ENVIRONMENTAL ASSESSMENT

Managing Damage and Threats of Damage Caused by Birds in the State of Mississippi

Prepared by

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

In Cooperation with:

The Tennessee Valley Authority

January 2020

EXECUTIVE SUMMARY

Wildlife is 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 entities. 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 Mississippi, WS has and continues to receive requests for assistance to reduce and prevent damage associated with several bird species.

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 Tennessee Valley Authority (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).

Chapter 1 of this EA discusses the need for action and the scope of analysis associated with requests for assistance that WS receives involving several bird species in Mississippi, including requests for assistance to manage damage and threats of damage on properties owned or managed by the TVA. Chapter 2 identifies and discusses the issues that WS and the TVA identified during the scoping process for this EA and through consultation with state and federal agencies. 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. 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.

Chapter 3 provides information needed for making informed decisions by comparing the environmental consequences of the four alternative approaches in comparison 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 on the significance of the environmental effects, which will aid the decision-makers with determining the need to prepare an EIS or concluding the EA process with a Finding of No Significant Impact.

TABLE OF CONTENTS

LIST OF APPENDICES

ACRONYMS

AI	Avian Influenza
APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
CBC	Christmas Bird Count
CEQ	Council on Environmental Quality
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
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
HDP	2-hydroxy-4,6-dimethylpyrimidine
HP	Highly Pathogenic
LD	Median Lethal Dose
LC	Median Lethal Concentration
MBTA	Migratory Bird Treaty Act
MDAC	Mississippi Department of Agriculture and Commerce
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NWRC	National Wildlife Research Center
PL	Public Law
ROD	Record of Decision
T&E	Threatened and Endangered
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 is an important public resource greatly valued by people. In general, people regard wildlife as providing economic, recreational, emotional, and esthetic benefits. Knowing that wildlife exists in the natural environment provides a positive benefit to many people. However, the behavior of animals may result in damage to agricultural resources, natural resources, 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 2015) 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).

Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower 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 damages acceptable to individuals or groups (Decker and Brown 2001).

Animals have no intent to do harm. They utilize habitats (*e.g.*, feed, shelter, reproduce) 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. Therefore, the threshold of damage that triggers a person to seek assistance is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where 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 the esthetic value of property and other situations where 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.

1.2 PURPOSE OF THIS DOCUMENT

When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other entities. 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. The WS program has offices in Mississippi that provide assistance with managing damage caused by wildlife when people request such assistance.

In Mississippi, WS has and continues to receive requests for assistance to reduce and prevent damage associated with several bird species. WS has identified those bird species most likely to be responsible for causing damage in Mississippi based on previous requests for assistance and assessments of the threat of bird strike hazards at airports in the state. Those bird species include feral/free-ranging domestic fowl[2], rock pigeons (*Columba livia*), Eurasian collared-doves (*Streptopelia decaocto*), mourning doves (*Zenaida macroura*), killdeer (*Charadrius vociferous*), laughing gulls (*Leucophaeus atricilla*), ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus*), American white pelicans (*Pelecanus erythrorhynchos*), great blue herons (*Ardea herodias*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), little blue herons (*Egretta caerulea*), cattle egrets (*Bubulcus ibis*), black vultures (*Coragyps atratus*), turkey vultures (*Cathartes aura*), American crows (*Corvus brachyrhynchos*), purple martins (*Progne subis*), cliff swallows (*Petrochelidon pyrrhonota*), barn swallows (*Hirundo rustica*), American robins (*Turdus migratorisus*), European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), house finches (*Haemorhous mexicanus*), Savannah sparrows (*Passerculus sandwichensis*), eastern meadowlarks (*Sturnella magna*), red-winged blackbirds (*Agelaius phoeniceus*), brown-headed cowbirds (*Molothrus ater*), and common grackles (*Quiscalus quiscula*).

In addition to those species, WS could also receive requests for assistance to manage damage and threats of damage associated with several other bird species, but requests for assistance associated with those species would occur infrequently and/or requests would involve a small number of individual birds of a species. Damages and threats of damages associated with those species would occur primarily at airports where individuals of those species pose a threat of aircraft strikes. Appendix E contains a list of species that WS could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage. Section 1.4 discusses the need for action associated with requests for assistance that WS receives involving several bird species in Mississippi, including requests for assistance to manage damage and threats of damage on properties owned or managed by the Tennessee Valley Authority (TVA)[3].

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

[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]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 mallards, Muscovy ducks, and mallard-Muscovy hybrids.

[3]See Section 1.4.7 for the role and authorities of the TVA

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.

1.2.1 Complying with the NEPA

As part of the decision-making process associated with the NEPA, WS follows the Council on Environmental Quality (CEQ) regulations implementing the NEPA (40 CFR 1500 et seq.) 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, making informed decisions, and including agencies and the public in their planning to support informed decision-making.

To comply with the NEPA and CEQ regulations, WS, in cooperation with the TVA, is preparing this Environmental Assessment (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 CEQ (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 CEQ (2007) further states, "*The EA process concludes with either a Finding of No Significant Impact…or a determination to proceed to preparation of an EIS*".

1.2.2 Using this EA to Inform Decisions

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. Similarly, the TVA is also required to comply with the NEPA before making decisions about actions that occur on properties they own and/or manage. WS and the TVA 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[4] to conclude this EA process, WS and the TVA 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 1.4) and to ensure that the analyses are complete for informed decision-making.

Public outreach 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 *Clarion Ledger* newspaper. WS will provide for a minimum of a 30-day comment period for the public and interested

[4]As discussed in Section 1.2.1, the EA process concludes with either a Finding of No Significant Impact or the publication of a Notice of Intent to prepare an EIS.

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, efficient use of agency and tribal expertise, and to promote interagency and tribal coordination, which includes the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP). WS and the TVA have asked each consulting agency to review the draft EA and provide input and direction to WS and the TVA to ensure proposed activities would comply with applicable federal and state regulations and policies, federal land management plans, Memorandum of Understandings (MOUs), and cooperative agreements.

1.2.3 The Geographical Scope of this EA

WS and the TVA have decided that one EA analyzing potential effects of implementing the alternatives approaches of meeting the need for action for the entire State of Mississippi 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 1.1 and Appendix E occur statewide and throughout the year in Mississippi. Birds are dynamic and mobile; therefore, damage and threats of damage caused by birds can occur wherever those bird species occur in the state. 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, the program cannot predict the specific locations or times at which affected resource owners would determine that damage had become intolerable and they request assistance from WS. WS must be ready to provide assistance on short notice anywhere in Mississippi 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, state, county, city, and private lands, when requested, including properties that the TVA owns and/or manages.

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 Mississippi when WS receives a request for such assistance from the appropriate landowner or land 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.

1.2.4 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/or the TVA determine that new or additional needs for action, changed conditions, new issues, and/or new alternatives 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 if the changes would have "*environmental relevance*" (40 CFR 1502.9(c)), 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 program effects 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.

1.2.5 Relationship of This Document to Other Environmental Documents

Additional environmental documents relate to activities that WS could conduct to manage damage or threats of damage associated with bird species in the state. Environmental documents relate to 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.

Resident Canada Goose Management Final Environmental Impact Statement

The United States Fish and Wildlife Service (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 (ROD) 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 ROD and adopted the FEIS (72 FR 35217).

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. 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 migrate and winter throughout the United States. The USFWS published a ROD and issued a final rule that went into effect on December 5, 2008.

WS' Canada Goose Damage Management Environmental Assessment

WS, in cooperation with the TVA, prepared an EA to evaluate potential impacts to the human environment from the implementation of a management program to address damage to agricultural resources, natural resources, property, and to reduce threats to human safety caused by Canada geese in Mississippi. The EA evaluated the need for WS' activities and the relative effectiveness of three alternatives to meet that proposed need, while accounting for the potential environmental effects of those activities (USDA 2015*a*). The EA also evaluated activities to manage damage caused by Canada geese on properties owned and/or managed by the TVA. After consideration of the analysis contained in the EA and review of public comments, WS issued a Decision and Finding of No Significant Impact (FONSI) for the EA on January 11, 2016. The Decision and FONSI selected the proposed action alternative, which implemented an integrated damage management program using multiple methods to address the need to manage Canada goose damage.

WS' Double-crested Cormorant Damage Management Environmental Assessment

The WS program in Mississippi has also developed an EA to evaluate alternatives and issues related to the reduction of double-crested cormorant damage to property, agricultural resources, natural resources, and threats to human safety in Mississippi. The EA evaluated the need for WS' activities and the relative effectiveness of five alternatives to meet that proposed need, while accounting for the potential environmental effects of those activities. After consideration of the analysis contained in the EA and review of public comments, WS issued a Decision and FONSI for the EA on July 1, 2019. The Decision and FONSI selected the proposed action alternative, which implemented an integrated damage management program using multiple methods to address the need to manage double-crested cormorant damage.

WS' Bird Damage Management Environmental Assessment

WS, in cooperation with the TVA, previously developed an EA that analyzed the need for action to manage damage associated with several bird species. That EA identified the issues associated with managing damage associated with several bird species in the state and analyzed alternative approaches to meet the specific need identified in the EA while addressing the identified issues. Changes in the need for action and the affected environment have prompted WS and the TVA 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 effects of program alternatives based on a new need for action, primarily a need to address damage and threats of damage associated with several additional species of birds. Because this EA will re-evaluate activities conducted under the previous EA, the outcome of the Decision issued based on the analyses in this EA will supersede the previous EA that addressed birds.

Southeast United States Waterbird Conservation Plan

The USFWS and their partners developed a regional waterbird conservation plan for the southeastern region of the United States to assist with the recovery of high priority waterbird species (Hunter et al. 2006). The plan addresses waterbirds from eastern Texas and Oklahoma, through Florida, and northward into eastern North Carolina and Virginia, which includes 10 Bird Conservation Regions and 2 pelagic Bird Conservation Regions[5] (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.

---

[5]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 Mississippi lies almost entirely within the Southeastern Coastal Plain, also known as Bird Conservation Region 27. Areas within the State along the Mississippi River and the Mississippi Delta Region lie within the Mississippi Alluvial Valley, also known as Bird Conservation Region 26.

TVA Natural Resource Plan

TVA has developed an extensive plan to strategically evaluate both renewable and nonrenewable resources and fulfill the responsibilities associated with good stewardship of TVA lands and resources. The Natural Resource Plan is designed to integrate the objectives of six resource areas (biological, cultural, recreation, water, public engagement and reservoir lands planning); provide optimum public use benefit; and balance competing and sometimes conflicting resource uses (TVA 2011*a*).

TVA Environment Impact Statement Assessing the Natural Resource Plan

TVA has 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 and 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 (TVA 2011*b*).

Mississippi State Wildlife Action Plan

The primary goal of the Mississippi State Wildlife Action Plan is "…*to provide a guide to effective and efficient long-term conservation of Mississippi's biological diversity*" (Mississippi Museum of Natural Science 2015). By state statue, the MDWFP is the state agency responsible for conserving, developing, and protecting Mississippi's natural resources and providing outdoor recreational opportunities (Mississippi Museum of Natural Science 2015).

1.3 PREPARATION OF AN EA INSTEAD OF 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 1.2, 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 (see 40 CFR 1501.4, 40 CFR 1508.9(a)(3)). WS and the TVA prepared this EA so that WS and the TVA 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 and the TVA are 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 and the TVA 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 in accordance with the NEPA implementing regulations of the CEQ (40 CFR 1508.9(a)(3)).

1.3.1 How WS and the TVA will Evaluate Significant Impacts

The process for determining if a project or program may have significant impacts is based on the CEQ regulations at 40 CFR 1508.27. Chapter 3 evaluates the direct, indirect, and cumulative impacts associated with the alternative approaches of meeting the need for action. The need for action involves the requests for assistance that WS receives to manage damage to agricultural resources, natural resources, and property caused by several bird species in Mississippi. In addition, WS receives requests for assistance to reduce risks to human health and safety associated with bird species in the state. A similar need for action arises from damage and threats of damage occurring on properties owned and/or managed by the TVA.

Most of the factors included in 40 CFR 1508.27(b) include the phrase "*the degree to which*" a particular type of resource might be adversely affected, not a determination of no adverse impact at all. Therefore, WS and the TVA evaluate the impacts to resources and documents the predicted effects in this EA. WS and the TVA will use those effect analyses to determine if the levels of impact are indeed "*significant*" impacts for which a Finding on No Significant Impact would not be appropriate; thus, requiring the need to prepare an EIS. If WS and the TVA determines that the levels of impacts are not significant, WS and the TVA will document the rationale for not preparing an EIS in a publicly available Decision and Finding of No Significant Impact in accordance with guidance from the CEQ. WS and the TVA will review the impacts evaluated in Chapter 3 of this EA in two ways: the severity or magnitude of the impact on a resource and the context of the impact. For example, WS and the TVA may consider the context of activities when the resource is rare, vulnerable, not resilient, or readily changed long-term with even a short-term stressor.

The factors identified in 40 CFR 1508.27 are not checklists, nor do they identify thresholds of impacts, but they are factors for consideration by the agency while making the decision regarding whether to prepare a Finding of No Significant Impact or preparing an EIS. WS and the TVA will determine how to consider those factors in its decision on whether to prepare a Finding of No Significant Impact or an EIS. WS and the TVA will determine the *degree* to which a factor applies or does not apply to the impacts documented in the EA. An outline of how WS and the TVA will use this EA, and the criteria at 40 CFR 1508.27, to make the decision regarding whether a Finding of No Significant Impact or an EIS is appropriate occurs below (see Section 1.3.2 through Section 1.3.6).

1.3.2 Controversy Regarding Effects

The factor at 40 CFR 1508.27(b)(4) is described as "*the degree to which the effects on the quality of the human environment are likely to be highly controversial*." The failure of any particular organization or person to agree with every act of a federal agency does not create controversy regarding effects. Dissenting or oppositional public opinion, rather than concerns expressed by agencies with jurisdiction by law or expertise and/or substantial doubts raised about an agency's methodology and data, is not enough to make an action "*controversial*". This EA evaluates peer-reviewed and other appropriate published literature, reports, and data from agencies with jurisdiction by law to conduct the impact analyses and evaluate the potential for significant impacts. This EA also includes and evaluates differing professional opinions and recommendations expressed in publications where they exist and that are applicable to the informed decision-making of WS and the TVA.

1.3.3 Unique or Unknown Risks

Another concern commonly expressed in comments involves the potential for unknown or unavailable information (40 CFR 1502.22) to potentially result in uncertain, unique, or unknown risks (40 CFR 1508.27(b)(5)), especially related to population numbers and trends and the extent and causes of mortality of wildlife species. Throughout the analyses in this EA, WS and the TVA use the best available data and information. For example, the EA uses data from the USFWS, which has jurisdiction by law to manage migratory bird populations in the United States. In addition, WS and the TVA will use the scientific literature to make informed decisions.

Population and mortality data for many native wildlife species are typically non-existent from any source, in or outside of Mississippi. WS and the TVA recognize that estimating wildlife populations over large areas can be extremely difficult, labor intensive, and expensive. Instead, the USFWS and the MDWFP may choose to monitor population health using other factors, such as indices of abundance and/or trend data to evaluate the status of populations that do not have direct population data. This EA uses the best available information from wildlife management agencies, including the USFWS and the MDWFP, when available, and peer-reviewed literature to assess potential impacts to bird species.

If population estimates are available, then the analyses will use the lowest density or number estimates for wildlife species populations (where high and low population estimates are provided in the text) to arrive at the most conservative impact analysis. Coordination with the USFWS and/or the MDWFP and providing the opportunity for agency review of and involvement in this EA ensure that analyses are as robust as possible. The analyses in this EA provide information to determine if the cumulative mortality from all known sources, including mortality that could occur by WS or mortality on property owned and/or managed by the TVA, would adversely affect target bird populations, and non-target wildlife species.

1.3.4 Threatened or Endangered Species, Unique Geographic Areas, Cultural Resources, and Compliance with Environmental Laws

This EA also provides analyses and documentation related to threatened and endangered species, areas with special designations, such as wilderness areas, cultural and historic resources, and compliance with other environmental laws, including state laws. This will be used to address the significance criteria at 40 CFR 1508.27(b)(3), CFR 1508.27(b)(8), CFR 1508.27(b)(9), and CFR 1508.27(b)(10).

Evaluation of those issues occurs in the following sections of this EA:

- Impacts to threatened and endangered species occurs in Section 3.2.2
- Impacts to unique geographic areas occurs in Section 2.1.2
- Impacts to cultural and historic resources occurs in Section 2.1.2
- Compliance with other environmental laws occurs in Sections 1.4.8

1.3.5 Cumulatively Significant Impacts

Another common comment involves the criterion for the analysis of "*cumulatively significant impacts*" (40 CFR 1508.27(b)(7)), which this EA considers in various ways. Cumulative impacts, as defined by the CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time. Cumulative impacts could potentially occur from either damage management activities over time by WS or from the aggregate effects of those activities combined with the activities of other agencies and private entities. Many of the issues identified in Section 2.1.1 and evaluated in detail in Section 3.2 are inherently cumulative impact analyses. For example:

- Impacts to target bird populations would evaluate known sources of mortality, only one of which could be removal by WS
- Impacts to wildlife species listed as threatened or endangered pursuant to the Endangered Species Act (ESA), as these species' populations are already cumulatively impacted by many sources of mortality, loss of habitat, climate change, and other stressors, causing them to be listed

The underlying intent for preparing an EA is to determine if a proposed action might have a significant impact on the human environment. The EA development process is issue driven, meaning issues that were raised during the interdisciplinary process and through public involvement that were substantive, would be used to drive the analysis and determine the significance of the environmental impacts of the alternatives. Therefore, the level of site specificity must be appropriate to the issues. The issues raised during the scoping process of this EA drove the analysis. As discussed previously, one EA analyzing impacts for the entire state would provide a more comprehensive and less redundant analysis that allows for a better cumulative impact analysis. If WS and the TVA determined through this EA that the alternative approaches developed to meet the need for action could result in a significant impact on the quality of the human environment, then an EIS would be prepared.

1.3.6 Public and Employee Health and Safety

The concern regarding public health and safety (significance criterion at 40 CFR 1508.27(b)(2)) is evaluated in several analyses in this EA. For example:

- The deposition of lead into the environment from ammunition used in firearms occurs in Section 2.1.2
- The risk of injury to the public from methods available to alleviate bird damage occurs in Section 3.2.3
- The risk of injury to WS' employees occurs in Section 3.2.3

1.4 NEED FOR ACTION

As discussed in Section 1.2, when people seek assistance with managing bird damage, they may seek assistance from the WS program. Therefore, the need for action to manage damage and threats associated with birds in Mississippi arises from requests for assistance[6] that WS could receive to reduce and prevent damage from occurring. WS has identified those bird species most likely to be responsible for causing damage in Mississippi based on previous requests for assistance and assessments of the threat of bird strike hazards at airports in the state (see Section 1.2). Birds can cause damage to agricultural resources, natural resources, property, and pose threats to human safety.

Table 1.1 and Appendix E show the bird species associated with requests for assistance that WS could receive and the resource types those bird species could damage in Mississippi. Most requests for assistance that WS receives are associated with aircraft strike hazards at airports in the state. All of those bird species shown in Table 1.1 and Appendix E could pose a threat to aircraft when those bird species occur at or near air facilities. Bird strikes can cause substantial damage to aircraft, which can require costly repairs. In addition, bird strikes can lead to the catastrophic failure of aircraft, which can pose a threat to the safety of people.

---

[6]WS would only conduct bird damage management after receiving a request for assistance. Before initiating bird damage activities, WS and the entity that requests WS' assistance must sign a Memorandum of Understanding, 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.

