtle	T
	Graptemys geographica	Common Map Turtle	R
	Graptemys pulchra	Alabama Map Turtle	R
	Heterodom simus	Southern Hognose Snake	T
	Lepidochelys kempii	Kemp's Ridley Sea Turtle	E
	Macrochelys temminckii	Alligator Snapping Turtle	T
	Malaclemys terrapin	Diamondback Terrapin	U
	Ophisaurus mimicus	Mimic Glass Lizard	R
Plants	*Acmispon helleri*	Carolina Trefoil	E
	Allium speculae	Flatrock Onion	T
	Alnus maritime subsp. georgiansis	Georgia Alder	T
	Amorpha georgiana	Georgia Indigo-bush	E
	Amphianthus pusillus	Pool Sprite	T
	Arabis georgiana	Georgia Rockcress	T
	Arnoglossum diversifolium	Variable-leaf Indian-plantain	T
	Asclepias purpurascens	Purple Milkweed	R
	Asplenium heteroresiliens	Marl Spleenwort	T
	Asplenium scolopendrium var. Americanum	American Hart's-tongue Fern	T
	Astragalus michauxii	Sandhill Milk-vetch	T
	Aureolaria patula	Spreading Yellow Foxglove	T
	Balduina atropurpurea	Purple Honeycomb Head	R
	Baptisia arachnifera	Hairy Rattleweed	E
	Berberis Canadensis	American Barberry	E
	Brickellia cordifolia	Heartleaf Brickellia	T
	Calamagrostis porteri	Porter's Reed-grass	R
	Calamintha ashei	Ohoopee Dunes Wild Basil	T
	Carex baltzellii	Baltzell Sedge	E

Carex biltmoreana	Granite Dome Sedge	T
Carex dasycarpa	Velvet Sedge	R
Carex misera	Wretched Sedge	T
Carex rodfordii	Radford's Sedge	T
Carya myristiciformis	Nutmeg Hickory	R
Ceratiola ericoides	Sandhill Rosemary	T
Chamaecyparis thyoides	Atlantic White-cedar	R
Chelone cuthbertii	Cuthbert's Turtlehead	T
Clematis fremontii	Fremont's Leatherflower	E
Clematis morefieldii	Morefield's Leatherflower	E
Clematis socialis	Alabama Leatherflower	E
Convallaria majuscule	American Lily-of-the-valley	R
Coreopsis integrifolia	Floodplain Tickseed	T
Coreopsis latifolia	Broadleaf Tickseed	R
Coreopsis triflora	Three-flowered Hawthorn	T
Croomia pauciflora	Croomia	T
Cuscuta harperi	Harper Dodder	E
Cymophyllus fraserianus	Fraser Sedge	T
Cypripedium acaule	Pink Ladyslipper	U
Cyripedium kentuckiense	Kentucky Ladyslipper	E
Cypripedium parviflorum	Yellow Ladyslipper	R
Desmodium ochroleucum	Cream-flowered Trick-trefoil	T
Dichanthelium hirstii	Hirst's Witch Grass	E
Dicerandera radfordiana	Radford's Mint	E
Draba aprica	Sun-loving Draba	E
Echinacea laevigata	Smooth Purple Coneflower	E
Elliottia racemosa	Georgia Plume	T
Epidendrum conopseum	Greenfly Orchid	U
Eriocaulon koernickianum	Dwarf Hatpins	E
Fimbristylis perpusilla	Harper Fimbry	E
Forestiera godfreyi	Godfrey's Wild Privet	E
Foresteria segregate	Florida Wild Privet	R
Fothergilla gardenii	Dwarf Witch-alder	T
Fothergilla major	Mountain Witch-alder	T
Gentianopsis crinita	Fringed Gentian	T
Gymnoderma lineare	Rock Gnome Lichen	E
Hartwrightia floridana	Hartwrightia	T
Helianthus verticillatus	Whorled Sunflower	E
Hydrastis canadensis	Goldenseal	E
Hymenocallis coronaria	Shoals Spiderlily	T
Illicium floridanum	Florida Anise	E
Isoetes melanospora	Black-spored Quillwort	E
Isoetes tegetiformans	Mat-forming Quillwort	E
Isotria medeoloides	Small Whorled Pogonia	T
Jamesianthus alabamensis	Alabama Warbonnet	E
Jeffersonia diphylla	Twinleaf	R
Kalmia carolina	Carolina Bog Laurel	T
Leavenworthia exigua var. exigua	Least Gladecress	T
Leiophyllum buxifolium	Sand-myrtle	T
Leitneria floridana	Corkwood	T