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

Species	Resource*				Species	Resource			
	A	N	P	H		A	N	P	H
Domestic Waterfowl				X	Turkey Vulture			X	X
Rock Pigeon			X	X	American Crow	X			X
Eurasian Collared-Doves			X	X	Purple Martin			X	X
Mourning Dove				X	Cliff Swallow			X	X
Killdeer				X	Barn Swallow			X	X
Laughing Gull				X	American Robin				X
Ring-billed Gull				X	European Starling	X		X	X
Herring Gull				X	House Sparrow	X		X	X
Great Blue Heron	X			X	House Finch				X
Great Egret	X			X	Savannah Sparrow				X
Snowy Egret	X			X	Eastern Meadowlark				X
Little Blue Heron	X			X	Red-winged Blackbird	X			X
Cattle Egret				X	Brown-headed Cowbird	X	X		X
Black Vulture			X	X	Common Grackle	X			X

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

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

Some of the species addressed in this EA are gregarious (*i.e.*, form large flocks), especially during the fall and spring migration periods or during the breeding season. Although damage and threats can occur throughout the year, damage or the threat of damage is often highest during those periods when birds are concentrated into large flocks, such as migration periods, and during winter months when food sources are limited. For some bird species, high concentrations of birds occur during the breeding season where suitable nesting habitat exists, such as swallows. The flocking behavior of many bird species during migration periods and during the breeding season can pose increased risks when those species occur near or on airport properties. Aircraft striking multiple birds not only can increase the damage to the aircraft but can also increase the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines. The following subsections of the EA provide additional information regarding the need to manage bird damage.

1.4.1 Need for Bird Damage Management on TVA Properties and Facilities

The TVA owns and manages over 293,000 acres in the Tennessee River system. All of these lands support TVA's goals of power generation and transmission, flood control, and economic development of the Tennessee River Valley. In addition, the TVA operates public recreation areas throughout the Tennessee Valley region, including campgrounds, day-use areas, and boat launching ramps. The TVA operates five combustion turbine sites in Mississippi and two solar facilities. The TVA also owns or maintains electrical power substations and switching stations in Mississippi along with the associated transmission lines and rights-of-way easements. Part of the Pickwick Reservoir is located in northeastern

Mississippi, which includes 90 miles of public shoreline. In addition, the TVA manages more than 1,700 acres of public land in Mississippi.

Bird damage and threats of damage occurring at facilities and properties owned or managed by the TVA have occurred primarily to property and human safety. 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 pathogens 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 also 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 threatens human safety by creating slick surfaces where employees work at extreme heights and increases the risk of pathogen 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 occurring to customers if the birds or fecal material shorts out the power supply the towers support.

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 debris carried by osprey contacts transmission equipment. Ospreys often construct nests 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. For example, the average size of an osprey nest in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (United States Geological Survey 2005). In 2001, 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites (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.

1.4.2 Need to Resolve Bird Damage to Agricultural Resources

In 2017, approximately 10.4 million acres were devoted to agricultural production in Mississippi (USDA 2019*b*). The total market value of agricultural products sold in the state was nearly $6.2 billion in 2017. The market value of crop production in the state was nearly $2.3 billion in 2017. The market value of livestock, poultry, and their products during 2017 was over $3.9 billion (USDA 2019*b*). The cattle and calf inventory for Mississippi was 937,000 head during 2017. In 2017, the market value of products sold from aquaculture production in the state was nearly $231 million (USDA 2019*b*).

As shown in Table 1.1, many of the bird species that WS could address can cause damage to or pose threats to agricultural resources in Mississippi. Damage and threats of damage to agricultural resources is often associated with bird species that exhibit flocking behaviors (*e.g*., red-winged blackbirds) or colonial nesting behavior (*e.g*., rock pigeons). Damage occurs through direct consumption of agricultural resources, the contamination of resources from fecal droppings, or the threat of disease transmission to livestock from contact with fecal matter.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic organisms. Damage can also result from the death of fish and other aquatic wildlife from injuries suffered when birds attempt to prey upon aquatic organisms. As birds move between sites there is a threats of pathogen transmission from one impoundment to another or from one aquaculture facility to other facilities, which can also be a concern for aquaculture producers. In 2017, there were 223 aquaculture operations in Mississippi with sales of nearly $231 million (USDA 2019*b*). The principal species propagated at aquaculture facilities in Mississippi is channel catfish, but people farm other freshwater aquatic species in the state, including trout, hybrid striped bass, tilapia, crawfish, baitfish, and turtles (Mississippi State University Extension Service 2017, USDA 2019*b*). Of those birds shown in Table 1.1 associated with damage to agriculture, herons, egrets, and gulls are of primary concern to owners and/or managers of aquaculture facilities in Mississippi. American white pelicans can also be a concern to owners and/or managers of aquaculture facilities (King 1997, King 2005).

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

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

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

In Europe, birds may be a possible source of transmission of Spring Viraemia of Carp, Viral Hemorrhagic Septicaemia, and Infectious Pancreatic Necrosis, 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 tract of black-headed gulls (*Chroicocephalus ridibundus*) when artificially inserted into the esophagus of the gulls.

Birds may also transmit bacterial pathogens through fecal droppings and on their feet (Price and Nickum 1995). The bacterial pathogen that causes Enteric Septicemia of Catfish can occur within the intestines and rectal areas of great blue herons, great egrets, and snowy egrets from aquaculture facilities (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. They 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 pathogens 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). 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 Mississippi. 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 also defecate while feeding, which can increase the possibility of disease transmission through livestock directly contacting or consuming fecal droppings. Birds can also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be 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 during those periods when birds are concentrated into large flocks, such as during migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can occur during the breeding season where suitable nesting habitat exists, such as pigeons, house sparrows, and swallows. Of primary concern to livestock feedlots and dairies in Mississippi 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 either from roosting and/or nesting behavior can lead to economic losses to agricultural producers from the consumption of livestock feed and from the increased risks associated with the transmission of diseases from fecal matter being deposited in feeding areas and in water used by livestock.

Economic damages associated with starlings and blackbirds feeding on livestock rations has been documented in France and Great Britain (Feare 1984), and in the United States (Besser et al. 1968, Dolbeer et al. 1978, Glahn and Otis 1981, Glahn 1983, Glahn and Otis 1986). Starlings cause approximately $800 million in damage to agricultural resources per year (Pimentel et al. 2005). Diet rations for cattle contain all of the nutrients and fiber that cattle need; however, cattle are unable to select any single component over others. Livestock feed and rations ensure proper health of the animal. Livestock producers and feedlots often supplement higher fiber roughage in livestock feed with corn, barley, and other grains to ensure weight gain and, in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs is most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered, which can negatively affect the health and production of livestock. The removal of this high-energy source by European starlings may reduce milk yields and weight gains, which can be economically critical (Feare 1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, freezing temperatures, and the number of livestock on feed.

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

Damage and threats to livestock operations can also occur from transmission of pathogens from birds to livestock. Agricultural areas provide ideal habitat for many bird species, which can attract a large number of birds to those locations. Large concentrations of birds feeding, roosting, or loafing in those areas increases the possibility of and the concern over the transmission of diseases from birds to livestock. This concern can have far-reaching implications (Daniels et al. 2003, Fraser and Fraser 2010, Miller et al. 2013). Birds feeding alongside livestock in open livestock 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. Many bird species, especially those encountered at livestock operations, are known to carry infectious diseases, which can be excreted in fecal matter and pose not only a risk to individual livestock operations, but can be a source of transmission to other livestock operations as birds move from one area to another.

Although the rate of transmission is likely very low, birds can act as vectors of many diseases transmittable to livestock, which means they can pose a threat. A number of diseases that affect livestock have been associated with rock pigeons, European starlings, and house sparrows (Weber 1979, Carlson et al. 2010, Carlson et al. 2011*a*). Pigeons, starlings, and house sparrows can be carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981). Weber (1979) also reported pigeons, starlings, and house sparrows as carriers of several viral, fungal, protozoal, and rickettsial diseases, 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 *E. 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 present (Carlson et al. 2010, Carlson et al. 2011*b*, Carlson et al. 2012). Poultry operations can be highly susceptible to pathogens spread by wild birds, including those from starlings and house sparrows. This includes salmonella, campylobacter, and clostridium (Craven et al. 2000).

Contamination of livestock facilities through fecal accumulation by various bird species can be an important concern to those facilities. Numerous pathogens can spread through feces, with Salmonellosis and *E. coli* being two diseases of concern. Salmonellosis is an infection caused by bacteria called *Salmonella* and numerous bird species may be reservoirs for *Salmonella* (Friend and Franson 1999, Tizard 2004). Although *E. coli* is a fecal coliform bacteria associated with the fecal material of warm-blooded animals, certain strains can cause illnesses. Multiple studies document birds as an important source of *E. coli* contamination of both land and water sources (Fallacara et al. 2001, Kullas et al. 2002, Hansen et al. 2009, Silva et al. 2009). Multiple species of birds can carry dangerous strains of *E. coli*, including gulls, geese, pigeons, and starlings (Pedersen and Clark 2007). European starlings may also harbor various strains of *E. coli* (Gaukler et al. 2009), including O157:H7, a strain that can cause human mortalities (LeJeune et al. 2008, Cernicchiaro et al. 2012). Salmonella transmission by gulls to livestock can also be a concern (Williams et al. 1977, Johnston et al. 1979, Coulson et al. 1983). Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. Pedersen and Clark (2007) did an extensive review of the literature and found Canada geese, gulls, pigeons, house sparrows, cowbirds, grackles, blackbirds and starlings have the potential to play a role in the direct transmission of *E. coli* and *S. enterica* among cattle at feedlots and dairies and between livestock operations. Migratory birds are capable of spreading pathogens over a larger area, and domestic species might serve as reservoirs within farm operations. The birds also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be 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 it is difficult to document, there is a strong association of wild birds and the contamination of food and water sources at livestock facilities. The potential for introduction of *E. coli* or *Salmonella* spp. to a livestock operation or the transmission of these pathogens between sites by wild birds is a strong possibility (Pedersen and Clark 2007).

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

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

Wild and domestic waterfowl, as well as a variety of other bird species, are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2010). Typically avian influenza (AI) circulates among these birds without clinical signs, and does not cause mortality in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006); however, certain strains of AI can produce devastating disease in domestic poultry making its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). Although wild birds carry low pathogenic strains of AI (Stallknecht 2003, Pedersen et al. 2010), they also carry high pathogenic strains (Brown et al. 2006, Keawcharoen et al. 2008)which, if transmitted to domestic poultry facilities, can result in high levels of mortality (Nettles et al. 1985, Gauthier-Clerc et al. 2007, Pedersen et al. 2010). The potential impacts from a severe outbreak of HPAI in domestic poultry could be devastating, and possibly cripple the multi-billion dollar industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

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

Although birds can be carriers (vectors) of diseases that are transmissible to livestock, the rate of transmission is unknown but is likely to be low. Because many sources of pathogen transmission exist, identifying a specific source can be difficult. Birds can be vectors of disease, especially when large numbers of birds congregate and defecate in livestock feed or water.

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. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. In Mississippi, 74.4% 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 by pulling eyes out followed by attacks to the rectal area or directly attacking the rectal area. During a difficult birth, vultures can harass the mother and peck at the half-expunged calf. This predation behavior often results in serious injury to livestock, which can cause livestock to die from those injuries or require the producers to euthanize livestock due to the extent of the injuries.

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

Direct damage can also result from raptors, particularly red-tailed hawks, preying on domestic fowl, such as chickens and waterfowl (Washburn 2016). Free-ranging fowl or fowl allowed to range outside of confinement for a period are particularly vulnerable to predation by raptors.

Damage to Agricultural Crops

Besser (1985) estimated damage to agricultural crops associated with birds exceeded $100 million annually in the United States. Bird damage to agricultural crops occurs primarily from the consumption of crops (*i.e*., loss of the crop and revenue), but also consists of trampling emerging crops, compaction of soil, consumption of cover crops used to prevent erosion and condition soil, damage to fruits associated with feeding, and fecal contamination. In 2017, the market value of all agricultural crops accounted for almost 37% of the total market value of agricultural commodities (livestock and crops) in Mississippi. Some of the crop commodities harvested in 2017 include soybeans, corn, cotton, rice, peanuts, blueberries, wheat, oats, and sorghum (USDA 2019*b*). Table 1.1 and Appendix E identify several bird species that can cause damage to agricultural resources, including agricultural crops.

Several studies have shown that European starlings can pose a great economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, Feare 1984). Starlings and sparrows can also have a detrimental 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). Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits, and localized damage can be considerable because sparrows often feed in large flocks on a small area (Fitzwater 1994).

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, 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 can cause damage to apples (Mitterling 1965). Damage is infrequently reported in apples because harvest of the crop typically occurs before apples reach a stage when damage is likely with damage being greatest during periods of drought (Mitterling 1965).

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

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985). Damage to sprouting corn occurs primarily by 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.

1.4.3 Need to Resolve Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.1 can be closely associated with human habitation and often exhibit gregarious roosting or flocking behavior, such as vultures, gulls, pigeons, sparrows, starlings, waterfowl, crows, swallows, grackles, cowbirds, and red-winged blackbirds. The close association of those bird species with human activity can pose threats to human safety from disease transmission and threaten the safety of air passengers if aircraft struck 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 and on the risks to people or domestic animals from transmission of those diseases (Clark and McLean 2003). Complicating the study 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.

Fecal droppings often accumulate in areas where birds congregate for long periods of time (*e.g.*, roosts, nesting areas). Accumulation of fecal droppings can pose a threat to human health and safety in areas where people may encounter those accumulations of fecal droppings. 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 humans may come in direct contact with fecal 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*, 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. Elevated contaminant levels associated with breeding and/or roosting concentrations of birds and their potential effects on water supplies can be concerns.

Birds can play a role in the transmission of diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Birds may also play a direct and indirect role in transmission of *E. coli* and *S. enterica* to humans 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 humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). Public health officials and residents at such sites express concerns for human health related to the potential for disease transmission where fecal droppings accumulate. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms, which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum*, which causes the disease histoplasmosis in humans (Weeks and Stickley 1984).

In Mississippi, crows, blackbirds, and starlings can form large communal roosts, which could facilitate the growth of disease organisms, such as *H. capsulatum* (Weeks and Stickley 1984). The disturbance of soil or fecal droppings at these roosts where fecal droppings have accumulated can cause *H. 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). *H. capsulatum* can remain in the soil and can become airborne several years after blackbirds abandon a roost (Clark and McLean 2003).

Chlamydia psittaci bacteria can cause Ornithosis (also known as Psittacosis) in people. Ornithosis is a respiratory disease that people can contract when exposed to infected bird droppings. Waterfowl, herons, and rock pigeons are the most commonly infected wild birds in North America (Locke 1987). Pigeons are most commonly associated with the spread of Ornithosis to people. Ornithosis spreads when fecal particles containing the bacteria become airborne after disturbing infected bird droppings.

Waterfowl may affect human health through the distribution and incubation of various pathogens and through nutrient loading. There are several pathogens involving waterfowl that may be contracted by people, typically by incidental contact with contaminated material. Direct contact with fecal matter would not be a likely route of disease unless ingested. Although intentional contact with feces is not likely, transmission can occur when people unknowingly contact and ingest contaminated material. Linking the transmission of diseases from waterfowl to people can be especially difficult because many pathogens occur naturally in the environment and pathogens can be attributed to contamination from other sources. However, the presence of disease causing organisms in waterfowl feces can increase the risk of exposure and transmission of zoonoses wherever people may encounter large accumulations of feces from waterfowl.

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

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. has 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 songbirds, common in doves and pigeons, occasional in starlings, blackbirds and cowbirds, and infrequent in crows. Infection by *Salmonella* spp. causes gastrointestinal illness, including diarrhea in humans. 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.

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

Campylobacteriosis is an infectious disease caused by bacteria of the genus *Campylobacter*. *Campylobacter jejuni* is a bacterium usually associated with food-borne pathogens (Center for Food Safety and Applied Nutrition 2012). In the mid-Atlantic, Keller et al. (2011) found *Campylobacter* in multiple bird species, with prevalence rates of >20% in gulls and crows. Although it is unknown what role wild birds play in the transmission of this bacteria, birds such as crows and gulls are often in close contact with people, there is a potential for transmission. In persons with compromised immune systems, *Campylobacter* occasionally spreads to the bloodstream and causes a serious life-threatening infection; in healthy people, it typically causes diarrhea and is one of the most common diarrheal illnesses in the United States (Centers for Disease Control and Prevention 2019).

E. coli are fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *E. coli* with the majority of serological types not causing disease in humans (Sterritt and Lester 1988). The serological type of *E. coli* that is best known for causing serious illness is *E. 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, beaches are often temporarily closed to the public even though the strain of *E. 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 animal species and link those animal sources of coliform bacteria to fecal contamination (Simmons et al. 1995, Jamieson 1998).

For example, Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998, Alderisio and DeLuca 1999). In addition, fecal coliform bacteria counts coincided with the number of Canada geese and gulls roosting at the reservoir. Cole et al. (2005) found that geese might serve as a vector of antimicrobial resistance genes, indicating that they not only harbor and spread zoonotic 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., *E. 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). 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.

Wild and domestic waterfowl can be reservoirs of a variety of avian influenza viruses (Davidson and Nettles 1997, Pedersen et al. 2010), but they can occur in a variety of other bird species (Alexander 2000, Stallknecht 2003). Avian influenza virus can circulate in wild waterfowl without causing clinical signs or mortality (Davidson and Nettles 1997, Clark and Hall 2006). However, 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, Clark and Hall 2006, Gauthier-Clerc et al. 2007). Although low pathogenic strains of avian influenza virus are most commonly detected in wild birds (Stallknecht 2003, Pedersen et al. 2010), high pathogenic strains have also been identified in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). Although most subtypes of avian influenza virus infect birds, highly pathogenic strains such as H5N1 can be transmitted to humans and in certain cases result 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).

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 humans have been demonstrated to occur. 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 of Aircraft Striking Birds at Airports and Military Bases

In addition to the potential of transmitting various zoonotic pathogens, birds also pose a threat to human safety when found near airports. When aircraft strike birds, especially when birds enter or are ingested into engines, structural damage to the aircraft and catastrophic engine failure can occur. 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). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transportation industry as a whole (Conover et al. 1995). Wildlife strikes pose increasing risks and economic losses to the aviation industry worldwide. Annual economic losses from wildlife strikes with civil aircraft are likely to exceed $1.2 billion worldwide (Allan 2002). From January 2000 through October 2019, the Federal Aviation Administration (2019) reported aircraft strikes of up to 1,073 birds in Mississippi. In Mississippi, nearly 97% of the reported aircraft strikes from January 2000 through October 2019 involved birds (Federal Aviation Administration 2019).

Many bird species involved in strikes are not or cannot be identified and up to 80% of bird strikes may go unreported (Linnell et al. 1999, Wright and Dolbeer 2005). From January 1990 through October 2019, 494 aircraft strike reports in Mississippi indicated the aircraft struck an "*unknown bird*" species. In addition, some reports provide limited identification information, such as aircraft striking "*sparrows*" or "*blackbirds*" (Federal Aviation Administration 2019). Therefore, additional species were likely involved in airstrikes in Mississippi during this period.

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 Oklahoma, an aircraft struck American white pelicans causing the plane to crash, which killed all five people aboard (Dove et al. 2009). Injuries can also occur to pilots and passengers from bird strikes. Between 1990 and 2017, 239 bird strikes involving civil aircraft have caused 313 injuries to people in the United States, including strikes with vultures, waterfowl, gulls, raptors, egrets, pigeons, robins, doves, blackbirds, sparrows, and owls (Dolbeer and Begier 2019). Globally, wildlife strikes have killed more than 287 people and destroyed more than 263 aircraft from 1988 through November 2018 (Dolbeer and Begier 2019).

It is more common for wildlife-aircraft strikes to result in expensive repairs, flight delays, or aborted aircraft movements than in injury or loss of human life. 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 2017, Federal Aviation Administration records indicate total reported losses from bird strikes cost the civil aviation industry nearly $700 million in monetary losses and greater than 708,000 hours of aircraft downtime (Dolbeer and Begier 2019). These figures are an underestimate of total damage because the number of actual bird strikes is likely to be much greater than that reported. An estimated 80% of civil bird strikes may go unreported (Linnell et al. 1999, Wright and Dolbeer 2005). Between 2004 and 2008, Dolbeer (2009) estimated the Federal Aviation Administration received reports on only 39% of the actual aircraft strikes; therefore, 61% of aircraft strikes went unreported. 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 paying for hotels for passengers, rescheduling aircraft and flight cancellations. In 2017, Dolbeer and Begier (2019) projected the annual cost to the civil aviation industry in the United States from wildlife-aircraft strikes to be a minimum of 71,253 hours of aircraft downtime with $143 million in direct costs and other losses; however, the actual losses may be two or more times higher.

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 taking off and landing. Dolbeer and Begier (2019) found that 71% of commercial aircraft strikes and 73% of general aviation aircraft strikes occurred at less than 500 feet above ground level. For this reason, management of the area immediately surrounding taxiways, runways, and runway approaches is important. Dolbeer and Begier (2019) found the most common bird species involved in strikes reported to the Federal Aviation Administration (when identification of the bird species occurred) from 1990 to 2017 were pigeons/doves (14%), followed by raptors (13%), gulls (11%), shorebirds (9%), and waterfowl (5%). Waterfowl were responsible for 28% of the damage occurring in which the bird type was identified (Dolbeer and Begier 2019).

Doves, pigeons, gulls, raptors, shorebirds, and waterfowl are the most frequently struck bird groups in the United States (Dolbeer and Begier 2019). Their large body size, flocking behavior, and behavioral tendency to loaf in open areas, including on airport runways, makes those species a primary hazard. From January 2000 through October 2019, there have been 28 reports of aircraft striking gulls at airports in Mississippi (Federal Aviation Administration 2019).

Raptors, as well as vultures, present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Of the total known birds struck in the United States from 1990 through 2017, raptors accounted for 13% of reported strikes and 22% of the damage (Dolbeer and Begier 2019). Aircraft have struck numerous raptors, owls, and vultures in the state from January 2000 through October 2019, including American kestrels, bald eagles, red-tailed hawks, black vultures, and turkey vultures (Federal Aviation Administration 2019). Raptors and vultures have a large body size making them capable of causing substantial damage to aircraft. Vultures are one of the most hazardous bird groups for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (DeVault et al. 2011, Dolbeer et al. 2013).

DeVault et al. (2011) concluded that ducks, turkey vultures, herring gulls, great egrets, great blue herons, great-horned owls, wild turkeys, 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). Species of birds that congregate in large flocks or bird species that form large flight lines entering or exiting a roost at or near airports are the most hazardous species.

Additional Human Safety Concerns Associated with Birds

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife, especially around urban areas, has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension can occur, which can lead those species to exhibit threatening or abnormal behavior toward people. This behavior will likely continue to increase as human populations expand. 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.

In addition to raptors, waterfowl can also 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 could occur if waterfowl react aggressively to the presence of those people or pets (Conover 2002). Additionally, slipping hazards can be created by the buildup of feces from birds on docks, walkways, and other foot traffic areas. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

1.4.4 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 can cause damage to property in Mississippi. 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 out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, which can scratch paint and siding.

Property Damage to Aircraft from Bird Strikes

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. Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are one of the most hazardous birds for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000, DeVault et al. 2011, Dolbeer et al. 2013). 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.

Gulls, raptors, waterfowl, and doves/pigeons are the bird groups most frequently struck by aircraft in the United States. Dolbeer and Begier (2019) indicated that damage to an aircraft or a negative effect on the flight was most likely to occur when aircraft strikes occurred with waterfowl (61%), followed by raptors/vultures (39%), gulls (24%), and pigeons and doves (9%). Between 1990 and 2017, over $251 million in reported damages to civil aircraft have occurred in the United States from strikes involving waterfowl (Dolbeer and Begier 2019). Aircraft strikes involving herons, bitterns, and egrets have resulted in nearly $18 million in damages to aircraft (Dolbeer and Begier 2019). In total, aircraft strikes involving birds has resulted in over $698 million in reported damages to civil aircraft from 1990 through 2017 in the United States (Dolbeer and Begier 2019).

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.

The open, grassland habitats of airports and military facilities can provide ideal habitat for many grassland bird species, such as Savannah sparrows. From 1990 through 2017, the Federal Aviation Administration has received 675 reports of aircraft striking Savannah sparrows in the United States causing over $21,000 in damages to aircraft (Dolbeer and Begier 2019). Barn swallows and cliff swallows 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. Between 1990 and 2017, 5,293 reported civil aircraft strikes have occurred in the United States involving barn swallows resulting in 375 hours of aircraft downtime and nearly $89,000 in damages to aircraft (Dolbeer and Begier 2019). Of the 30 bird species identified most frequently as being struck by civil aircraft in the United States, barn swallows ranked fourth from 1990 through 2017 (Dolbeer and Begier 2019). Between 1990 and 2017, 1,750 reported civil aircraft strikes have occurred in the United States involving cliff swallows resulting in 72 hours of aircraft downtime and nearly $286,000 in damages to aircraft (Dolbeer and Begier 2019).

An air facility in Mississippi often requests WS' assistance with reducing threats of aircraft colliding with cliff swallows that nest under bridges near the facility. The bridges are less than two miles from the air facility and nesting cliff swallows use the open space of the airfield to forage. The air facility serves as a flight training facility with a high volume of flights conducted simultaneously. Large concentrations of cliff swallows foraging on the airfield create strike hazards for aircraft, which can cause damage to aircraft and threaten pilot safety. Additionally, fledgling swallows learn to fly in the immediate area of the airfield and they are naïve to aviation traffic, which can make them less likely to avoid oncoming aircraft. Cliff swallows are the species most often struck by aircraft at the air facility. There have been incidents where all aircraft flying has ceased because of the presence of thousands of cliff swallows foraging on the airfield.

In addition, WS often receives requests to remove nests under the bridges to reduce the number of cliff swallows using the airfield. During previous high water events, persistent high water destroyed the cliff swallow nests under the bridges and prevented re-nesting, which reduced the number of swallows using the airfield because they likely dispersed to other areas. Therefore, the removal of nests under the bridges can reduce the number of swallows using the airfield, which would reduce the threat of aircraft strikes.

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 meadowlarks occur at airports in Mississippi. 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 2017, there have been 4,249 reported civil aircraft strikes involving meadowlarks in the United States causing over $1 million in damages (Dolbeer and Begier 2019). From January 1990 through October 2019, 37 reported civil aircraft strikes involving meadowlarks have occurred in Mississippi (Federal Aviation Administration 2019).

Purple martins are colonial and highly social birds during the breeding and migratory periods. When large flocks occur near air facilities, aircraft strike risks can increase. Between 1990 and 2017, there have been 215 reported civil aircraft strikes in the United States involving purple martins resulting in 314 hours of aircraft downtime and $112,000 in damages (Dolbeer and Begier 2019). Similarly, American robins often form large flocks during migration, which can pose aircraft strike risks when they occur on or near airports. Between 1990 and 2017, there have been 1,279 reported civil aircraft strikes in the United States involving robins resulting in 3,964 hours of aircraft downtime and nearly $4.6 million in damages (Dolbeer and Begier 2019). In Mississippi, the Federal Aviation Administration has received reports of four aircraft strikes involving great blue herons (Federal Aviation Administration 2019). Across the United States, great blue herons have been involved with 430 reported aircraft strikes resulting in nearly $8.6 million in damages (Dolbeer and Begier 2019).

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. 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 water front 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. In the United States, some crow roosts may reach a half-million birds (Verbeek and Caffrey 2002). 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.

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

In addition to damage caused by the accumulation of droppings, damage can also 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. 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. Waterfowl can cause damage to landscaping, when they consume or trample flowers, gardens, and lawns (Conover 1991). 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.

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). 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 (Avery et al. 2002*a*, 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 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). Landfills may contribute 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 residents.

Active[7] swallow nests on bridges can hinder maintenance or replacement. The destruction of active nests is a violation of the MBTA without the necessary permits from the USFWS. Therefore, 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 create a safety issue for people. Delays can also result in additional costs if contractors are unable to meet deadlines due to the presence of swallow nests.

1.4.5 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. 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. Direct depredation occurs when predatory bird species feed on other wildlife species, which can negatively influence those species' populations, especially when depredation occurs on threatened and endangered (T&E) species. 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, brood parasitism by brown-headed cowbirds has become a concern for many wildlife professionals where those birds are plentiful. Somewhat unique in their breeding habits, brown-headed cowbirds are known as brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the

[7]Under a memorandum issued in 2003, the United States Fish and Wildlife Service determined the Migratory Bird Treaty Act "…*does not contain any prohibition that applies to the destruction of a migratory bird nest alone (without birds or eggs), provided that no possession occurs during the construction*." Therefore, the United States Fish and Wildlife Service defined an "*active*" nest as a nest that contains birds or eggs.

nests of over 220 species of birds (Lowther 1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species. Young cowbirds often out-compete the young of the host species (Lowther 1993). Due to this, brown-headed cowbirds can have adverse effects on the reproductive success of other species (Lowther 1993), and can threaten the viability of a population or even the survival of a host species (Trail and Baptista 1993).

Crows and gulls consume a variety of food items, including the eggs and chicks of other birds (Verbeek and Caffrey 2002, Pollet et al. 2012, Burger 2015, Nisbet et al. 2017). They are among the most frequently reported avian predators of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). Some of the species listed as threatened or endangered under the ESA are preyed upon or otherwise could be adversely affected by certain bird species. 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 egrets, herons, and osprey also have the potential to impact fish and amphibian populations, especially those of T&E species.

Gulls can also displace other colonial nesting birds (Hunter et al. 2006). European starlings and house sparrows can be aggressive and often out-compete native species, destroying their eggs, and killing nestlings (Cabe 1993, Lowther and Cink 2006). Miller (1975) and Barnes (1991) reported European starlings were responsible for a severe depletion of the eastern bluebird (*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 (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.

Scherer et al. (1995) reported that waterfowl metabolize food very rapidly. Therefore, most of the phosphorus contributed by bird feces into water bodies probably originates from food sources within the lake. In addition, assimilation and defecation converted the phosphorus into a more soluble form; therefore, the phosphorus from fecal droppings was likely 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).

Bird species that roost, nest, and/or loaf in large concentrations can cause damage to natural resources and property because accumulations of fecal droppings can kill vegetation and cause property damage. For example, cattle egrets form gregarious nesting colonies, or heronries, generally in medium to tall upland trees found in woodlands, swamps, and wooded islands adjacent to water. However, proximity to water is not a requirement of egret nesting sites with many heronries located in or near residential areas (Telfair II 2006). The accumulation of guano under heronries can defoliate and kill vegetation (Telfair II 2006). Telfair II and Bister (2004) noted that the composition of vegetation under heronries rapidly changed within two- to three-years after the establishment of a cattle egret heronry in Texas due to large concentrations of feces. Similarly, a study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

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 habitat, 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).

1.4.6 Need to Protect Birds from Oil Spill and Other Hazards

WS could also receive requests for assistance with birds 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, 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 oil.

1.4.7 Roles and Authorities of Other State and Federal Agencies

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

Tennessee Valley Authority

The TVA is a federal corporation created by an Act of Congress in May 18, 1933 [48 Stat. 58-59, 16 USC Sec. 831, as amended]. The TVA provides electricity for business 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 – 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 over 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 to provide assistance with managing wildlife damage on its land and at its facilities.

United States Fish and Wildlife Service Authority

The USFWS is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats. The USFWS shares responsibility with other federal, state, tribal, 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 2018).

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.

Mississippi Department of Wildlife, Fisheries, and Parks

The MDWFP authority in wildlife management is given within the Mississippi Code Annotated Section 49-4-1 et seq., the official regulations of the Commission of Wildlife, Fisheries and Parks and applicable state laws. The mission of the MDWFP is to conserve, manage, develop, and protect the natural resources and wildlife in the state. The mission of the MDWFP is to "…*conserve and enhance Mississippi's wildlife, fisheries, and parks, provide quality outdoor recreation, and engage the public in natural resource conservation*" (MDWFP 2018*a*).

Mississippi Department of Agriculture and Commerce

The Pesticide Program within the Bureau of Plant Industry of the Mississippi Department of Agriculture and Commerce (MDAC) enforces state laws pertaining to the use and application of pesticides. The Mississippi Pesticide Application Act (Sections 69-23-101 through 69-23-133) regulates the use of pesticides in a variety of pest management situations. The Act also licenses private and commercial pesticide applicators and pesticide contractors. Under the Mississippi Pesticide Law (Section 69-23-1 through 69-23-27), the program licenses restricted use pesticide dealers and registers all pesticides for sale and distribution in the State of Mississippi.

1.4.8 State and Federal 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 are highly relevant to the WS program 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.

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 alternatives in regards to the ESA will occur in Section 3.2.2 of this EA.

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.

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 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 MDWFP has the authority to manage wildlife populations in the State of Mississippi.

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

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to 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 cause 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 blackbird species that WS could lethally remove pursuant to the blackbird depredation order that are addressed in this EA include American crows, red-winged blackbirds, Brewer's blackbirds, common grackles, and brown-headed cowbirds.

Control Order for Muscovy Ducks (50 CFR 21.54)

Muscovy ducks are native to South America, Central America, and Mexico with a small naturally occurring population in southern Texas. Muscovy ducks have also been domesticated and have been sold and kept for food and as pets in the United States. In many states, Muscovy ducks have been released or escaped captivity and have formed feral populations, especially in urban areas, that are non-migratory. The USFWS has issued a Final Rule on the status of the Muscovy duck in the United States (75 FR 9316-9322). Because naturally occurring populations of Muscovy ducks are known to inhabit parts of south Texas, the USFWS has included the Muscovy duck in the list of bird species afforded protection under the MBTA at 50 CFR 10.13 (75 FR 9316-9322). To address damage and threats of damage associated with Muscovy ducks, the USFWS has also established a control order for Muscovy ducks under 50 CFR 21.54 (75 FR 9316-9322). Under 50 CFR 21.54, Muscovy ducks, and their nests and eggs, may be removed or destroyed without a depredation permit from the USFWS at any time in the United States, except in Hidalgo, Starr, and Zapata Counties in Texas (75 FR 9316-9322).

Federal Insecticide, Fungicide, and Rodenticide Act

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

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 a reasonable effort has been made to protect the items and the proper authority has been notified.

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

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

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

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

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

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 damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. 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.

1.4.9 Areas Where WS' Activities could Occur

Damage or threats of damage caused by those bird species identified in Section 1.2 and Appendix E can occur statewide in Mississippi wherever those species of birds occur. However, WS would only provide assistance when the appropriate landowner or manager requested such assistance and only on properties where WS and the appropriate landowner or manager has signed a MOU, work initiation document, or another similar document. Most species of birds addressed in this EA are capable of utilizing a variety of habitats and occur statewide where suitable habitat exists for foraging, loafing, roosting, and nesting. In addition, many of the bird species occur throughout the year in the state. Because several bird species addressed in this EA occur statewide, requests for assistance to manage damage or threats of damage could occur in areas of the state occupied by those bird species.

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, nuclear, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, on ship fleets, military bases, or at any other sites where birds may roost, loaf, or nest. 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 (see Section 1.4.1). Therefore, the geographic scope of the actions and analyses in this EA is statewide and this EA analyzes actions that could occur on federal, state, county, city, and private lands, when requested.

CHAPTER 2: ISSUES AND ALTERNATIVES

The WS program in Mississippi has identified a need for action based on requests for assistance that WS receives to manage damage caused by birds in the state (see Section 1.4). The TVA has identified a need to manage damage or threats of damage caused by bird species on property they own or manage in the state (see Section 1.4.1). WS and the TVA have identified several issues associated with the activities that WS could implement to meet that need for action. 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 the implementation of alternative approaches to meet the need for action. Section 2.1.1 discusses issues carried forward for further analysis in Chapter 3. Section 2.1.2 discusses additional issues that WS and the TVA identified; however, the EA does not analyze those issues further in Chapter 3 for the reasons provided in Section 2.1.2.

WS and the TVA developed four alternative approaches to meet the need for action that Section 1.4 of this EA identifies and to address the identified issues discussed in Section 2.1. Section 2.2.2 discusses the four alternative approaches that WS could implement to meet the need for action. Section 2.2.3 discusses alternatives 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 ASSOCIATED WITH MEETING THE NEED FOR ACTION

Chapter 3 analyzes several issues in detail for their potential direct and indirect impacts on the human environment. WS and the TVA identified those issues based on experience, previous EAs developed by WS, and public comments on those EAs. Chapter 3 discusses the issues as they relate to the possible implementation of the alternative approaches to meeting the need for action discussed in Section 1.4. WS and the TVA evaluated, in detail, the following issues.

2.1.1 Issues Analyzed Further in Chapter 3

This section describes the issues that WS and the TVA identified during the scoping process for this EA. Section 3.2 analyzes the environmental consequences of each alternative in comparison to determine the extent of actual or potential impacts on the issues.

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

A common issue when addressing damage caused by wildlife is the potential impacts of management actions on the populations of target species. Methods available to alleviate bird damage or threats of damage are either non-lethal or lethal methods. Non-lethal methods available can 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. The number of individuals from a target species that WS could remove from a population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, and the efficacy of methods employed.

The 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. The WS program in Mississippi would monitor the annual take of target bird species by comparing the number of birds lethally removed with overall populations or trends. WS' personnel would only use lethal methods at the request of a cooperator seeking assistance. In addition, the lethal take of those migratory bird species protected pursuant to the MBTA would only occur after the USFWS authorized the take. For those bird species not protected by the MBTA that are managed by the MDWFP (*e.g*., wild turkeys), lethal take by WS would only occur when authorized by the MDWFP.

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

Section 3.2.1 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

People can monitor bird populations by using trend data derived from bird observations collected during the BBS. During the BBS, observers count birds at established survey points along roadways for a set duration along a pre-determined route. In the United States and Canada, survey routes are 24.5 miles long with the observer stopping every 0.5 miles along the route to conduct the survey. The observer records the number of birds observed and heard within 0.25 miles of each of the survey points during a 3-minute sampling period at each point. A survey along the route occurs once per year. Surveys first occurred in 1966 and occur in June, which is generally the period of time when those birds present at a location are likely breeding in the immediate area. The BBS occurs annually in the United States and Canada, across a large geographical area, under standardized survey guidelines. The BBS is a large-scale inventory of North American birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (United States Geological Survey 2019). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. 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

Numerous 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. Researchers have found that population trends reflected in CBC data tend to correlate well with those from censuses taken by more stringent means (National Audubon Society 2010).

PARTNERS IN FLIGHT LANDBIRD POPULATION ESTIMATE

The intent of the BBS is to monitor bird population trends, but it is also possible to use BBS data to develop a general estimate of the size of bird populations (Will et al. 2018). Using relative abundances derived from the BBS conducted from 2006 through 2015, the Partners in Flight (2019) 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. 2018). 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 (2019) makes assumptions on the detectability of birds, which can vary for each species (see Will et al. 2018). 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. 2018).