Lilium michiganense	Michigan Lily	R
Lilium philadelphicum	Wood Lily	E
Lindera melissifolia	Pondspicebush	E
Litsea aestivalis	Pondspice	R
Lysimachia fraseri	Fraser Loosestrife	R
Lythrum curtissii	Curtiss Loosestrife	T
Macbridea caroliniana	Carolina Bogmint	R
Macranthera flammea	Hummingbird Flower	T
Marshallia mohrii	Coosa Barbara Buttons	T
Marshallia ramosa	Pineland Barbara Buttons	R
Matelea alabamensis	Alabama Milkvine	T
Matelea pubiflora	Trailing Milkvine	R
Megaceros aenigmaticus	Bighorn Hornwort	T
Monotropis odorata	Sweet Pinesap	T
Morella inodora	Odorless Bayberry	T
Myriophyllum laxum	Lax Water Milfoil	R
Naja filifolia	Narrowleaf Naiad	E
Nestronia umbellula	Indian Olive	R
Neviusia alabamensis	Alabama Snow-wreath	T
Oxypolis canbyi	Canby Dropwort	E
Pachysandra procumbens	Allegheny-spurge	R
Packera millefolia	Blue Ridge Golden Ragwort	T
Paronychia virginica	Yellow Nailwort	T
Pedicularis lanceolata	Swamp Louswort	E
Pediomelum peidmontanum	Dixie Mountain Breadroot	E
Penstemon dissectus	Cutleaf Beardtongue	R
Pinguicula primuliflora	Clearwater Butterwort	T
Pityopsis pinifolia	Sandhill Golden-aster	R
Platanthera integrilabia	Monkeyface Orchid	T
Prenanthes barbata	Barbed Rattlesnake Root	R
Pteroglossaspis ecristata	Crestless Plume Orchid	T
Ptilimnium nodosum	Harperella	E
Quercus oglethorpensis	Oglethorpe Oak	T
Rhododendron prunifolium	Plumleaf Azalea	T
Rhus michauxii	Dwarf Sumac	E
Rhynchospora solitaria	Solitary Breakrush	E
Rudbeckia auriculata	Swamp Black-eyed Susan	E
Rudbeckia heliopsidis	Little River Black-eyed Susan	T
Sabatia capitata	Cumberland Rose Gentian	R
Sageretia minutiflora	Climbing Buckthorn	T
Sagittaria secundifolia	Kral's Water-plantain	T
Salix floridana	Florida Willow	E
Sanguisorba canadensis	Canada Burnet	T
Sapindus marginatus	Soapberry	R
Sarracenia flava	Yellow Flytrap	U
Sarracenia leucophylla	Whitetop Pitcherplant	E
Sarracenia minor	Hooded Pitcherplant	U
Sarracenia oreophila	Green Pitcherplant	E
Sarracenia psittacina	Parrot Pitcherplant	T
Sarracenia purpurea	Purple Pitcherplant	E
Sarracenia rosea	Rose Pitcherplant	E