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 MDWFP implements in the state. Those bird species addressed in this EA that have established hunting seasons include mourning dove, wild turkeys, northern bobwhite, American crow, wood ducks, blue-winged teal, snow geese, gadwalls, mallards, green-winged teal, ring-necked ducks, greater scaup, American coots, and Wilson's snipe. In addition, people can harvest Eurasian collared-doves during the annual hunting season for mourning doves.

For crows, take can also occur under the blackbird depredation order established by the USFWS pursuant to the MBTA. Therefore, the take of crows can occur during annual hunting seasons and under the blackbird depredation order that allows people to take crows to alleviate damage and to alleviate threats of damage. For many migratory bird species considered harvestable during a hunting season, the USFWS and/or the MDWFP estimates the number of birds harvested during the season.

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

The potential for effects on non-target species and threatened or endangered species arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. 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 3.2.2 discusses in further detail.

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 were legally available, selective for target species, and were effective at resolving the damage associated with the target species. Still, some concerns exist regarding the safety of methods despite their legality, selectivity, and effectiveness. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public and employees of WS. Section 3.2.3 further evaluates the risks to human safety as this issue relates to the alternative approaches.

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 3.2.4 will discuss concerns regarding the humaneness of available methods and animal welfare concerns.

2.1.2 Issues Considered But Not Analyzed Further in Chapter 3 for the Reasons Provided

WS and the TVA identified additional issues during the scoping process of this EA. WS and the TVA 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.

Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 2.2.2 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 2.2.2 do not involve major ground disturbance, construction, or habitat alteration. Activities that WS could conduct during implementation of those alternative approaches discussed in Section 2.2.2 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 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, and WS Directive 2.627.

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. Occasionally, WS' personnel could use lead ammunition in rifles, handguns, air rifles, and shotguns[8].

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove birds lethally. 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 21.41. The depredation order for blackbirds (see 50 CFR 21.43(b)) 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

[8]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.

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 misses occurred, 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 8 inches). There is concern 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 further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e.*, requiring action to treat the water to remove lead). The study found that the dissolution (*i.e.*, capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments, 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.

Because the take of birds could occur by other entities when authorized by the USFWS and/or the MDWFP, 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, further reducing 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 and when targeting blackbirds pursuant to the blackbird depredation order, only non-toxic shot would be used by WS pursuant to 50 CFR 20.21(j). Additionally, WS may utilize non-toxic ammunition in rifles, air rifles, and handguns as the technology improves and ammunition becomes more effective and available.

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. 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. The Federal Aviation Administration anticipates issuing final test reports on alternative fuels to replace aviation gasoline that contain lead additives by mid-2020 (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[9]. Similarly, label requirements for 4-Aminopyridine (Avitrol) may include not placing treated bait directly in water,

[9]DRC-1339 is an avicide available to manage damage associated with pigeons, crows, blackbirds, starlings, and gulls in certain locations (*e.g*., feedlots, blackbird staging areas) using certain bait types (*e.g*., cracked corn, brown rice).

not using treated bait within 25 feet of permanent bodies of water, and not contaminating water when cleaning of equipment or disposing of waste[10].

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 MDWFP. 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, the WS program in Mississippi and the TVA do not expect that implementing any of the alternative approaches discussed in Section 2.2.2 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.

Greenhouse Gas Emissions by the WS Program

Under the alternative approaches intended to meet the need for action discussed in Section 2.2.2, the WS program in Mississippi could potentially produce criteria pollutants (*i.e.*, pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, travel at field locations (vehicles or all-terrain vehicles), and from other work-related travel (*e.g.*, attending meetings). During evaluations of the national program to manage feral swine (*Sus scrofa*), the WS program reviewed greenhouse gas emissions for the entire national WS program (see pages 266 and 267 in USDA 2015*b*). The analysis estimated effects of vehicle, aircraft, office, and all-terrain vehicle use by WS for federal fiscal year (FY) 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by feral swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended by CEQ for actions requiring detailed review of impacts on greenhouse gas emissions. The activities that WS could conduct under the alternative approaches discussed in Section 2.2.2 would have negligible cumulative effects on atmospheric conditions, including the global climate.

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, carbon dioxide for euthanasia, and some components associated with ammunition (*e.g.*, black powder, shot) and pyrotechnics (*e.g.*, black powder, cardboard), no irreversible or irretrievable commitments of resources result from the WS program.

[10]4-Aminopyridine is the active ingredient of Avitrol. Avitrol is a flock dispersal method available for public use to manage damage associated with house sparrows, red-winged blackbirds, Brewer's blackbirds, common grackles, brown-headed cowbirds, European starlings, rock pigeons, American crows, laughing gulls, ring-billed gulls, and herring gulls.

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. The WS program in Mississippi would only provide direct operational assistance if WS implements Alternative 1 or Alternative 2 (see Section 2.2.2). 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 MOU, work initiation document, work plan, or a similar 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, the WS program in Mississippi 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, MOUs, 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 2.2.2 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.

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

Another issue often raised is that the dispersal of birds from a roost location to alleviate damage or conflicts at one site could result in new damage or conflicts at a new roost site. While the original complainant may see resolution to the bird problem when the roost is dispersed, the recipient of the bird roost may see the bird problem as imposed on them. Thus, overall, there is no resolution to the original bird problem (Mott and Timbrook 1988). Bird roosts usually are dispersed using a combination of harassment methods including pyrotechnics, propane cannons, effigies, and electronic distress calls (Avery et al. 2008*a*, Chipman et al. 2008, Seamans and Gosser 2016). A similar conflict could develop when habitat alteration was used to disperse a bird roost. This concern would be heightened in large metropolitan areas where the likelihood of birds dispersed from a roost, finding a new roost location, and not coming into conflict would be very low. WS has developed alternatives to minimize the potential of dispersing bird roosts in urban/suburban areas by evaluating a management option to depopulate a bird roost.

In urban areas, WS would often work with the community or municipal leaders to address bird damage involving large bird roosts that would likely be affecting several people; therefore, WS often consults not only with the property owner where roosts 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 roosts that relocated to other areas to be addressed 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 and the TVA did not consider this issue further.

2.2 DESCRIPTION OF THE ALTERNATIVES

Section 2.2 discusses those alternative approaches that WS and the TVA identified during the initial scoping process for this EA. WS and the TVA developed the alternative approaches based on the need for action. The need for action identified by WS is associated with requests for assistance that WS receives to manage damage and threats of damage caused by birds in Mississippi (see Section 1.4). The TVA has identified a need to manage damage or threats of damage caused by bird species on property they own or manage in the state (see Section 1.4.1). WS and the TVA also developed the alternative approaches to address those issues identified in Section 2.1.

Section 2.2.1 addresses actions that would be common to all of the alternatives. Section 2.2.2 discusses those alternative approaches WS and the TVA considered in detail within Chapter 3 of this EA. Chapter 3 analyzes the environmental consequences of each alternative as that alternative relates to the identified issues. Section 2.2.3 discusses additional alternative approaches that WS and the TVA identified but this EA will not analyze those alternative approaches in detail within Chapter 3 for the reasons provided in the description of each alternative.

2.2.1 Actions Common to the Alternatives

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 2.2.2.

WS' Co-managerial Approach to Making Decisions

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

If a person and/or entity requested assistance from WS and WS was able to provide assistance, the WS program in Mississippi 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 the local community would be officials or representatives of the communities that residents of a community have elected to represent them. The elected officials or representatives would be people who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. In the case of private property owners, the decision-maker would be the individual that 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.

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. All of 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 and the aversive conditioning egg treatment referred to as mesurol, which are currently only available for use by WS. Therefore, despite the level of involvement by the WS program in Mississippi, 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.

Effectiveness of Methods to Address Damage and Threats of Damage

Defining the effectiveness of any 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 risks or damages. To determine that effectiveness, WS must be able to complete management actions expeditiously to minimize harm to non-target animals and the environment, while at the same time, using methods as humanely as possible. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of people using the method and, for WS' personnel, the guidance provided by WS' directives and policies. For any management methods employed, the proper timing is essential in effectively dispersing those birds causing damage. Employing methods soon after damage begins or soon after identifying damage threats increases the likelihood that those damage management activities would achieve success in addressing damage. Therefore, coordination and timing of methods is necessary to be effective in achieving expedient resolution of bird damage.

WS is considering several methods (see Appendix B) that WS' personnel could incorporate into alternative approaches (see Section 2.2.2) 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 2.2.2), 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*b*) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Non-lethal methods have been effective in dispersing crow roosts (Gorenzel et al. 2000, Chipman et al. 2008), including the use of crow effigies (Avery et al. 2008*a*), lasers (Gorenzel et al. 2002), and electronic distress calls (Gorenzel and Salmon 1993). Chipman et al. (2008) found the use of only non-lethal methods to disperse urban crow roosts often requires a long-term commitment of affected parties, including financial commitments, to achieve and maintain the desired result of reducing damage.

The 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 has been successful in reducing bird damage (Boyd and Hall 1987, 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. Similarly, the use of DRC-1339 can 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.

Often of concern with the use of lethal methods is that birds that are lethally taken would only be replaced by other birds either during the application of those methods (from other birds that immigrate into the area) or by birds the following year (increase in reproduction that could result from less competition). 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 2 to 8 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 increased despite the use of non-lethal methods each year. Despite the need to re-apply non-lethal methods annually, the return of birds to roost locations previously dispersed, and the number of crows increasing annually at some roosts, Chipman et al. (2008) determined the use of non-lethal methods could be effective at dispersing urban crow roosts in New York. Avery et al. (2008*a*) found similar results during the use of crow effigies and other non-lethal methods to disperse urban crow roosts in Pennsylvania. Crows returned to roost locations in Pennsylvania annually despite the use of non-lethal methods and effigies (Avery et al. 2008*a*). Gorenzel et al. (2002) found that crows returned to roost locations after the use of lasers. Therefore, the use of both lethal and non-lethal methods may require repeated use of those methods.

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 how effective a method or methods were during previous requests for assistance and/or how effective methods were when used by those entities experiencing damage or threats of damage. When using methods, WS' personnel would continue to evaluate method effectiveness during the use of those methods. 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 the 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 and the TVA are considering. In addition, the CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA.

Research Methods and Information on the Life History of Birds

Under any of the alternatives, the national WS program would continue to research and develop methods to address bird damage through the National Wildlife Research Center (NWRC). The NWRC functions as the research unit of WS by providing scientific information and by developing methods to address damage caused by animals. Research biologists with the NWRC work closely with 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 NWRC is aviation safety and reducing risks of aircraft striking birds at airports and military facilities. In addition, the NWRC could conduct research to understand the life history of bird species, such as migration routes and feeding habits.

Authorization of Migratory Bird Take by the USFWS

As noted in Section 1.4.8, 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 turkey) and non-native species (*e.g*., domestic waterfowl, house sparrows, European starlings). Pursuant to 50 CFR 21.41, "…*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 process. 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 21.43). Section 1.4.8 discusses the depredation and control orders that could apply to WS' activities.

Authorization of Take by the MDWFP

WS may also need authorization from the MDWFP to address damage and threats of damage caused by certain bird species. For example, WS may need authorization from the MDWFP to live-capture and translocate wild turkeys to alleviate damage or threats of damage.

Influence of Global Climate Change on Bird Populations

The State of the Climate in 2012 report indicates that every year has been warmer than the long-term average since 1976 (Blunden and Arndt 2013). Impacts of this change will vary throughout the United States, but some areas could experience air and water temperature increases, alterations in precipitation, and increased severe weather events. Temperature and precipitation often influence the distribution and abundance of a plant or animal species. According to the EPA (2016), as temperatures continue to increase, the ranges of many species will likely expand into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g.*, less snowfall, range expansions of other species). 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 in 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 the WS program selected an alternative approach to meeting the need for action that allows the program in Mississippi to provide assistance (see Section 2.2.2), 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 there is a new need for action, changed conditions, new issues, or new alternatives 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 a 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 MDWFP. Therefore, WS' activities would only occur when authorized by the USFWS and/or the MDWFP, when required, and take would not exceed the levels authorized. WS would submit activity reports to the USFWS and/or the MDWFP, when required, so the USFWS and/or the MDWFP had 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 MDWFP 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, the WS program in Mississippi 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.

2.2.2 Alternatives Carried Forward for Further Analysis in Chapter 3

As discussed in Section 1.2 and Section 1.4, 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. The WS program is the lead federal agency responsible for managing conflicts between people and wildlife (see Section 1.2); therefore, people could request assistance from WS, including the TVA. WS and the TVA identified four alternative approaches to meeting the need for action that also address the issues identified in Section 2.1. Section 2.2.2 describes those alternative approaches identified by WS and the TVA and provides a description of how WS would implement those approaches.

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

If WS implements Alternative 1, the WS program in Mississippi 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 MOU, work initiation document, or another comparable document. Funding for WS' activities could occur from state and/or federal appropriations and/or from cooperative service agreements with an entity requesting WS' assistance. WS' activities to manage damage associated with birds in Mississippi would comply with WS Directive 2.301.

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, 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. Similarly, 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. Similarly, the MDWFP may also require authorization before conducting activities that lethally remove or captures a target bird species. Many non-native species, such as rock pigeons, European starlings, and house sparrows, do not require authorization from the USFWS or the MDWFP to use lethal methods or live-capture methods.

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 in a cost-effective[11] manner while minimizing the potentially harmful effects on people, target and non-target species, and the environment. Therefore, 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 - The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi 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 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 inactive nest destruction, 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 to conduct surveillance and monitoring of bird populations in the state. 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 MDWFP, 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. The USFWS could continue to authorize the lethal take of migratory birds protected by the MBTA and the MDWFP could authorize the lethal take of resident bird species, such as wild turkeys and northern bobwhite.

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

Alternative 3 - The WS program would recommend an integrated methods approach to managing bird damage in Mississippi 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 available and appropriate methods available. The implementation of methods and techniques to alleviate or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g*., loaning of propane cannons). Similar to 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, state and county agents, 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 and mesurol, which are currently only available for use by WS.

Those entities seeking assistance with reducing damage could seek direct operational assistance from other governmental agencies, private entities, or conduct activities on their own. In situations where non-lethal methods were ineffective or impractical, WS could advise the property owner or manager of appropriate lethal methods to supplement non-lethal methods. In addition, WS' personnel would also advise the property owner or manager of the potential need to seek authorization from the USFWS and/or the MDWFP to take target bird species, such as the need to apply for a depredation permit from the USFWS to take migratory birds.

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. 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 damages or risks, the number of birds involved, and recommended methods to alleviate damage (see 50 CFR 21.41 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 – The WS program would not provide any assistance with managing damage caused by birds in Mississippi

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 MDWFP and/or to private entities. This alternative would not prevent other federal, state, 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 agencies and private entities to manage damage and threats associated with birds. The only methods discussed in Appendix B that would not be available for other entities to use would be the avicide DRC-1339 to alleviate damage associated with red-winged blackbirds, Brewer's blackbirds, American crows, rock pigeons, common grackles, brown-headed cowbirds, and gulls and the chemical repellent mesurol for crows.

2.2.3 Alternatives Considered But Not Analyzed Further In Chapter 3 for the Reasons Provided

In addition to those alternatives discussed in Section 2.2.2, WS and the TVA identified several additional alternative approaches to meeting the need for action. However, those alternatives will not receive detailed analysis in Chapter 3 for the reasons provided for each alternative. Those alternatives 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 methods 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 and the TVA 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 was sufficient to warrant harassing 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 harassing 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). In 1988, 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 (Stickley and Andrews 1989). 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.

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[12] 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 and the TVA 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*b*, 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 and the TVA 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.

[12]Farm gate is the price of goods if someone purchased those products directly from a farm (*i.e.*, no markup added by retailers).

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 damages 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 and the TVA 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 and the TVA 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 managing wildlife and wildlife damage increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall. Therefore, WS and the TVA 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 and the TVA did not carry this alternative forward for further analysis.

Trap and translocate birds only by WS

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods. Birds could be live-captured using live-traps, cannon nets, rocket nets, bow nets, net guns, mist nets, or hand-capture. All birds live-captured through direct operational assistance by WS would be translocated. Prior to live-capture, 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 MDWFP. For example, WS would need prior approval from the MDWFP 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, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. In addition, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (*e.g.*, urban crow roosts); therefore, translocation would be unrealistic in those circumstances. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, the potential for disease transmission, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988, Craven et al. 1998, Massei et al. 2010). Therefore, WS and the TVA did not consider this alternative in detail.

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

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

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

If a reproductive inhibitor becomes available to manage a large number of bird populations and proven effective in reducing localized bird populations, WS could evaluate the use of the inhibitor as a method available under the alternatives. 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 Mississippi, a formulation of nicarbazin is available under the trade name of OvoControl® P (Innolytics, LLC, San Clemente, 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, 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 alternatives. Section 3.1 provides further discussion on how WS and the TVA will evaluate significance as it relates to the NEPA. To determine if the real or potential effects are greater, lesser, or the same as the environmental baseline, Section 3.2 compares the environmental consequences associated with each of the four alternatives. A discussion occurs on the cumulative and unavoidable impacts, including direct and indirect effects, in relation to the issues for each of the alternatives. 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 occur later in time or further removed in distance, and are still reasonably foreseeable, are indirect effects. The analyses discuss the cumulative effects in relationship to each of the alternatives 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 EVALUATION OF SIGNIFICANCE

Section 3.2 evaluates the direct, indirect, and cumulative impacts associated with implementation of the four alternatives under each of the issues. The NEPA describe the elements that determine whether an impact is "*significant*". Significance is dependent upon the context and intensity of the action. When reviewing the context and intensity of the four alternatives, WS and the TVA considered the magnitude of the impact, the duration/frequency of the action, the likelihood of the impact, the geographic extent, the legal status, and conforming to statutes, regulations, and policies.

3.1.1 Magnitude of the Impact

The basis for determining the magnitude of an impact is the size, number, or relative amount of the impact (intensity). For example, the analysis that occurs in Section 3.2 measures the number of birds that WS could lethally remove annually in relation to the abundance of those bird species to determine the magnitude of impact to those species' populations from the lethal removal of those birds. Magnitude may be determined either quantitatively or qualitatively. Determinations based on population estimates, allowable harvest levels, and actual harvest data would be quantitative. Determinations based on population trends and harvest trend data would be qualitative.

3.1.2 Duration and Frequency of the Action

The duration and frequency of the impact relates to factors, such as, is the impact temporary, seasonal, or ongoing throughout the year (intensity). The duration and frequency of activities associated with the alternatives would be highly variable. Abiotic and biotic factors affecting bird behavior would affect the duration and frequency of activities conducted by WS if WS implemented any of the alternative approaches. Although activities may involve programs of long duration, the frequency of individual activities within the program may be highly variable depending upon spatial, temporal, and biotic factors affecting the behavior of target bird species that are causing damage. For instance, some requests for assistance are associated with birds that nest further north but spend the winter in Mississippi or pass through Mississippi to wintering areas before they migrate back northward in the spring to nest. Therefore, some activities that could occur if WS implemented Alternative 1, Alternative 2, or Alternative 3 would occur in the fall, winter, and early spring when the number of birds present in the state increases. Projects involving damage management activities at individual sites are generally of short duration but may happen frequently at different sites.

3.1.3 Likelihood of the Impact

This factor can relate to the likelihood that there would be a need for a particular damage management action, and to the likelihood that an impact may occur because of a damage management action. For example, most requests for assistance that WS receives in Mississippi involve risks of aircraft striking birds at air facilities; therefore, the likelihood that WS could address a bird species to alleviate aircraft strike risks may be relatively high. WS receives very few requests for assistance involving accumulations of fecal droppings causing damage to property in Mississippi; therefore, the need to address birds to alleviate property damage caused by fecal accumulations may be much lower.