Sarracenia rubra	Sweet Pitcherplant	T
Schisandra glabra	Bay Starvine	T
Schwalbea americana	Chaffseed	E
Scutellaria montana	Large-flowered Skullcap	T
Scutellaria ocmulgee	Ocmulgee Skullcap	T
Sedum nevii	Nevius Stonecrop	T
Sedum pusillum	Granite Stonecrop	T
Shortia galacifolia	Oconee Bells	E
Sibbaldiopsis tridentata	Mountain Cinquefoil	E
Sideroxulon macrocarpum	Ohoopee Bumelia	R
Sideroxylon thornei	Swamp Buckthorn	E
Silene ovata	Ovate Catchfly	R
Silene polypetala	Fringed Campion	E
Silene regia	Royal Catchfly	E
Solidago simulans	Cliffside Goldenrod	E
Spiraea virginiana	Virginia Spirea	T
Spiranthes magnicamporum	Great Plains Ladies-tresses	E
Stewartia malacodendron	Silky Camellia	R
Streptopus lanceolatus	Rosy Twisted Stalk	T
Stylisma pickeringii var. pickeringii	Pickering Morning-glory	T
Symphyotrichum georgianum	Georgia Aster	T
Thalictrum cooleyi	Cooley Meadowrue	E
Thalictrum debile	Trailing Meadowrue	T
Thaspium pinnatifidum	Glade Meadowparsnip	E
Torreya taxifolia	Florida Torreya	E
Trientalis borealis	Starflower	E
Trillium persistens	Persistent Trillium	E
Trillium pusillum	Dwarf Trillium	E
Trillium reliquum	Relict Trillium	E
Tsuga caroliniana	Carolina Hemlock	E
Veratrum woodii	Ozark Bunchflower	R
Viburnum bracteatum	Limerock Arrow-wood	E
Waldsteinia lobata	Barren Strawberry	R
Xerophyllum asphodeloides	Eastern Turkeybeard	R
Xyris tennesseensis	Tennessee Yellow-eyed Grass	E

T=Threatened; R=Rare; E=Endangered; U=Unusual

APPENDIX E

ADDITIONAL TARGET BIRD SPECIES THAT WS COULD ADDRESS IN GEORGIA

In addition to the bird species identified in Section 1.2 of the EA, WS could receive requests for assistance to manage damage and threats of damage associated with several additional bird species, but those requests would occur infrequently, or the requests would involve only a few individual birds. Damage and threats of damage associated with those species would occur primarily at airports or military facilities 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 WS could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage include snow geese (*Anser caerulescens*), cackling geese (*Branta hutchinsii*), black-bellied whistling-ducks (*Dendrocygna autumnalis*), fulvous whistling-ducks (*Dendrocygna bicolor*), greater white-fronted geese (*Anser albifrons*), wood ducks (*Aix sponsa*), blue-winged teal (*Spatula discors*), northern shovelers (*Spatula clypeata*), gadwalls (*Mareca strepera*), American wigeons (*Mareca americana*), American black ducks (*Anas rubripes*), mottled ducks (*Anas fulvigula*), northern pintails (*Anas acuta*), green-winged teal (*Anas crecca*), canvasbacks (*Aythya valisineria*), redheads (*Aythya americana*), ring-necked ducks (*Aythya collaris*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), buffleheads (*Bucephala albeola*), common goldeneyes (*Bucephala clangula*), hooded mergansers (*Lophodytes cucullatus*), common mergansers (*Mergus merganser*), red-breasted mergansers (*Mergus serrator*), ruddy ducks (*Oxyura jamaicensis*), northern bobwhite (*Colinus virginianus*), ruffed grouse (*Bonasa umbellus*), pied-billed grebes (*Podilymbus podiceps*), horned grebes (*Podiceps auritus*), common ground doves (*Columbina passerina*), white-winged doves (*Zenaida asiatica*), yellow-billed cuckoos (*Coccyzus americanus*), common nighthawks (*Chordeiles minor*), Chuck-will's-widows (*Antrostomus carolinensis*), eastern whip-poor-wills (*Antrostomus vociferus*), chimney swifts (*Chaetura pelagica*), king rails (*Rallus elegans*), clapper rails (*Rallus crepitans*), Virginia rails (*Rallus limicola*), soras (*Porzana carolina*), common gallinules (*Gallinula galeata*), American coots (*Fulica americana*), purple gallinules (*Porphyrio martinica*), yellow rails (*Coturnicops noveboracensis*), sandhill cranes (*Antigone canadensis*), black-necked stilts (*Himantopus mexicanus*), American avocets (*Recurvirostra americana*), black-bellied plovers (*Pluvialis squatarola*), American golden-plovers (*Pluvialis dominica*), semipalmated plovers (*Charadrius semipalmatus*), upland sandpipers (*Bartramia longicauda*), whimbrels (*Numenius phaeopus*), stilt sandpipers (*Calidris himantopus*), sanderlings (*Calidris alba*), dunlins (*Calidris alpina*), least sandpipers (*Calidris minutilla*), white-rumped sandpipers (*Calidris fuscicollis*), pectoral sandpipers (*Calidris melanotos*), semipalmated sandpipers (*Calidris pusilla*), western sandpipers (*Calidris mauri*), American woodcocks (*Scolopax minor*), Wilson's snipe (*Gallinago delicata*), spotted sandpipers (*Actitis macularia*), solitary sandpipers (*Tringa solitaria*), lesser yellowlegs (*Tringa flavipes*), willets (*Tringa semipalmatu*), greater yellowlegs (*Tringa melanoleuca*), Wilson's phalaropes (*Phalaropus tricolor*), Bonaparte's gulls (*Chroicocephalus philadelphia*), laughing gulls (*Leucophaeus atricilla*), herring gulls (*Larus argentatus*), Caspian terns (*Hydroprogne caspia*), common terns (*Sterna hirundo*), Forster's terns (*Sterna forsteri*), magnificent frigatebirds (*Fregata magnificens*), common loons (*Gavia immer*), anhingas (*Anhinga anhinga*), American white pelicans (*Pelecanus erythrorhynchos*), brown pelicans (*Pelecanus occidentalis*), American bitterns (*Botaurus lentiginosus*), least bitterns (*Ixobrychus exilis*), little blue herons (*Egretta caerulea*), tricolored herons (*Egretta tricolor*), green herons (*Butorides virescens*), white ibises (*Eudocimus albus*), glossy ibis (*Plegadis falcinellus*), swallow-tailed kite (*Elanoides forficatus*), golden eagles (*Aquila chrysaetos*), northern harriers (*Circus hudsonius*), sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks

(*Accipiter cooperii*), bald eagles (*Haliaeetus leucocephalus*), Mississippi kites (*Ictinia mississippiensis*), red-shouldered hawks (*Buteo lineatus*), broad-winged hawks (*Buteo platypterus*), red-tailed hawks (*Buteo jamaicensis*), rough-legged hawks (*Buteo lagopus*), barn owls (*Tyto alba*), eastern screech-owls (*Megascops asio*), great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), long-eared owls (*Asio otus*), short-eared owls (*Asio flammeus*), northern saw-whet owls (*Aegolius acadicus*), belted kingfishers (*Megaceryle alcyon*), red-headed woodpeckers (*Melanerpes erythrocephalus*), red-bellied woodpeckers (*Melanerpes carolinus*), yellow-bellied sapsuckers (*Sphyrapicus varius*), downy woodpeckers (*Dryobates pubescens*), hairy woodpeckers (*Dryobates villosus*), northern flickers (*Colaptes auratus*), pileated woodpeckers (*Dryocopus pileatus*), American kestrels (*Falco sparverius*), merlins (*Falco columbarius*), eastern kingbirds (*Tyrannus tyrannus*), eastern phoebes (*Sayornis phoebe*), loggerhead shrikes (*Lanius ludovicianus*), blue jays (*Cyanocitta cristata*), fish crows (*Corvus ossifragus*), horned larks (*Eremophila alpestris*), bank swallows (*Riparia riparia*), cave swallows (*Petrochelidon fulva*), tree swallows (*Tachycineta bicolor*), northern rough-winged swallows (*Stelgidopteryx serripennis*), purple martins (*Progne subis*), cedar waxwings (*Bombycilla cedrorum*), gray catbirds (*Dumetella carolinensis*), brown thrashers (*Toxostoma rufum*), northern mockingbirds (*Mimus polyglottos*), house finches (*Haemorhous mexicanus*), purple finches (*Haemorhous purpureus*), grasshopper sparrows (*Ammodramus savannarum*), savannah sparrows (*Passerculus sandwichensis*), song sparrows (*Melospiza melodia*), bobolinks (*Dolichonyx oryzivorus*), rusty blackbirds (*Euphagus carolinus*), Brewer's blackbirds (*Euphagus cyanocephalus*), northern cardinals (*Cardinalis cardinalis*), and dickcissels (*Spiza americana*).