3.1.4 Geographic Extent

If WS implemented Alternative 1, Alternative 2, or Alternative 3, WS would continue to provide assistance in areas of Mississippi where people request assistance and, when applicable, agreements for activities are in place. Because most requests for assistance are associated with predation on aquaculture resources and aircraft strike risks, most activities would occur at aquaculture farms and airports/military facilities in the state. Mississippi encompasses about 46,923 square miles of land area (United States Census Bureau 2010), which equates to approximately 30 million acres. However, agreements to conduct activities to manage damage associated with birds comprise a small portion of the land area in the state and not all properties where people request assistance may need assistance with birds in any given year. From FY 2014 through FY 2018, WS conducted activities associated with birds on less than 1% of the total land area of the state annually.

3.1.5 Legal Status

The legal status of an affected resource would be a contextual consideration. Legal status may range from protected by federal law or state law to no protection. In addition to the NEPA, several state and federal regulations would be relevant to activities that WS could conduct when providing assistance (see Section 1.4.8). For example, the MBTA protects migratory birds from take. In another example, federal law protects species of wildlife and plants listed as threatened or endangered pursuant to the ESA.

3.1.6 Complying with Statutes, Regulations, and Policies

Statues, regulations, and policies provide contextual information in the analysis. Compliance with applicable statutes, regulations, and policies can also serve as mitigation to ensure that certain types of adverse effects on the environment do not occur.

3.2 ENVIRONMENTAL CONSEQUENCES BY ISSUE ANALYZED IN DETAIL

WS and the TVA developed alternative approaches (see Section 2.2.2) to meet the need for action identified in Section 1.4 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 TVA, the USFWS, the MDWFP, and the MDAC.

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

Maintaining viable populations of native species is a concern of the public and of biologists within state, tribal, and federal wildlife and land management agencies, including WS. If WS implemented Alternative 1, Alternative 2, or Alternative 3, the WS program in Mississippi 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 Mississippi when someone requests such assistance. If WS implemented Alternative 4, WS would not conduct any activities in Mississippi 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.

- **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 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 (United States Geological Survey 2013). The low and high refer to the potential of the viruses to kill domestic poultry (United States Geological Survey 2013). In wild birds, low pathogenic avian influenza rarely causes signs of illness and it is not an important mortality factor (Davidson and Nettles 1997, Clark and Hall 2006). In contrast, high pathogenic avian influenza has caused clinical signs and killed large numbers of wild birds in China (United States Geological Survey 2013). 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, United States Geological Survey 2013).

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 a highly pathogenic avian influenza virus in wild birds in North America (United States Geological Survey 2015*a*). The detection of the highly pathogenic avian influenza virus in North America coincided with the detection of the virus in poultry across the western and central United States (USDA 2015*c*). 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 that agencies sampled as part of monitoring efforts (Bevins et al. 2016). Although mortality events involving highly pathogenic avian influenza virus have occurred in waterfowl, there have been no reports of major waterfowl die-offs from the virus. In addition, no reports of major die-offs of other bird species have occurred. Therefore, there is no evidence to suggest that the avian influenza virus is or will have an effect on bird populations. As stated previously, most strains of avian influenza do not cause severe illnesses or death in wild bird populations.

➢ **Population Impact Analyses of the Alternatives - Direct, Indirect, and Cumulative Effects**

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 geographically. Indirect effects may include impacts related to actions that induced changes in population density, ecosystems, and land use changes. Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time. The potential cumulative impacts analyzed below would occur from either WS' damage management program activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities.

As discussed in Section 1.4.7, the USFWS and/or the MDWFP are the federal and state entities responsible for managing those bird species addressed in this EA. Through ongoing communication with the USFWS and the MDWFP, WS can consider the activities of other agencies and private entities to the extent that those agencies know those activities occur. WS does not typically conduct direct damage management activities concurrently with other federal, state, or private entities at a location, but may conduct damage management activities at adjacent sites within the same period.

WS' actions would be occurring simultaneously over time with other natural processes and human generated changes that are currently taking place. These activities include, but are not limited to

- Natural mortality of birds
- Human-induced mortality through vehicle strikes, aircraft strikes, and illegal take
- Human-induced mortality of birds through private damage management activities
- Human-induced mortality through regulated harvest
- Human and naturally induced alterations of wildlife habitat

- Annual and perennial cycles in wildlife population densities

All those factors play a role in the dynamics of bird populations. 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, in order to avoid cumulative adverse impacts on target species.

With management authority over bird populations, the USFWS and/or the MDWFP 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 MDWFP had the opportunity to consider the activities conducted by WS. As stated previously, WS would not use or recommend those lethal methods available as population management tools over broad areas. WS would use and recommend lethal methods to reduce the number of birds present at a location where damage was occurring by targeting those birds causing damage or posing threats; therefore, the intent of lethal methods would be to manage those birds causing damage and not to manage entire bird populations.

Because take of most bird species can only legally occur when authorized by the USFWS and/or the MDWFP, the USFWS and the MDWFP can consider take when determining population objectives for those bird species. Therefore, the USFWS and/or the MDWFP 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 MDWFP. Any bird population declines or increases induced through the regulation of take would be the collective objective for bird populations established by the USFWS and/or the MDWFP.

As discussed previously, the analysis for magnitude of impact from lethal take can 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, published literature, and harvest data. The potential impacts of conducting the alternatives on the populations of target bird species occurs below for each alternative.

Alternative 1 - The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi (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 sign a MOU, work initiation document, or a similar 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.

A common concern is whether damage management actions would adversely affect the population of a target bird species, especially when WS and other entities use 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 but 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).

Therefore, 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 WS' personnel could use lethal methods to remove an individual bird or a group of birds to alleviate damage. WS would only target an individual bird or a group of birds identified as causing damage or posing a threat to human safety. Therefore, if WS implemented Alternative 1, WS could lethally remove birds, which could potentially have direct, indirect, and cumulative effects on the populations of target bird species. WS would only take migratory bird species protected by the MBTA when authorized by the USFWS and only at authorized levels. Similarly, WS would only take resident bird species when authorized by the MDWFP and only at authorized levels.

A lethal method that WS could employ would be the destruction of active and inactive nests of target bird species. 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 a depredation permit from the USFWS. People often use nest destruction to alleviate damage associated with the nesting activities and/or to discourage nesting in an area where damages occur or could occur. Many bird species have the ability to identify areas with regular human disturbance and low reproductive success and they will relocate to nest elsewhere when confronted with repeated nest failure. 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.

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. If WS' personnel encounter eggs and/or nestlings in an active nest, WS could destroy the eggs by puncturing the eggs, oiling the eggs, shaking the eggs, or by breaking the eggs open. If WS' personnel encountered nestlings in an active nest, WS' personnel would euthanize those nestlings in accordance with WS Directive 2.505. For the purposes of the analysis, WS will consider nestlings euthanized as part of the cumulative take of a target bird species.

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. The number of birds removed from a population using lethal methods would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, and the efficacy of methods employed. WS' personnel would only target the bird or birds that they identify as responsible for causing damage or posing a threat of damage. The potential impacts on the populations of target bird species from the implementation of Alternative 1 occurs below.

DOMESTIC 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 the birds with no regard or understanding of the consequences that releasing them 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 they often do not resemble that of the wild mallard. Urban mallard ducks 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 Mississippi. 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 Mississippi. Federal and state laws do not protect domestic and feral fowl from take and neither the USFWS nor the MDWFP 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 Mississippi. 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 Mississippi. The USFWS has revised 50 CFR 21.14 (permit exceptions for captive-bred migratory waterfowl other than mallards), 50 CFR 21.25 (waterfowl sale and disposal permits), and has added 50 CFR 21.54, 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. 1997). 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. 1997). 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. 1997). 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.

In FY 2012, WS captured 41 Muscovy ducks using corral traps. In FY 2015, WS captured six Muscovy ducks using live-capture methods. After live capturing those Muscovy ducks, WS euthanized those ducks using carbon dioxide. WS did not conduct activities involving domestic waterfowl in the state from FY 2013 through FY 2014 and from FY 2016 through 2018. The number of feral waterfowl or other fowl addressed by other entities in the state is currently unknown. The reporting of feral fowl take is not currently required.

Based on previous efforts to alleviate the threat of damage associated with feral fowl and in anticipation of an increase in the number of requests received by WS annually, WS could lethally remove up to 200 feral fowl annually in the state. In addition, WS could destroy up to 100 feral fowl nests (including eggs) annually, when requested. The number of feral waterfowl and other fowl present in the state is currently unknown; however, because feral fowl often compete with native wildlife species for resources, any reduction of the feral fowl population in the state, even to the extent of complete eradication from the natural environment, could provide some benefit.

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 2014). 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 2014). Rock pigeons are non-migratory and they are closely associated with people, where human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994, Lowther and Johnston 2014). Thus, pigeons commonly occur around city buildings, bridges, parks, farmyards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994, Lowther and Johnston 2014). 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, Lowther and Johnston 2014).

In Mississippi, pigeons occur statewide throughout the year and are a common resident of the state (Turcotte and Watts 1999, Lowther and Johnston 2014). The number of rock pigeons observed along routes surveyed during the BBS in the state have shown a decreasing trend since 1966, which has been estimated at -1.1% annually, with a -0.7% annual decline from 2007 through 2017 (United States Geological Survey 2019). Based on data from the BBS, the Partners in Flight (2019) estimated the statewide breeding population at 45,000 rock pigeons. The number of rock pigeons observed in areas of the state surveyed during the CBC is showing a general increasing trend in the state since 1966 (National Audubon Society 2010).

Table 3.1 shows the number of rock pigeons dispersed or lethally removed by WS in Mississippi to alleviate damage and threats from FY 2014 through FY 2018. Since FY 2014, WS has employed non-lethal hazing methods to disperse an average of 10 rock pigeons per year in the state to address requests for assistance to manage damage. WS addressed rock pigeons using non-lethal harassment methods, such as vehicle activity and the noise associated with the discharge of a firearm. The WS program in Mississippi also used lethal methods to remove rock pigeons that employees identified as causing damage or the threat of damage. From FY 2014 through FY 2018, WS lethally removed an average of 118 rock pigeons per year in the state to alleviate damage or threats of damage. The highest annual take of rock pigeons by WS in the state occurred during FY 2014 when WS lethally removed 475 rock pigeons in the state to alleviate damage or threats of damage. From FY 2014 through FY 2018, the lethal take of rock pigeons by WS occurred from the use of firearms and euthanasia after live-capture in cage traps and decoy traps.

Table 3.1 – Rock pigeons addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	475	6
2015	56	24
2016	10	2
2017	45	14
2018	4	2

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 3,000 rock pigeons annually and up to 100 nests annually to alleviate damage or threats throughout the state. Based on a breeding population estimated at 45,000 pigeons, take of up to 3,000 pigeons by WS would represent 6.7% 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, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

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

The Eurasian collared-dove is another species that is not native to North America. The first introductions of the Eurasian collared-dove to North America occurred in the Bahamas during the mid-1970s. Since the introductions in the Bahamas, Eurasian collared-doves have quickly expanded their range throughout North America and Central America (Romagosa 2012). Eurasian collared-doves occur primarily in urban, suburban, and agricultural areas (Romagosa 2012).

Eurasian collared-doves occur statewide in Mississippi throughout the year (Romagosa 2012). Since 1966, data from the BBS indicates the breeding population of Eurasian collared-doves has increased annually in Mississippi at an estimated rate of 22.7%; however, from 2007 through 2017, the number observed during the BBS has declined -1.0% annually (United States Geological Survey 2019). The Partners in Flight (2019) estimated the statewide breeding population to be 140,000 Eurasian collared-doves. The first occurrences of Eurasian collared-doves on the CBC occurred in 1993 when observers counted three collared-doves on one count (National Audubon Society 2010). In 2017, observers counted 321 collared-doves on 15 counts in the state (National Audubon Society 2010). Observers have documented Eurasian collared-doves on the CBC every year since 1996 (National Audubon Society 2010). In general, the number of Eurasian collared-doves observed in areas of the state surveyed during the CBC has shown an increasing trend (National Audubon Society 2010).

The WS program in Mississippi has previously only addressed Eurasian collared-doves during FY 2016, FY 2017, and FY 2018. In FY 2016, WS' personnel dispersed three Eurasian collared-doves and lethally removed one Eurasian collared-dove to alleviate damage threats. In FY 2017, WS dispersed 10 Eurasian collared-doves and lethally removed 10 Eurasian collared-doves to alleviate damage threats. In FY 2018, WS dispersed five Eurasian collared-doves and lethally removed six Eurasian collared-doves.

Outside of the breeding season, Eurasian collared-doves tend to be gregarious and can mix with flocks of mourning doves (Romagosa 2012). Based on the increasing population trends of Eurasian collared-doves along with the gregarious behavior of Eurasian collared-doves, WS anticipate 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 and the number of Eurasian collared-doves associated with those requests, WS anticipates the need to take up to 500 Eurasian collared-doves per year to alleviate damage and threats of damage. In addition, WS could destroy up to 100 Eurasian collared dove nests per year, including eggs in those nests.

The take of up to 500 Eurasian collared-doves by WS would represent 0.4% of a statewide breeding population estimated at 140,000 Eurasian collared-doves. 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. However, WS anticipates take by other entities is likely of low magnitude because Eurasian collared-doves are not associated with causing extensive damage to resources. Most requests for assistance associated with Eurasian collared-doves occur at airports and military facilities where Eurasian collared-doves may pose a risk to aircraft.

Eurasian collared-doves are similar in appearance to mourning doves and people may harvest Eurasian collared-doves during the annual hunting for mourning doves. People can harvest mourning doves under frameworks established by the USFWS and implemented by the MDWFP. However, because Eurasian collared-doves are a non-native species, no frameworks for the harvest of Eurasian collared-doves exists. Therefore, the number of Eurasian collared-doves that people harvest annually in the state during the annual 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. 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 (Otis et al. 2008).

Mourning doves occur throughout the year in Mississippi (Turcotte and Watts 1999, Otis et al. 2008). According to BBS trend data provided by the United States Geological Survey (2019), the number of mourning doves observed on routes surveyed in the state has shown a stable trend since 1966, with an estimated annual increase of 0.3% occurring from 2007 through 2017. Based on BBS data, the Partners in Flight (2019) estimated the statewide breeding population at 1.9 million mourning doves. The number of mourning doves observed in areas of the state surveyed during the CBC has shown a general increasing trend in the state (National Audubon Society 2010). The USFWS publishes a report on the population status of mourning doves annually based upon survey data. Seamans (2019) estimated the absolute abundance of mourning doves in the Eastern Management Unit[13] ranged from 56.5 million to 105.4 million mourning doves over the past ten years. In 2018, Seamans (2019) estimated the absolute abundance of mourning doves in the Eastern Management Unit at 56.5 million doves, which represented a decline from an estimated abundance of 65.2 million mourning doves in the Eastern Management Unit during 2017.

Table 3.2 shows the number of mourning dove lethally removed or dispersed by WS to alleviate damage and threats in the state from FY 2014 through FY 2018. Since FY 2014, WS has employed non-lethal harassment methods to disperse an average of 258 mourning doves per year in the state to address requests for assistance to manage damage. WS addressed mourning doves using non-lethal harassment methods, such as physical hand/voice actions, pyrotechnics, vehicle activity, and the noise associated with the discharge of a firearm. The WS program in Mississippi also used lethal methods to remove mourning doves that employees identified as causing damage or the threat of damage. From FY 2014 through FY 2018, WS lethally removed an average of 39 mourning doves per year in the state to alleviate damage or threats of damage. The highest annual take of mourning doves by WS in the state occurred during FY 2014 when WS lethally removed 58 mourning doves in the state to alleviate damage or threats of damage. From FY 2014 through FY 2018, the lethal take of mourning doves by WS occurred from the use of firearms and euthanasia after live-capture in cage traps.

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 3,000 mourning doves could be lethally removed by WS annually in the state to address damage or threats of damage. In addition, WS could destroy up to 20 mourning dove nests annually to alleviate damage or

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

threats of damage, including eggs in the nests. The lethal removal of up to 3,000 mourning doves by WS would represent 0.2% of the statewide breeding population estimated at 1.9 million mourning doves.

Table 3.2 – Mourning doves addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	58	439
2015	40	382
2016	24	82
2017	41	265
2018	33	121

From 2014 through 2018, other entities reported removing 2,328 mourning doves pursuant to depredation permits issued by the USFWS, which includes mourning doves lethally removed by WS acting as a subpermittee under depredation permits issued to other entities. Therefore, on average, other entities reported the lethal removal of 467 mourning doves per year in the state pursuant to depredation permits issued by the USFWS. The highest annual reported take of mourning doves by other entities occurred in 2016 when other entities reported the take of 679 doves.

Many states have regulated annual hunting seasons for mourning doves with generous bag limits. Hunters harvested nearly 11.6 million mourning doves in the United States during the 2017 hunting season and nearly 10.4 million mourning doves during the 2018 hunting season (Raftovich et al. 2019, Seamans 2019). Hunters in Mississippi harvested an estimated 316,500 mourning doves during the 2017 hunting season and an estimated 273,400 mourning doves in the state during the 2018 hunting season (Raftovich et al. 2019, Seamans 2019).

The take of 3,000 mourning doves by WS would represent 1.0% of the 316,500 mourning doves that hunters harvested in the state during the 2017 hunting season and 1.1% of the 273,400 mourning doves that hunters harvested during the 2018 hunting season in Mississippi. Migrating mourning doves likely augment local populations of mourning doves in the state during the migration periods and during the winter months. If other entities in the state continued to take an average of 467 doves per year under depredation permits issued by the USFWS, the combined take by WS and by other entities would represent 0.2% of the estimated breeding population in the state and 1.3% of the number of mourning doves harvested during the 2018 season. If take by other entities reached 679 doves annually, which was the highest reported take from 2014 through 2018, the combined take by WS and the take by other entities would represent 0.2% of estimated breeding population in the state and 1.4% of the number of mourning doves harvested during the 2018 season. 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 when authorized by the USFWS and only at levels authorized by the USFWS, which ensures the USFWS has the opportunity to consider take by WS and other entities, including hunter harvest, to achieve the desired population management levels of doves in Mississippi.

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 2000). Although killdeer are technically in the family of shorebirds, they are unusual 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 Mississippi, killdeer occur statewide and throughout the year (Turcotte and Watts 1999, Jackson and Jackson 2000). Killdeer that nest further north augment the resident breeding population in the state during the migration periods and during the winter. In the fall and winter, killdeer may occur in flocks of a hundred killdeer or more (Turcotte and Watts 1999). Since 1966, the number of killdeer observed during the breeding season in the state has shown an increasing trend estimated at 1.6% annually, with a 1.8% annual increase estimated from 2007 through 2017 (United States Geological Survey 2019). In those areas of the state surveyed during the CBC, the number of killdeer observed has shown a general increasing trend between 1966 and 2016 (National Audubon Society 2010). A breeding population estimate from the Partners in Flight (2019) is not available for Mississippi. Birdlife International (2016*a*) 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*a*) estimated the killdeer 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 3.3 shows the number of killdeer lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. Since FY 2014, WS has employed non-lethal harassment methods to disperse an average of 385 killdeer per year in the state to address requests for assistance to manage damage. WS addressed killdeer using non-lethal harassment methods, such as physical actions (hand/voice), vehicle activity, pyrotechnics, and the noise associated with the discharge of a firearm. The WS program in Mississippi also used lethal methods to remove killdeer that employees identified as causing damage or the threat of damage. From FY 2014 through FY 2018, WS lethally removed an average of 102 killdeer per year in the state to alleviate damage or threats of damage. The highest annual take of killdeer by WS in the state occurred during FY 2017 when WS lethally removed 128 killdeer in the state to alleviate damage or threats of damage. From FY 2014 through FY 2018, the lethal take of killdeer by WS occurred with the use of firearms.