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 that those bird species primarily damage in Georgia occur in Table E-1.

Table E-1: Additional bird species that WS could address in Georgia and the primary resource types damaged by those species

Species	Resource[†]				Species	Resource[†]			
	A	N	P	H		A	N	P	H
Snow goose*	X		X	X	Herring gull	X	X	X	X
Cackling goose*	X		X	X	Caspian tern	X		X	X
Black-bellied whistling-duck*			X	X	Common tern	X		X	X
Fulvous whistling-duck*			X	X	Forster's tern			X	X
Greater white-fronted goose*	X		X	X	Magnificent frigatebirds			X	X
Wood duck*			X	X	Common loon			X	X
Blue-winged teal*			X	X	Anhinga	X		X	X
Northern shoveler*			X	X	American white pelican	X		X	X
Gadwall*			X	X	Brown pelican			X	X
American wigeon*			X	X	American bittern			X	X
American black duck*			X	X	Least bittern			X	X
Mottled duck*			X	X	Little blue heron	X		X	X
Northern pintail*			X	X	Tricolored heron	X		X	X
Green-winged teal*			X	X	Green heron	X		X	X
Canvasback*			X	X	White ibis			X	X
Redhead*			X	X	Glossy ibis			X	X
Ring-necked duck*			X	X	Swallow-tailed kite[‡]			X	X
Greater scaup*	X		X	X	Golden eagle			X	X
Lesser scaup*	X		X	X	Northern harrier		X	X	X
Bufflehead*			X	X	Sharp-shinned hawk		X	X	X
Common goldeneyes*			X	X	Cooper's hawk		X	X	X
Hooded merganser*	X		X	X	Bald eagle			X	X

Common merganser*	X		X	X	Mississippi kite			X	X
Red-breasted merganser*	X		X	X	Red-shouldered hawk		X	X	X
Ruddy duck*			X	X	Broad-winged hawk			X	X
Northern bobwhite*			X	X	Red-tailed hawk	X	X	X	X
Ruffed grouse*			X	X	Rough-legged hawk			X	X
Pied-billed grebe	X		X	X	Barn owl	X	X	X	X
Horned grebe	X		X	X	Eastern screech-owl			X	X
Common ground dove			X	X	Great horned owl	X	X	X	X
White-winged dove*			X	X	Barred owl	X	X	X	X
Yellow-billed cuckoo‡			X	X	Long-eared owl			X	X
Common nighthawk‡			X	X	Short-eared owl‡			X	X
Chuck-will's-widow‡			X	X	Northern saw-whet owl‡			X	X
Eastern whip-poor-will‡			X	X	Belted kingfisher	X		X	X
Chimney swift‡			X	X	Red-headed woodpecker‡			X	X
King rail*‡			X	X	Red-bellied woodpecker			X	X
Clapper rail*			X	X	Yellow-bellied sapsucker			X	X
Virginia rail*			X	X	Downy woodpecker			X	X
Sora*			X	X	Hairy woodpecker			X	X
Common gallinule*			X	X	Northern flicker			X	X
American coot*			X	X	Pileated woodpecker			X	X
Purple gallinule*			X	X	American kestrel‡	X	X	X	X
Yellow rail‡			X	X	Merlin			X	X
Sandhill crane	X		X	X	Eastern kingbird			X	X
Black-necked stilts			X	X	Eastern phoebe			X	X
American avocet			X	X	Loggerhead shrike			X	X
Black-bellied plover			X	X	Blue Jay			X	X
American golden-plover			X	X	Fish crow*	X	X	X	X
Semipalmated plover			X	X	Horned lark			X	X
Upland sandpiper			X	X	Bank swallow			X	X
Whimbrel‡			X	X	Cave swallow			X	X
Stilt sandpiper			X	X	Tree swallow			X	X
Sanderling			X	X	Northern rough-winged swallow			X	X
Dunlin‡			X	X	Purple martin			X	X
Least sandpiper			X	X	Cedar waxwing			X	X
White-rumped sandpiper			X	X	Gray catbird			X	X
Pectoral sandpiper‡			X	X	Brown thrasher			X	X
Semipalmated sandpiper‡			X	X	Northern mockingbird			X	X
Western sandpiper			X	X	House finch			X	X
American woodcock*			X	X	Purple finch			X	X
Wilson's snipe*			X	X	Grasshopper sparrow‡			X	X
Spotted sandpiper			X	X	Savannah sparrow			X	X
Solitary sandpiper			X	X	Song sparrow			X	X
Lesser yellowlegs‡			X	X	Bobolink‡			X	X
Willet‡			X	X	Rusty blackbird‡	X		X	X
Greater yellowlegs			X	X	Brewer's blackbird	X		X	X
Wilson's phalaropes			X	X	Northern cardinal			X	X
Bonaparte's gull	X		X	X	Dickcissel			X	X
Laughing gull	X	X	X	X					