Table 3.3 – Killdeer addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	111	506
2015	125	842
2016	60	236
2017	128	238
2018	87	101

In anticipation of additional efforts to address requests associated with killdeer, WS could take up to 250 killdeer each year and destroy up to 50 nests annually to alleviate damage or threats throughout the state, including any eggs in those nests. Destroying the nests could cause killdeer to abandon the nesting location and disperse from the site. WS' personnel would destroy nests by hand and/or using hand tools. The removal of the nest and eggs would occur in an attempt to cause the killdeer to abandon the nest site and to disperse the killdeer from the area. The MBTA prohibits the take of active killdeer nests, including the removal of killdeer eggs, unless the USFWS authorizes the take through the issuance of a depredation permit.

From 2014 through 2018, other entities reported removing 463 killdeer pursuant to depredation permits issued by the USFWS, which includes killdeer lethally removed by WS acting as a subpermittee under depredation permits issued to other entities. Therefore, on average, other entities reported the lethal removal of 93 killdeer per year in the state pursuant to depredation permits issued by the USFWS. The highest annual reported take of killdeer by other entities occurred in 2015 when other entities reported the take of 146 killdeer.

With a population estimated at one to two million killdeer in the United States, the take of up to 250 killdeer by WS in Mississippi would represent 0.01% to 0.03% of the population. Like other bird species, the actual population in the state likely fluctuates throughout the year. 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*a*). The United States Shorebird Conservation Plan Partnership (2016) indicated the killdeer was a species of "*moderate concern*".

Given the increasing population trends for killdeer in the state and the limited take proposed by WS to alleviate damage and threats, WS' proposed take should not have an adverse effect on killdeer populations. The take of killdeer could only occur when authorized through the issuance of depredation permits by the USFWS. 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. The destruction of a limited number of nests generally has no adverse effects on bird populations. WS would continue to assist airport personnel in identifying habitat and other attractants to killdeer on airport property. Killdeer would continue to be addressed using primarily non-lethal harassment and dispersal methods. All take of killdeer would occur within the levels permitted by the USFWS pursuant to the MBTA.

LAUGHING GULL POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The laughing gull is a common gull species found throughout the year in the southeastern United States with breeding colonies occurring along the coastal areas of the Atlantic Ocean, Gulf of Mexico, and the coastal areas of the Caribbean Islands (Burger 2015). Localized breeding colonies also occur along the Gulf of California and the Pacific Coast of Mexico (Burger 2015). Characterized by a black hood, laughing gulls are often associated with human activities near coastal areas where food sources are readily available (Burger 2015). Burger (2015) cites several sources that indicate laughing gulls are opportunistic foragers feeding on a wide-range of aquatic and terrestrial invertebrates, small vertebrates, garbage, and plant material, such as berries.

Belant and Dolbeer (1993) estimated the population of breeding laughing gulls in the United States at 258,851 pairs based on state population records. Belant and Dolbeer (1993) did not consider non-breeding and sub-adult gulls as part of the breeding population in the United States. In Mississippi, the laughing gull is an abundant permanent resident along the coastal areas of the state, and occasionally occurs inland on large bodies of water (Turcotte and Watts 1999). The laughing gull is the only gull species known to nest in the state, with nesting occurring along the coast and on offshore islands of the state during June and July (Turcotte and Watts 1999).

The current population of laughing gulls in Mississippi is unknown. There is currently no BBS data for laughing gulls in Mississippi (United States Geological Survey 2019). In areas of the state surveyed during the CBC, the number of laughing gulls observed has shown a general stable to slightly increasing trend since 1966 (National Audubon Society 2010). Belant and Dolbeer (1993) estimated a minimum of 230,000 adult laughing gulls might winter in states along the Gulf Coast. In the southeastern United States, Hunter et al. (2006) estimated the breeding population of laughing gulls to be 170,000 breeding pairs with an estimated 46,116 breeding pairs occurring in the southeastern coastal plain region (Bird Conservation Region 27), which does not include non-breeding laughing gulls. Dolbeer (1998) estimated that the number of non-breeding laughing gulls equaled about 50% of the nesting population. Therefore, the breeding population in the southeastern coastal plain region could be approximately 92,000 breeding laughing gulls and 46,000 non-breeding laughing gulls. In the southeastern coastal plain, the number of laughing gulls observed along routes surveyed during the BBS has increased annually by an estimated 3.7% since 1966 (United States Geological Survey 2019). The number of gulls present in the state may increase during the migration period as gulls begin arriving within the state from nesting areas further north. However, the exact population of laughing gulls in Mississippi is currently unknown and likely varies throughout the year and from year to year.

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

From FY 2014 through FY 2016, the WS program in Mississippi did not provide direct operational assistance involving damage or threats of damage associated with laughing gulls. WS dispersed two laughing gulls during FY 2017. WS did not provide direct operational assistance involving laughing gulls during FY 2018. In FY 2005, WS dispersed 4,253 laughing gulls to alleviate damage and used lethal methods to take 214 laughing gulls in the state. In FY 2010, WS dispersed 90 laughing gulls to alleviate damage or to reduce threats of damage. Requests for assistance associated with laughing gulls are primarily associated with airports where gulls can pose strike risks to aircraft. Based on the gregarious behavior of laughing gulls and in anticipation of additional efforts to address damage, WS anticipates that employees could lethally remove up to 1,000 laughing gulls annually. In addition, WS could destroy up to 100 nests annually to alleviate damage and threats, including eggs and/or nestlings in those nests. The take of laughing gulls by WS, including the take of active nests, would only occur after the issuance of a depredation permit by the USFWS.

From 2014 through 2018, other entities reported removing 228 laughing gulls under depredation permits issued by the USFWS, which includes laughing gulls lethally removed by WS acting as a subpermittee under those depredation permits. Therefore, on average, other entities reported the lethal removal of 46 laughing gulls per year in the state pursuant to depredation permits issued by the USFWS. The highest annual reported take of laughing gulls by other entities occurred in 2016 when other entities reported the take of 155 laughing gulls.

Take of up to 1,000 laughing gulls by WS annually in the state would represent 0.4% of the 230,000 adult laughing gulls that overwinter along the Gulf Coast states (Belant and Dolbeer 1993). Hunter et al. (2006) estimated the breeding population at 170,000 breeding pairs of laughing gulls or 340,000 adults in the southeastern United States. Take of up to 1,000 laughing gulls by WS annually would represent 0.3% of the estimated breeding population, if the population remains at least stable. Hunter et al. (2006) estimated the number of laughing gulls breeding in the southeastern coastal plain at 46,116 breeding pairs. Take of up to 1,000 laughing gulls by WS annually would represent 1.1% of the estimated breeding population in the southeastern coastal plain, if the population remains at least stable. If the breeding population were 25,000 breeding pairs in the southeastern coastal plain, which is the population objective recommend by Hunter et al. (2006), take of up to 1,000 laughing gulls would represent 2.0% of the breeding population, if the population remained at least stable.

As discussed previously, from 2014 through 2018, entities reported removing 46 laughing gulls per year in the state to alleviate damage and threats of damage with the highest annual reported take occurring in 2016 when entities reported the take of 155 laughing gulls. If other entities in the state continued to take an average of 46 laughing gulls per year under depredation permits issued by the USFWS, the combined take by WS and by other entities would represent 2.1% of the breeding population, if the breeding population occurred at the management objective of 25,000 breeding pairs. If take by other entities reached 155 laughing gulls annually, which was the highest reported take from 2014 through 2018, the combined take by WS and the take by other entities would represent 2.3% of a breeding population estimated at 25,000 breeding pairs.

Based on increasing population trends for laughing gulls along the southeastern coastal plain and permitting of the take by the USFWS pursuant to the MBTA, WS' take of up to 1,000 laughing gulls annually would occur within allowable take levels to reach desired population objectives. Take of laughing gulls would only occur as determined and analyzed by the USFWS to achieve the desired population objectives for laughing gulls.

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. Ring-billed gulls winter in the southern and the coastal areas of the United States and across most of Mexico (Pollet et al. 2012). Ring-billed gulls are inland, colonial ground nesters on sparsely vegetated islands in large lakes with occasional colonies on mainland peninsulas and near-shore oceanic islands (Pollet et al. 2012). Ring-billed gulls commonly occur in large numbers at garbage dumps, 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. 2012).

In Mississippi, ring-billed gulls are common migrants and winter residents across the state, with most observations occurring near the coast or on or near large bodies of water (Turcotte and Watts 1999). Non-breeding ring-billed gulls can be present in the state during the breeding season but observations of ring-billed gulls in the state during the breeding season are rare. Ring-billed gulls are more common from October through May, with peak numbers occurring from November through mid-April (Turcotte and Watts 1999). Inland, Turcotte and Watts (1999) considered ring-billed gulls to be uncommon to fairly common on inland waters during winter and regularly common to abundant during fall and winter along the coast. The number of ring-billed gulls observed in areas surveyed during the CBC has shown a general increasing trend in Mississippi (National Audubon Society 2010). Because ring-billed gulls nest further north and are rare in the state during the nesting season, no trend data for Mississippi is available from the BBS (United States Geological Survey 2019). In all areas of the United States and Canada surveyed during the BBS, the number of ring-billed gulls observed has increased 1.1% per year since 1966 (United States Geological Survey 2019). In the southeastern coastal plain region, the number of ring-billed gulls observed has decreased -1.0% annually since 1966 (United States Geological Survey 2019). The number of ring-billed gulls that migrate through and winter in Mississippi 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 (2019) estimated the ring-billed gull population at nearly 2.6 million ring-billed gulls. BirdLife International (2018*a*) 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 2014 through FY 2018, the WS program in Mississippi dispersed 18 ring-billed gulls during FY 2015 using pyrotechnics and used a firearm to take one ring-billed gull during FY 2018. Based on the possibility of addressing a large number of gulls at a location to alleviate damage or to reduce threats of damage, WS could lethally remove up to 100 ring-billed gulls in the state annually. From 2014 through 2018, other entities reported removing 187 ring-billed gulls under depredation permits issued by the USFWS. Therefore, on average, other entities reported the lethal removal of 37 ring-billed gulls per year in the state pursuant to depredation permits issued by the USFWS. The highest annual reported take of ring-billed gulls by other entities occurred in 2016 when other entities reported the take of 131 ring-billed gulls.

The only information currently available to evaluate the magnitude of WS' proposed take of up to 100 ring-billed gulls annually in the state is the number of ring-billed gulls observed in areas of the state surveyed during the CBC. Data from the CBC provides an indication of long-term trends in the number of birds observed wintering in the state and is not representative of estimates for wintering bird populations. However, the analysis will use this information to evaluate the magnitude of lethal take that could occur by WS. The number of ring-billed gulls observed in areas of the state surveyed during the CBC would be a minimum estimate given the survey parameters of the CBC and that it covers a small portion of the state.

On average, observers involved with the CBC have recorded 16,642 ring-billed gulls in areas of the state surveyed from 2008 through 2017 (National Audubon Society 2010). If WS removed 100 ring-billed gulls, WS' take would have represented 0.6% of the average number of ring-billed gulls observed in the state from 2008 through 2017 during the CBC. Over that 10-year period, the number of gulls observed during the CBC in the state has ranged from a low of 6,916 gulls observed in 2015 to a high of 40,731 gulls observed in 2017 (National Audubon Society 2010). Therefore, if WS removed 100 ring-billed gulls annually from 2008 through 2017 in the state, the annual take by WS would have ranged from a low of 0.3% to a high of 1.5% of the number of gulls observed in the state during the CBC.

If other entities removed 37 ring-billed gulls per year in the state under depredation permits issued by the USFWS, the combined take by WS and by other entities would represent 0.8% of the average number of ring-billed gulls recorded in areas of the state surveyed from 2008 through 2017. If take by other entities reached 131 gulls annually, the combined take by WS and the take by other entities would represent 1.4% of the average number of ring-billed gulls recoded in areas of the state surveyed from 2008 through 2017.

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

HERRING GULL POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Herring gulls are large, white-headed gulls with a wide distribution in North America, Europe, and Central Asia (Nisbet et al. 2017). Herring gulls are the most widely distributed gull species in the Northern Hemisphere. Herring gulls breed in colonies near bodies of water, such as oceans, lakes, or rivers (Nisbet et al. 2017). Herring gulls nest across the northern and eastern parts of Canada, with breeding populations in Alaska, the Great Lakes, and along the Atlantic coast in the United States. North Carolina is the southern limit of the Atlantic coast nesting range of herring gulls; however, populations of herring gulls have been expanding their range in North Carolina and increasing in numbers (Hunter et al. 2006). Herring gulls are increasingly nesting on man-made structures, particularly on rooftops, break walls used to protect areas from waves, or in areas with complete perimeter fencing such as electrical substations.

The herring gull is a migrant in Mississippi and a common winter resident along the coast and inland on large bodies of water (Turcotte and Watts 1999). No known breeding colonies of herring gulls occur in Mississippi; however, non-breeding herring gulls may be present in the state during the breeding season, especially along the coast, but are uncommon. The number of herring gulls present in the state begins to increase as individuals arrive in October during the fall migration and continues through May when the spring migration ends. The peak period for herring gull numbers in the state occurs from November through mid-April (Turcotte and Watts 1999).

Data gathered in Mississippi during the CBC indicates the number of herring gulls observed during the survey has shown a general declining trend in the state (National Audubon Society 2010). Because no breeding colonies occur in the state (Turcotte and Watts 1999), no data from the BBS is currently available for Mississippi (United States Geological Survey 2019). The number of herring gulls observed in areas surveyed during the BBS in the southeastern coastal plain has shown an annual declining trend estimated at -0.3% since 1966 (United States Geological Survey 2019). Across all BBS routes surveyed in the United States, herring gulls are showing a declining trend estimated at -3.8% annually since 1966 (United States Geological Survey 2019). No current population estimates are available for the number of herring gulls residing in the state. Hunter et al. (2006) recommended reducing the number of nesting herring gulls in the southeastern United States to minimize competition for nest sites between herring gulls and other higher priority waterbirds. Herring gulls are predatory, feeding on eggs and nestlings of other waterbird species, including terns and plovers (Hunter et al. 2006).

The WS program in Mississippi occasionally receives requests for assistance associated with herring gulls or addresses herring gulls as part of mixed species flocks of gulls, primarily at airports in the state. From FY 2014 through FY 2018, no direct operational assistance involving herring gulls occurred by WS in the state. Based on the gregarious behavior of gulls, WS anticipates addressing herring gulls at airports within the state where the presence of gulls could pose aircraft strike hazards. In anticipation of WS receiving requests to provide direct operational assistance in the future and involving the use of lethal methods, WS could lethally remove up to 75 herring gulls annually within the state. From 2014 through 2018, other entities reported removing 150 herring gulls under depredation permits issued by the USFWS. Therefore, on average, other entities reported the lethal removal of 30 herring gulls per year in the state pursuant to depredation permits issued by the USFWS. The highest annual reported take of herring gulls by other entities occurred in 2018 when other entities reported the take of 77 herring gulls.

The North American Waterbird Conservation Plan ranked the herring gull as a species of "*low concern*" in North America (Kushlan et al. 2002). The take of herring gulls by WS in Mississippi 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 herring gulls and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

GREAT EGRET POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Great egrets occur in freshwater, estuarine, and marine wetlands (McCrimmon et al. 2011). 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. 2011). 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 (McCrimmon et al. 2011). Following regulations that ended plume-hunting, great egret populations rapidly recovered with increases reported in the late 1920s and 1930s (McCrimmon et al. 2011). Similar fluctuations in great egret populations occurred throughout the southeastern United States with the number of egrets present in the state increasing during the 1940s and 1950s. Populations in the state again began to decline rapidly in the 1970s likely due to the conversion of lowland habitats to agricultural uses and the widespread use of organochloride pesticides (Hunter et al. 2006). However, populations of great egrets appear to be recovering.

In Mississippi, great egrets occur in appropriate habitat throughout the year but are more common along the Mississippi River and in southern Mississippi (Turcotte and Watts 1999, McCrimmon et al. 2011). The population of great egrets in Mississippi likely fluctuates throughout the year and is probably highest during migration periods. The number of great egrets that winter and nest in the state is currently unknown. Since the initiation of the BBS in 1966, the number of egrets observed along routes surveyed in Mississippi has shown an increasing trend estimated at 9.5% annually, with an annual increase of 10.0% occurring from 2007 through 2017 (United States Geological Survey 2019). The number of great egrets observed in areas of the state surveyed during the CBC has also shown a general increasing trend since 1966 (National Audubon Society 2010).

In the southeastern coastal plain region (Bird Conservation Region 27), which includes most of the state, Hunter et al. (2006) estimated the breeding population of great egrets to be over 28,000 breeding pairs. Along the Mississippi Alluvial Valley (Bird Conservation Region 26), which includes areas of the state within the Mississippi River floodplain, Hunter et al. (2006) estimated the great egret population to be 25,000 breeding pairs. In the southeastern United States, Hunter et al. (2006) estimated the breeding population of great egrets to be 119,266 breeding pairs. Of the five tiers of action levels for waterbirds in the southeastern United States, Hunter et al. (2006) assigned great egrets to the planning and responsibility tier, which includes birds that require some level of planning to maintain sustainable populations in the region. The planning and responsibility tier is the second lowest tier in terms of action priority ahead of only the last tier, which includes those waterbirds that are above management levels and could require population management (Hunter et al. 2006). Kushlan et al. (2002) estimated the population size of great egrets to be greater than 183,000 breeding great egrets across North America. The North American Waterbird Conservation Plan classified the great egret in the "*not currently at risk*" category of conservation concern (Kushlan et al. 2002). BirdLife International (2016*b*) considers the great egret to be a species of "*least concern*". Wetlands International (2019) estimated the North America population of great egrets to be 270,000 great egrets.

When receiving a request for assistance, WS may employ non-lethal methods to disperse great egrets in order to alleviate damage, threats of damage, or strike risks; however, lethal take could occur when non-lethal harassment methods have failed to disperse egrets or when posing an imminent threat to aircraft and human safety. From FY 2014 through FY 2018, WS' employees employed non-lethal methods to disperse an average of 1,099 great egrets per year using physical actions, pyrotechnics, vehicle presence, and the noise associated with discharging a firearm. In FY 2018, WS' employees dispersed 3,533 great egrets to alleviate damage or threats of damage within the state. In addition, the WS program in the state employed lethal methods to take an average of five great egrets per year, with the highest annual take occurring in FY 2014 when WS lethally removed 11 great egrets. Based on previous and current levels of take by WS to alleviate damage and threats of damage associated with great egrets, WS' anticipates that the WS program in Mississippi could take up to 75 great egrets per year in the state to manage damage and threats.

To address damages and threats associated with great egrets, the USFWS has issued depredation permits pursuant to the MBTA to entities other than WS that allow the take of great egrets to manage damage and threats. On average, entities have lethally removed 2,323 great egrets per year from 2014 through 2018 in the state. The highest level of annual take by other entities occurred in 2018 when other entities killed 2,952 great egrets.

The population of great egrets in Mississippi likely fluctuates throughout the year and is likely highest during migration periods. Nesting and winter populations of great egrets are currently unknown in Mississippi. Glahn et al. (1999*c*) estimated the great egret population in the Delta region of Mississippi to be 18,000 egrets based on density surveys at aquaculture facilities in that region. Because the number of great egrets present in Mississippi at any given time is unknown, this analysis will use the population estimate for the Delta Region of Mississippi despite the population estimate representing such a small geographical area of Mississippi. The number of egrets present in Mississippi is likely greater than 18,000 great egrets because the estimate provided by Glahn et al. (1999*c*) only included the Delta Region of Mississippi. Based on the estimated population in the aquaculture producing region of Mississippi, WS' take of up to 75 egrets would represent an estimated 0.4% of the great egret population in the aquaculture producing region along the Mississippi River.