†A=Agriculture, N=Natural Resources, P=Property, H=Human Health and Safety

*Bird species that people can harvest during annual hunting seasons in Georgia
‡Birds of Conservation Concern as designated by the USFWS in those Bird Conservation Regions that occur in Georgia

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, except WS would only use non-lethal methods when addressing bald eagles and golden eagles, the take of chuck-will's widows, eastern whip-poor-wills, merlin, yellow-billed cuckoos, red-headed woodpeckers, grasshopper sparrows, loggerhead shrikes, brown pelicans, and rusty blackbirds would not exceed five individuals, and for some of those waterfowl and game species identified in Table E-1 that have annual hunting seasons, WS could lethally remove up to 100 individuals of those species annually in the state. WS could also translocate those species identified in Table E-1 when appropriate and when authorized by the USFWS and/or the GDNR. WS would release birds into appropriate habitat on properties where the property owner or manager has provided WS with permission to release those bird species. WS would only conduct activities associated with those migratory bird species identified in Table E-1 when authorized and only at levels authorized by the USFWS and/or the GDNR.

As identified in Table E-1, people can harvest several bird species in the state during annual hunting seasons. For snow geese, cackling geese, black-bellied whistling-ducks, fulvous whistling ducks, greater white-fronted geese, wood ducks, blue-winged teal, northern shovelers, gadwalls, American wigeons, American black ducks, mottled ducks, northern pintails, green-winged teal, canvasbacks, redheads, ring-necked ducks, greater scaup, lesser scaup, bufflehead, common goldeneyes, ruddy ducks, American coots, and fish crows, WS could lethally remove up to 100 individuals of those species annually in the state because those species often occur during the migration periods in large numbers or congregate together in large numbers and the limited take of 100 individuals would be a minor component of the annual harvest of those species. Most requests for assistance associated with those species occur near airports where they 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. In addition, waterfowl can act as bioindicators to assess environmental quality and, thus, individuals of these species are frequently sampled for environmental toxins, viruses, and/or bacterial organisms. For those reasons, WS could potentially take up to 100 individuals of each of those harvestable species annually. When compared to the annual harvest levels of these species, WS take of up to 100 individuals a year would have little impact on the population or hunter harvest.

For chuck-will's widows, eastern whip-poor-wills, merlin, yellow-billed cuckoos, red-headed woodpeckers, grasshopper sparrows, loggerhead shrikes, brown pelicans, and rusty blackbirds, WS annual take would not exceed five individuals. WS anticipates addressing chuck-will's widows, eastern whip-poor-wills, merlin, yellow-billed cuckoos, red-headed woodpeckers, grasshopper sparrows, loggerhead shrikes, brown pelicans, and rusty blackbirds infrequently and primarily using non-lethal methods in Georgia. In addition, WS would only use non-lethal methods to disperse bald eagles and golden eagles. No intentional lethal take of bald eagles and golden eagles would occur by WS. WS would only haze and disperse bald eagles and golden eagles when authorized by the USFWS pursuant to the Bald and Golden Eagle Protection Act. WS would work with the USFWS to determine when a permit to haze and disperse bald and golden eagles would be required.

To alleviate damage or discourage nesting in areas where damage is occurring, WS could destroy up to 20 nests annually of those species in Table E-1 that nest in the state, including eggs in those nests. 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. Nest and egg removal would not be used by WS as a population management method. This method would be used by WS to inhibit nesting in an area experiencing damage due to nesting activity and would only be employed at a localized level. As with the lethal removal of migratory birds, the destruction of active migratory bird nests can only occur when authorized by the USFWS; therefore, the number of active nests taken by WS annually would occur at the discretion of the USFWS. WS would not destroy nests or eggs of bald eagles or golden eagles in the state.

Table E-1 identifies bird species of conservation concern designated by the USFWS in those Bird Conservation Regions that WS could address in Georgia. As discussed in Section 1.6.13 of the EA, the GDNR has prepared a State Wildlife Action Plan (GDNR 2015). The plan identifies those species of greatest conservation need in Georgia based on several criteria. Using criteria for ranking the species of greatest conservation need, the GDNR classified species using a priority score approach that ranges from one to five. The State Wildlife Action Plan states, "*…the higher the number, the more secure that species is thought to be at the state…level*" (GDNR 2015). Therefore, a Rank 1 species "*…is considered very rare or imperiled in the state…*" and a Rank 5 species "*…is considered common and secure*" (GDNR 2015). Table E-2 includes those bird species that WS could address infrequently or in limited numbers that the GDNR has identified as species with the greatest conservation need in the state and their priority score. WS would continue to address those species using primarily non-lethal methods and would only take those species when authorized by the USFWS and/or the GDNR. As indicated previously, WS would only use non-lethal methods to address bald eagles. The USFWS has not classified any of the species in Table E-2 as threatened or endangered pursuant to the ESA (see Appendix C).

Table E-2: Bird species that WS could address that are identified in the Georgia State Wildlife Action Plan and their priority score

Species	Priority Score†
Florida Sandhill Crane	1
Appalachian Yellow-bellied Sapsucker	1(Breeding) : 5(Migration)
Swallow-tailed Kite	2
Southeastern American Kestrel	2
Black-necked Stilt	2
Whimbrel	3
King Rail	3
Rusty Blackbird	3
Bald Eagle	3
Least Bittern	3
Loggerhead Shrike	3
Little Blue Heron	4
Tricolored Heron	4
Grasshopper Sparrow	4
Northern Bobwhite	5
Yellow Rail	Unknown
Barn Owl	Unknown

†Priority scores are based on a scale of 1 to 5; the higher the number, the more secure that species is thought to be at the state level (GDNR 2015)

WS does not expect the annual take of those species identified in Table E-1 and in Table E-2, including nest destruction, 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, including the destruction of nests, unless the USFWS permits the take pursuant to the MBTA. If the USFWS and/or the GDNR do not issue a permit, no take would occur by WS. In addition, take would only occur at those levels stipulated in a permit or authorization. Therefore, the take of those bird species would occur in accordance with applicable state and federal laws and regulations authorizing take of birds and their nests and eggs, including the USFWS and/or the GDNR permitting processes. The USFWS and/or the GDNR, as the agencies with management responsibility for 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 GDNR any take of the bird species listed in Table E-1 and Table E-2 in accordance with a permit or other authorization when required.