If the USFWS continued to issue permits to entities other than WS for the lethal removal of great egrets and the annual removal by other entities reached 2,323 great egrets in the state, the cumulative take of egrets would represent 13.3% of the estimated number of great egrets present in the Delta Region of Mississippi. If take by other entities reached 2,952 great egrets annually and WS removed 75 great egrets, the cumulative take would represent 16.8% of the estimated number of great egrets present in the Delta Region of Mississippi.

The permitting of take by the USFWS ensures the cumulative take of egrets in the southeastern United States, including the take proposed by WS in Mississippi, would not reach a magnitude where undesired adverse effects occur. Similar to other migratory birds addressed in this EA, the take of great egrets by WS would only occur at the discretion of the USFWS and only at levels permitted by the USFWS. Therefore, the USFWS would have the opportunity to evaluate all take of great egrets, including take by WS, pursuant to the objectives of the MBTA.

AMERICAN WHITE PELICAN POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

American white pelicans primarily nest in the western and north-central regions of Canada and the United States along with the Great Lakes region (Knopf and Evans 2004). American white pelicans winter along the southern United States into Mexico and Central America (Knopf and Evans 2004). American white pelicans can occur throughout the year in Mississippi but they are much more common during migration periods and during the winter months (Turcotte and Watts 1999). No known breeding colonies of white pelicans exist in Mississippi. However, pelicans can be present in the state during the breeding season. Those pelicans found in Mississippi during the breeding season are likely sexually immature birds and older birds that do not breed. Non-breeding pelicans occurring in Mississippi and surrounding States throughout the summer number from a few hundred to 2,000 individuals (King 2005). Large numbers of American white pelicans within the last 20 years now spend prolonged periods during migration (both fall and spring) in the southeastern United States in close association with catfish aquaculture (Hunter et al. 2006).

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

The number of pelicans observed along routes surveyed during the BBS has increased survey-wide estimated at 6.0% annually from 1966 through 2017 (United States Geological Survey 2019). From 2007 through 2017, the number of pelicans observed along BBS routes has increased annually estimated at 7.7% survey-wide (United States Geological Survey 2019). The number of American white pelicans observed in areas of the state surveyed during the CBC has shown a generally increasing trend since 1966 (National Audubon Society 2010). In 1978, observers counted four American white pelicans in one area of the state surveyed during the CBC. In 2017, observers counted 2,109 American white pelicans in twelve areas of the state surveyed during the CBC (National Audubon Society 2010). During winter surveys conducted along the coastal areas of Louisiana from 1997 through 1999, King and Michot (2002) estimated the wintering population of pelicans along this area ranged from 18,000 to 35,000 individuals.

Table 3.4 shows the number of American white pelicans addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi has addressed requests for assistance associated with American white pelicans using pyrotechnics, lasers, and vehicle activity. No lethal take of American white pelicans occurred by WS in Mississippi from FY 2014 through FY 2018. Based on requests for assistance received by WS previously and in anticipation of receiving additional requests for assistance, WS could lethally take up to 50 American white pelicans annually in the state.

Table 3.4 – American white pelicans addressed by WS in Mississippi, FY 2014 – FY 2018

Fiscal Year	Take	Dispersed
2014	0	13
2015	0	3,000
2016	0	0
2017	0	244
2018	0	11,502

In addition to the take of American white pelicans occurring by WS to alleviate damage, additional take also occurs pursuant to the MBTA by other entities through the issuance of depredation permits by the USFWS to those entities. From 2014 through 2018, other entities in the state have reported lethally removing an average of 632 American white pelicans per year pursuant to depredation permits issued by the USFWS. The highest level of annual take by other entities occurred in 2018 when other entities reported taking 946 American white pelicans.

The number of American white pelicans that overwinter in the state is currently unknown but likely fluctuates throughout the year and from year to year. If the American white pelican population were 157,000 pelicans as estimated by King and Anderson (2005), the take of up to 50 American white pelicans by WS in Mississippi would represent 0.03% of the population. From 2008 through 2017, observers counted an average of 3,835 American white pelicans in areas of the state surveyed during the CBC. The take of up to 50 American white pelicans by WS would represent 1.3% of the average number of American white pelicans observed in areas of the state surveyed during the CBC from 2008 through 2017.

If the USFWS continued to issue permits to entities other than WS for the lethal removal of American white pelicans and the annual removal by other entities reached 632 American white pelicans in the state, the cumulative take of pelicans would represent 0.4% of the estimated population of American white pelicans. If take by other entities reached 946 American white pelicans annually and WS removed 50

American white pelicans, the cumulative take would represent 0.6% of the estimated population of American white pelicans.

Hunter et al. (2006) indicated the USFWS has issued depredation permits to lethally remove up to 3,000 American white pelicans per year (principally in Arkansas, but also in other southern states), with over 1,000 pelicans reportedly removed in recent years. Based on a population estimated to be less than 200,000 pelicans (including young of the year), Hunter et al. (2006) indicated the take of 1,000 pelicans each year would represent 0.5% of the total population. Other mortality events are also a concern in the southeastern United States, such as die-offs due to chemical contamination and mortality events associated with botulism outbreaks (Hunter et al. 2006). However, despite those mortality events and lethal take, data from the BBS continues to show long-term and short-term breeding population growth (United States Geological Survey 2019).

The North American Waterbird Conservation Plan ranks American white pelicans as a species of "*moderate concern*" in North America (Kushlan et al. 2002). Species of "*moderate concern*" are those species that are not highly imperiled or high concern species, but their "*…Populations are either a) declining with moderate threats or distributions; b) stable with known or potential threats and moderate to restricted distributions; or c) relatively small with relatively restricted distributions*" (Kushlan et al. 2002).

As discussed previously, the take of migratory birds, including American white pelicans, can only occur when authorized by the USFWS. In addition, take cannot exceed the levels authorized by the USFWS. Therefore, the take of American white pelicans by WS in Mississippi would only occur when authorized by the USFWS and only at the take levels the USFWS authorizes. The permitting of take by the USFWS ensures the cumulative take of American white pelicans in the southeastern United States, including the take proposed by WS in Mississippi, would not reach a magnitude where undesired adverse effects occur. Therefore, the USFWS would have the opportunity to evaluate all take of American white pelicans, including take by WS, pursuant to the objectives of the MBTA.

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. Great blue herons occur throughout the year in most of the United States, including Mississippi (Vennesland and Butler 2011). Great blue herons are most often located in freshwater and brackish marshes, lakes, rivers, and lagoons (Mid-Atlantic/New England/Maritimes Region Waterbird Working Group 2006, Vennesland and Butler 2011). Great blue herons feed mainly on fish but they may also capture invertebrates, amphibians, reptiles, birds, and mammals (Vennesland and Butler 2011).

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*c*). Glahn et al. (1999*c*) estimated the great blue heron population in the Delta region of Mississippi likely exceeded 25,000 herons based on density surveys conducted at aquaculture facilities in that region. The total breeding population of great blue herons in Mississippi is unknown and the number of great blue herons that migrate through and winter in Mississippi is unknown.

In Mississippi, great blue herons observed on BBS routes are showing an increasing trend estimated at 4.6% annually from 1966 through 2017, and 1.7% from 2007 through 2017 (United States Geological

Survey 2019). From 1966 through 1999, the number of great blue herons observed in areas of the state surveyed during the CBC shows a general increasing trend. From 2000 through 2016, the number of great blue herons observed in areas of the state surveyed during the CBC has shown a general declining trend but a stable trend 2012 through 2016 (National Audubon Society 2010). The number of 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 Mississippi is currently not available.

Table 3.5 shows the number of great blue herons lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed great blue herons using vehicle presence, physical actions, pyrotechnics, and the noise associated with a firearm. From FY 2014 through FY 2018, WS used firearms to remove an average of two great blue herons per year. The USFWS has also issued depredation permits for the take of great blue herons by other entities in the state. From 2014 through 2018, entities reported lethally removing an average of 2,110 great blue herons per year in the state to alleviate damage or threats. The highest level of take occurred in 2018 when other entities lethally removed 2,604 great blue herons in the state pursuant to depredation permits issued by the USFWS.

Table 3.5 – Great blue herons addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	1	1
2015	0	15
2016	3	13
2017	2	7
2018	5	460

If WS implements this alternative, WS would implement an integrated methods approach to alleviate damage, which could include the lethal removal of great blue herons to augment and reinforce the use of non-lethal methods. WS anticipates lethally removing up to 50 great blue herons per year in Mississippi as part of efforts to alleviate damage and threats of damage. In addition, WS could destroy up to 50 great blue heron nests per year in the state to discourage great blue herons from nesting in areas where they cause damage or pose a threat of damage.

As stated previously, the number of great blue herons in the Delta Region of Mississippi may exceed 25,000 herons. If the number of great blue herons present in the Delta Region of Mississippi were 25,000 great blue herons, the take of 50 great blue herons by WS in Mississippi would represent 0.2% of those great blue herons. The Delta Region consists of that portion of the Mississippi River floodplain that occurs in Mississippi. Therefore, the number of great blue herons present across the entire state would likely be higher and WS' anticipated take of up to 50 great blue herons per year would represent a smaller percentage of the actual statewide population. If the USFWS continued to issue depredation permits to entities other than WS for the lethal removal of great blue herons and the annual removal by other entities reached 2,110 great blue herons in the state, the cumulative take of great blue herons by WS and by other entities would be 2,160 great blue herons. The cumulative take of 2,160 great blue herons would represent 8.6% of the 25,000 great blue herons estimated in the Delta Region of Mississippi. If take by other entities reached 2,604 great blue herons annually and WS removed 50 great blue herons, the cumulative take would represent 10.6% of the estimated population of great blue herons in the Delta Region of Mississippi.

The North American Waterbird Conservation Plan ranked the great blue heron as a species "*not currently at risk*" in North America (Kushlan et al. 2002). The take of great blue herons by WS in Mississippi 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 great blue herons and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

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 2000). 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 2000). 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 2000).

In Mississippi, snowy egrets occur throughout the year along the coastal areas of the state with breeding colonies occurring inland across the southern portion of the state and along the Mississippi River floodplain. Snowy egrets can occur statewide during the migration periods (Parsons and Master 2000). The number of snowy egrets observed along routes surveyed during the BBS in the state have shown an increasing trend since 1966, which has been estimated at 6.4% annually, with a 7.9% annual increase from 2007 through 2017 (United States Geological Survey 2019). The number of snowy egrets observed in areas surveyed during the CBC is showing a general declining trend in the state since 1966 (National Audubon Society 2010).

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, Parsons and Master 2000, Hunter et al. 2006).

Table 3.6 shows the number of snowy egrets lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed great blue herons using vehicle presence, physical actions, and the noise associated with a firearm. During FY 2016, WS used firearms to remove two snowy egrets.

Table 3.6 – Snowy egrets addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	15
2015	0	52
2016	2	1
2017	0	2
2018	0	0

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 also issued depredation permits for the take of snowy egrets by other entities in the state. Entities issued permits reported lethally removing 10 snowy egrets in 2014, one snowy egret in 2016, and two snowy egrets in 2017 to alleviate damage or threats.

If WS implements this alternative, WS would continue to address requests for assistance associated with snowy egrets using lethal and non-lethal methods to alleviate damage and threats of damage. Across all activities associated with snowy egrets, WS anticipates lethally removing up to 50 snowy egrets per year in the state when employing lethal methods to alleviate damage or threats of damage. WS would continue to use the WS Decision Model to identify appropriate methods when addressing a request for assistance, including the continued use of non-lethal dispersal methods.

Hunter et al. (2006) estimated the southeastern population of snowy egrets to be about 45,000 breeding pairs, with approximately 10,630 breeding pairs of snowy egrets occurring in the Mississippi Alluvial Valley region. The Mississippi Alluvial Valley (Bird Conservation Region 26) includes areas of the state within the Mississippi River floodplain. The lethal take of up to 50 snowy egrets by WS annually to alleviate damage and threats in the state would represent 0.2% of the breeding population in the Mississippi Alluvial Valley region. As noted previously, damage and threats of damage associated with snowy egrets primarily occur during the migration periods and during the winter when snowy egrets are present in the state in higher numbers. Therefore, potential take by WS would likely represent a smaller percentage of the estimated breeding population.

If the USFWS continued to issue depredation permits to entities other than WS for the lethal removal of snowy egrets and the annual removal by other entities reached 10 snowy egrets in the state, the cumulative take of snowy egrets by WS and by other entities would be 60 snowy egrets. The cumulative take of 60 snowy egrets would represent 0.3% of the 21,260 snowy egrets estimated to be breeding within the Mississippi Alluvial Valley. The take of snowy egrets by WS in Mississippi 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.

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

Little blue herons are unique among heron species because they exhibit two color morphs between immature and adult little blue herons. First-year immature herons exhibit white plumage while adults show slate-blue plumages (Rodgers and Smith 2012). In the United States, breeding populations of little blue herons primarily occur in the southeastern United States, with little blue herons found throughout the year along the coast of the Gulf of Mexico and along the southern coast of the Atlantic Ocean. Little blue herons feed and nest in a variety of freshwater and marine-estuarine habitats. Little blue herons are opportunistic feeders that feed on a variety of small fish, small amphibians, and invertebrates in various shallow freshwater and marine wetland habitats (Rodgers and Smith 2012).

The North American Waterbird Conservation Plan ranked the little blue heron as a species of "*high concern*" in the Western Hemisphere (Kushlan et al. 2002). One of the recommended conservation priorities listed in the Southeast United States Regional Waterbird Conservation Plan is to increase populations of little blue herons in the region and to evaluate the take of little blue herons for damage management purposes on maintaining stable breeding populations of little blue herons (Hunter et al. 2006). The Southeast United States Regional Waterbird Conservation Plan places the little blue heron into an "*immediate action*" category due to declines across the range of the species in the United States

(Hunter et al. 2006). The cause of the decline is likely due to habitat loss but other factors could also be contributing to the declines, including competition with cattle egrets (Hunter et al. 2006). The International Union for Conservation of Nature and Natural Resources ranks the little blue heron as a species of "*least concern*" (BirdLife International 2017). The International Union for Conservation of Nature and Natural Resources assigned the ranking 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 2017).

One recommendation in the Southeast United States Regional Waterbird Conservation Plan is to evaluate the impacts that cattle egrets have on nesting little blue herons (Hunter et al. 2006). Another objective of the Southeast United States Regional Waterbird Conservation Plan is to increase the number of breeding pairs of little blue herons from approximately 57,000 pairs to approximately 75,000 breeding pairs across the southeastern United States. In the Mississippi Alluvial Valley (Bird Conservation Region 26) that includes parts of Mississippi, the objective is to increase the breeding pairs to approximately 22,500 pairs. The current population estimated for little blue herons in the Mississippi Alluvial Valley is 16,800 breeding pairs with approximately 1,000 breeding pairs occurring in Mississippi (Hunter et al. 2006). In the Southeastern Coastal Plain (Bird Conservation Region 27), which also includes most of Mississippi, the objective is approximately 5,000 to 10,000 breeding pairs of little blue herons. The current population in the Southeastern Coastal Plain is approximately 7,650 breeding pairs of little blue heron with an estimated 600 breeding pairs occurring in Mississippi (Hunter et al. 2006). Since 1966, the number of little blue herons observed in the state along routes surveyed during the BBS has shown a decreasing trend estimated at -0.4% annually; however, from 2007 through 2017, the number observed has shown an increasing trend estimated at 0.9% annually (United States Geological Survey 2019).

Requests for assistance associated with little blue herons primarily originate from airport and military facilities where they can pose a strike risk to aircraft. As with other colonial waterbirds, the food habits of little blue herons includes feeding on small fish and invertebrates, which can lead to requests for assistance to manage damage and threats of damage at aquaculture facilities in the state. Damage and threats of damage associated with little blue herons primarily occur during the migration periods and during the winter when little blue herons are present in the state in higher numbers. If WS implements this alternative, WS would continue to address requests for assistance associated with little blue herons using lethal and non-lethal methods to alleviate damage and threats of damage.

Table 3.7 shows the number of little blue herons lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed little blue herons using vehicle presence, physical actions, and the noise associated with a firearm. WS also used firearms to take little blue herons in the state to alleviate damage and threats of damage.

Table 3.7 – Little blue herons addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	0
2015	0	4
2016	3	10
2017	3	4
2018	6	4

Across all activities associated with little blue herons, WS anticipates lethally removing up to 50 little blue herons per year in the state when employing lethal methods to alleviate damage or threats of damage. WS would continue to use the WS Decision Model to identify appropriate methods when addressing a request for assistance, including the continued use of non-lethal dispersal methods.

Hunter et al. (2006) estimated a statewide breeding population in Mississippi at 1,000 breeding pairs, which equates to 2,000 little blue herons and does not include non-breeding little blue herons that could be present in the state. If WS' annual take of little blue herons reached 50 herons and the breeding population remains relatively stable, WS' take would represent 2.5% of the estimated statewide breeding population. As noted previously, damage and threats of damage associated with little blue herons primarily occur during the migration periods and during the winter when little blue herons are present in the state in higher numbers. Therefore, potential take by WS would likely represent a smaller percentage of the estimated breeding population.

The take of little blue herons by WS in Mississippi 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 little blue herons 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 2006). Today, cattle egrets occur across much of North America, including Mississippi (Telfair II 2006). As their name implies, cattle egrets are closely associated with cattle where they forage on invertebrates disturbed by foraging livestock, primarily grasshoppers, crickets, and flies (Telfair II 2006). Cattle egrets also consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2006).

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

The cattle egret population in the southeastern Bird Conservation Regions is approximately 350,000 breeding pairs. Nearly 57,000 breeding pairs occur in the Southeastern Coastal Plain (Bird Conservation Region 27) and approximately 33,000 breeding pairs occur in the Mississippi Alluvial Plain (Bird Conservation Region 26), which are the Bird Conservation Regions that encompass Mississippi (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 30,000 breeding pairs in the Southeastern Coastal Plain region and 20,000 breeding pairs in the Mississippi Alluvial Plain region. 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 the Southeastern Coastal Plain region and the Mississippi Alluvial Plain region that includes those egrets nesting in Mississippi, the Southeast United States Waterbird Conservation Plan calls for reducing the cattle egret breeding population by approximately 80,000 egrets (Hunter et al. 2006).

Like other bird species, the number of cattle egrets present in the state is unknown and likely fluctuates throughout the year and from year to year. BBS data indicates the number of cattle egrets observed in the state during the breeding season has increased annually at an estimated rate of 2.6% since 1966, with a

3.6% annual increase occurring from 2007 through 2017 (United States Geological Survey 2019). Surveyors only observe a few cattle egrets each year in areas of the state surveyed during the CBC (National Audubon Society 2010) because most egrets migrate further south during the winter (Telfair II 2006). Although cattle egrets can overwinter in the state, the number observed during the CBC has been variable with some years reporting no cattle egrets observed. The highest number of cattle egrets observed in the state during the CBC occurred in 2002 when surveyors counted 105 egrets (National Audubon Society 2010).

Table 3.8 shows the number of cattle egrets lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed cattle egrets using vehicle presence, pyrotechnics, and the noise associated with a firearm. WS also used firearms to take cattle egrets in the state to alleviate damage and threats of damage.

Table 3.8 – Cattle egrets addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	0
2015	2	11
2016	0	0
2017	3	4
2018	2	1

Based on previous requests for assistance and in anticipation of additional efforts to manage damage, the WS program in Mississippi could lethally remove up to 50 cattle egrets annually to alleviate damage in the state. The lethal take of cattle egrets by other entities in the state has also occurred. From 2014 through 2018, other entities in the state have reported lethally removing an average of seven cattle egrets per year pursuant to depredation permits issued by the USFWS. The highest level of annual take by other entities occurred in 2016 when other entities reported taking 27 cattle egrets.

As discussed previously, there are approximately 57,000 breeding pairs of cattle egrets in the Southeastern Coastal Plain region (Bird Conservation Region 27) and approximately 33,000 breeding pairs of cattle egrets in the Mississippi Alluvial Plain region (Bird Conservation Region 26), which includes those cattle egrets that nest in Mississippi. The lethal take of up to 50 cattle egrets by WS would represent 0.03% of the breeding population in the Southeastern Coastal Plain region and the Mississippi Alluvial Plain region. If other entities continued to take 27 cattle egrets annually in the state and WS' annual take reached 50 cattle egrets, the cumulative take of cattle egrets in the state would represent 0.04% of the estimated 180,000 cattle egrets that nest in the Southeastern Coastal Plain and the Mississippi Alluvial Plain regions.

The take of cattle egrets by WS in Mississippi 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 cattle egrets and would adjust management practices, including adjusting take through depredation permits, to achieve population objectives.

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 1999). However, black vultures are expanding their range northward in the eastern United States and now occur as far north as New Jersey, Ohio, Pennsylvania, West Virginia, and rarely into Connecticut and New York (Wilbur 1983, Rabenold and Decker 1989, Buckley 1999). In winter, black vultures migrate south from the most northern part of their range but are a locally resident species throughout most of their range (Parmalee and Parmalee 1967, Rabenold and Decker 1989). Black vultures are a permanent resident that occur statewide in Mississippi (Turcotte and Watts 1999). Nesting occurs in the state mainly during March and April with records of breeding occurring into May. Black vultures nest under fallen trees or treetops, near stumps, or in rotted hollow trees (Turcotte and Watts 1999). Large winter vulture roosts may occur in the state and usually include black vultures and turkey vultures (Turcotte and Watts 1999). 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 1999). Black vultures are highly social, roosting communally with other black vultures and turkey vultures in trees, electric towers, and other structures (Buckley 1999) where they can cause property damage. Vultures often occupy roosts for many years and in some cases decades (Buckley 1999). 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 1999).

According to BBS trend data provided by the United States Geological Survey (2019), the number of black vultures observed in the state during the breeding season has increased at an annual rate of 2.8% since 1966, with a 3.1% annual increase occurring from 2007 through 2017. The number of black vultures observed overwintering in the state during the CBC has also shown a general increasing trend since 1966 (National Audubon Society 2010). Partners in Flight (2019) estimated that statewide breeding population to be 94,000 black vultures.

Table 3.9 shows the number of black vultures lethally removed or dispersed by WS to alleviate damage and threats from FY 2014 through FY 2018. Since FY 2014, WS has employed non-lethal harassment methods to disperse an average of 716 black vultures per year in the state to address requests for assistance to manage damage. WS addressed black vultures using non-lethal harassment methods, such as physical actions, vehicle presence, effigies, lasers, pyrotechnics, and the noise associated with the discharge of a firearm. The WS program in Mississippi also used lethal methods to remove black vultures that employees identified as causing damage or the threat of damage. From FY 2014 through FY 2018, WS has lethally removed an average of 20 black vultures per year in the state to alleviate damage or threats of damage. The highest annual take of black vultures by WS in the state occurred during FY 2017 when WS lethally removed 67 black vultures in the state to alleviate damage or threats of damage. In addition to the take by WS, the USFWS has issued depredation permits to other entities for the take of black vultures. From 2014 through 2018, other entities in the state lethally removed 269 black vultures pursuant to depredation permits issued by the USFWS, which equates to an average removal of 54 black vultures per year in the state.

Table 3.9 – Black vultures addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	5	493
2015	3	986
2016	14	324
2017	67	809
2018	9	967

If WS implements Alternative 1, WS could continue to employ non-lethal and/or lethal methods in an integrated methods approach to alleviate damage or threats of damage. Similar to previous activities, the WS program would continue to use primarily non-lethal dispersal methods to address requests for assistance associated with black vultures. However, WS could use lethal methods when determined to be appropriate using the WS Decision Model (*e.g.*, when non-lethal dispersal methods were no longer effective, to address vultures posing imminent strike hazards at airports). 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 1,500 black vultures annually and WS could destroy up to 50 nests of black vultures annually to alleviate damage and threats, including eggs in those nests.

Increases in requests for assistance would likely be associated with vultures roosting on towers, power structures, and residential buildings, depredation to livestock, and threats of aircraft strikes at airports. Vultures repeatedly roosting on structures can lead to accumulations of fecal droppings, which can be esthetically displeasing, cause corrosive damage, be slippery, and pose threats of disease transmission when occurring in public-use or work areas. In addition, damages occur to residential structures, vehicles, and other property from vultures pulling and tearing shingles, weather stripping around windows and cars, or tearing seat cushions on mowers and boats. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. The soaring behavior of vultures and their large body size pose risks to aircraft when struck, which can cause damage to aircraft and threaten passenger safety.

Other entities lethally removed 269 black vultures in Mississippi from 2014 through 2018 to alleviate damage, which is an average take of 54 black vultures annually. If WS' annual lethal removal reached 1,500 black vultures, the annual take by WS would represent 1.6% of the estimated breeding population in the state, which Partners in Flight (2019) estimated at 94,000 black vultures. If the average annual take of black vultures by other entities in Mississippi remains similar to the average annual take of black vultures that occurred from 2014 through 2018 and if WS' removal reached 1,500 black vultures annually, the average annual take would be 1,554 black vultures. The cumulative annual take of 1,554 black vultures would represent 1.7% of the estimated statewide breeding population if the population remained at least stable. From 2014 through 2018, the highest reported annual take by other entities was 106 black vultures. If other entities continued to take 106 black vultures annually in the state, the cumulative take of 1,500 vultures by WS and the take of 106 black vultures by other entities would represent 1.7% of the estimated statewide breeding population.

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 take levels to achieve the desired population objectives for black vultures in the state. WS does not expect the take of up to 50 black vulture nests to alleviate damage or threats of damage to affect adversely the population of black vultures based on previous discussions related to limited nest/egg removal.

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, Rabenhold and Decker 1989, Kirk and Mossman 1998). Turkey vultures can occur in virtually all habitats but are most abundant where open land interrupts forested areas (Brauning 1992). Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Kirk and Mossman 1998). Turkey vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Turkey vultures prefer carrion but will eat virtually anything, including insects, fish, tadpoles, decayed fruit, pumpkins, and recently hatched heron and ibis chicks (Brauning 1992).

Turkey vultures are a permanent resident across the state (Turcotte and Watts 1999). Turkey vultures do show migratory patterns in the state and are more common during winter months. The breeding season occurs primarily in April in the state (Turcotte and Watts 1999). The number of turkey vultures observed in the state increases from mid-October through mid-March, which coincides with the migration periods and those vultures overwintering in the state (Turcotte and Watts 1999).

Partners in Flight (2019) estimated the breeding population at 150,000 turkey vultures based on BBS data. Trending data from the BBS indicates the number of turkey vultures observed along BBS routes in the state have shown an increasing trend estimated at 4.6% annually from 1966 through 2017, with an estimated 4.2% annual increase occurring from 2007 through 2017 (United States Geological Survey 2019). The number of turkey vultures observed in areas surveyed during the CBC in the state is also showing a general increasing trend since 1966 (National Audubon Society 2010).

From FY 2014 through FY 2018, the WS program in Mississippi dispersed an average of 341 turkey vultures per year in the state to alleviate damage or threats of damage using pyrotechnics, physical actions, vehicle presence, electronic harassment devices, and the noise associated with the discharge of a firearm. In addition, the WS program lethally removed an average of five turkey vultures per year from FY 2014 through FY 2018 in the state to alleviate damage. The highest annual take of turkey vultures by WS occurred in FY 2017 when WS lethally removed 10 turkey vultures in the state to alleviate damage or threats of damage (see Table 3.10). In addition to take by WS, other entities reported an average lethal removal of 11 turkey vultures per year in the state from 2014 through 2018 pursuant to depredation permits issued by the USFWS.

Based on previous requests for assistance and in anticipation of additional efforts to manage damage and the subsequent need to address more vultures, WS could lethally remove up to 600 turkey vultures annually in the state to address requests for assistance. In addition, the WS program could destroy up to 20 turkey vulture nests annually under Alternative 1 to alleviate damage and threats.

Table 3.10 – Turkey vultures addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	9	580
2015	3	455
2016	2	353
2017	10	105
2018	3	212

If WS' annual lethal removal reached 600 turkey vultures, the annual take by WS would represent 0.4% of the estimated breeding population in the state, which Partners in Flight (2019) estimated at 150,000 turkey vultures. If the average annual take of turkey vultures by other entities in Mississippi remains similar to the average annual take of turkey vultures that occurred from 2014 through 2018 and if WS' removal reached 600 turkey vultures annually, the average annual take would be 611 turkey vultures. The cumulative annual take of 611 turkey vultures would represent 0.4% of the estimated statewide breeding population if the population remained at least stable. From 2014 through 2018, the highest reported annual take by other entities was 29 turkey vultures. If other entities continued to take 29 turkey vultures annually in the state, the cumulative take of 600 turkey vultures by WS and the take of 29 turkey vultures by other entities would represent 0.4% of the estimated statewide breeding population.

The take of turkey 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 other entities would occur within allowable take levels to achieve the desired population objectives for turkey vultures in the state. WS does not expect the take of up to 20 turkey vulture nests to alleviate damage or threats of damage to affect adversely the population of turkey vultures based on previous discussions related to limited nest/egg removal.

AMERICAN CROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

American crows have a wide range, are extremely abundant, and found all across the United States (Verbeek and Caffrey 2002). American crows occur throughout the state and are present throughout the year (Turcotte and Watts 1999, Verbeek and Caffrey 2002). Partners in Flight (2019) estimated the American crow population in Mississippi to be 510,000 American crows based on BBS data. From 1966 through 2017, trend data from the BBS indicates the number of crows observed in the state during the survey has increased at an annual rate of 0.1%, with a 0.2% annual increase occurring from 2007 through 2017 (United States Geological Survey 2019). The number of crows observed throughout Mississippi in areas surveyed during the CBC has shown a general increasing trend since 1966 (National Audubon Society 2010).

From FY 2014 through FY 2018, WS dispersed an average of 984 American crows per year in Mississippi to manage damage or reduce threats using pyrotechnics, vehicle harassment, physical actions, and the noise associated with the discharge of a firearm. From FY 2014 through FY 2018, WS used firearms to remove an average of 24 American crows per year in Mississippi to alleviate damage or threats of damage. The highest annual take of American crows by WS occurred in FY 2015 when WS lethally removed 45 American crows in the state to alleviate damage or threats of damage (see Table 3.11).

Table 3.11 – American crows addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	17	1,131
2015	45	1,670
2016	41	953
2017	12	896
2018	6	269

Based on previous requests for assistance and in anticipation of additional efforts, WS' personnel could lethally remove up to 750 American crows annually in the state to address requests for assistance. The WS program in Mississippi would continue to address damage associated with crows using non-lethal dispersal methods; however, if deemed appropriate using the WS Decision Model, WS' personnel could employ lethal methods. The take of 750 crows would represent 0.2% of the estimated breeding population within Mississippi.

As discussed previously, people can take American crows without a depredation permit issued by the USFWS when they are committing damage or posing a threat to human safety under a blackbird depredation order (see 50 CFR 21.43). From 2014 through 2018, other entities reported lethally removing an average of 15 American crows per year in the state to alleviate damage or threats of damage. The highest reported annual take of American crows by other entities occurred in 2015 when other entities reported taking 46 American crows in the state. Some unreported take is likely to occur by private individuals to alleviate damage. It is reasonable to predict that the number of crows lethally removed by private individuals is 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 harassment rather than to remove crows, despite some limited take likely occurring.

In addition, people can harvest crows in the state during a regulated season that allows people to harvest an unlimited number of crows. Hunters harvesting crows during the regulated hunting season are not required to report their take to the USFWS or the MDWFP. Therefore, the number of American crows harvested annually in the state is unknown.

If entities other than WS continued to take an average of 15 American crows per year to alleviate damage in the state and WS' take reached 750 American crows, the cumulative take of 765 American crows would represent 0.2% of the estimated breeding population in the state. The highest annual take by other entities occurred in 2015 when other entities reported removing 46 American crows to alleviate aircraft strike risks. If the annual take of American crows by other entities reached 46 American crows annually in the state, the cumulative take of WS and other entities would represent 0.2% of the estimated breeding population in the state.

Given the relative abundance of American crows in the state and the long-term stable to increasing population trends observed for the species, the take of American crows by other entities to alleviate damage or threats of damage and the take of American crows during the annual hunting season is likely of low magnitude. The basis for using population trends as an index of magnitude is the assumption that annual harvests do not exceed allowable harvest levels. Wildlife management agencies act to avoid over-harvests by restricting take (either through hunting season regulation and/or permitted take) to ensure that annual harvests are within allowable harvest levels. The continued take of crows under the depredation order by other entities is likely to be a small contributor to the cumulative take of crows annually. Although some take is likely to occur, WS does not expect take to reach a high magnitude. Similarly, the take of crows during the annual hunting season is likely of low magnitude when compared to the statewide population. The number of American crows observed during statewide surveys is showing stable to increasing trends (National Audubon Society 2010, United States Geological Survey 2019); therefore, the American crow population has likely remained at least stable despite the take of American crows by WS and other entities under the depredation order and during the annual hunting season.

PURPLE MARTIN POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The purple martin is the largest of the North American swallows and is a popular tenant of backyard birdhouses. Purple martins are an aerial insectivore, which means they eat only flying insects that they catch in flight. Their diet can consist of dragonflies, damselflies, flies, midges, mayflies, stinkbugs, leafhoppers, Japanese beetles, June bugs, butterflies, moths, grasshoppers, cicadas, bees, wasps, flying ants, and ballooning spiders. Martins are secondary cavity nesters that exhibit colonial nesting tendencies with dozens of martins often nesting in the same location. In eastern North America, martins almost exclusively nest in nest boxes and martin houses (Brown and Tarof 2013).

From 1966 to 2017, the number of purple martins observed on BBS routes in the state has decreased at an annual rate estimated at -0.9% with a -1.3% annual decline occurring from 2007 through 2017 (United States Geological Survey 2019). The Partners in Flight (2019) estimated the breeding population of purple martins in Mississippi at 450,000 martins. BirdLife International (2016*c*) classified purple martins as a species of "*least concern*".

Table 3.12 shows the number of purple martins addressed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed purple martins using pyrotechnics and the noise associated with a firearm. WS also used firearms to take purple martins in the state to alleviate damage and threats of damage. The USFWS has not received reports of take by other entities, except for the take that occurred by WS as a subpermittee under a depredation permit issued to another entity. For example, airport managers may request assistance from WS to address aircraft strike hazards associated with purple martins at their air facility. If the USFWS has issued the airport a depredation permit to address strike hazards, the take of birds by WS would likely occur pursuant to the depredation permit issued to the airport. In those cases, WS would be a subpermittee designated by the airport pursuant to the depredation permit issued to the airport.

Table 3.12 – Purple martins addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	0
2015	0	125
2016	39	30
2017	1	50
2018	0	0

Based on previous requests for assistance, WS could lethally remove up to 75 purple martins annually in the state, which would represent 0.02% of the estimated breeding population in the state. Take is likely to occur during the migration periods as fledglings and the presence of martins from their northern range augment the local breeding population. Therefore, actual take is likely to represent a smaller percentage of the breeding population in the state. The permitting of take by the USFWS ensures the USFWS has the opportunity to consider and monitor the cumulative take of purple martins prior to issuing depredation permits. The take of purple martins by WS would only occur within allowed levels permitted by the USFWS.

CLIFF SWALLOW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Cliff swallows are migratory birds that occur throughout much of North America. Historically, cliff swallows occurred primarily in western North America (Brown et al. 2017). 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. 2017). Cliff swallows are colonial nesters and are one of the most social landbirds in North America (Brown et al. 2017). Nesting colonies of cliff swallows may contain up to 6,000 active nests (Brown et al. 2017), which can equate to 12,000 breeding adults at a single nesting site.

According to BBS trend data, the breeding population of cliff swallows has increased in the state at an annual rate of 27.0% since 1966 with a 28.1% annual increase occurring from 2007 through 2017 (United States Geological Survey 2019). Partners in Flight (2019) estimated the breeding cliff swallow population in Mississippi to be 510,000 cliff swallows. Cliff swallows also migrate through the state as they move between their breeding and wintering areas. Cliff swallows migrate further south to winter in South America after the breeding season. Therefore, there are no records of cliff swallows from those areas of the state surveyed during the CBC between 1966 and 2016 (National Audubon Society 2010).

Table 3.13 shows the number of cliff swallows addressed by WS to alleviate damage and threats from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS' personnel used non-lethal methods to disperse an average of 1,622 cliff swallows per year in the state to alleviate damage or to reduce the threat of damages occurring. In addition, WS used firearms to remove an average of 108 cliff swallows in the state to reinforce the use of non-lethal methods. The highest annual take of cliff swallows by WS occurred in FY 2014 when WS lethally removed 132 cliff swallows in the state to alleviate damage or threats of damage (see Table 3.13). In attempts to disperse nesting cliff swallows, WS also destroyed 72 cliff swallow nests in FY 2012, 1,050 nests during FY 2013, 145 nests during FY 2016, 55 nests during FY 2017, and 65 nests during FY 2018. From 2014 through 2018, the USFWS received reports of entities taking an average of 100 cliff swallows per year in the state pursuant to depredation permits with the highest annual reported take being 294 cliff swallows during 2015.

Previously, the lethal take of cliff swallows and the removal of nests by the WS program in Mississippi were primarily associated with reducing aircraft strike risks at an air facility where cliff swallows were nesting under bridges near the facility. Nest counts at the bridges indicated that the bridges might have 400 to 600 nests per year. With two adults per nest and clutch sizes ranging from one egg to six eggs (Brown et al. 2017), the potential for several thousand foraging cliff swallows to be present at the airfield is a possibility. Efforts to harass the swallows and dissuade them from foraging at the airfield are not always successful. Due to the length and sizes of the bridges, installing exclusion devices to prevent nesting on the bridges would be costly; high water could potentially damage the exclusion devices; and could potentially prevent inspectors from accessing areas of the bridges during safety inspections.

Table 3.13 – Cliff swallows addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	132	1,415
2015	83	4,493
2016	109	1,028
2017	116	768
2018	98	406

Therefore, the use of firearms and shooting can often reinforce the adverse noise associated with non-lethal methods. To prevent nesting in areas where damage or threats of damage occur, WS has attempted to remove nests as the cliff swallows are constructing the nests in the spring before they become active nests. The intent of removing nests at the onset of nest construction is to disperse the cliff swallows. If dispersal occurs early, the birds will likely nest in other areas. 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 swallows from the bridges to have any adverse effects on local populations because no lethal take would occur.

Based on the increasing population trend observed within the state and the close association of cliff swallows with human structures, WS could continue to receive requests for assistance associated with cliff swallows. Based on the colonial nesting behavior of cliff swallows, WS could lethally remove up to 500 cliff swallows annually in the state to alleviate damage and to supplement non-lethal harassment methods. In addition, WS could destroy up to 1,500 nests annually in the state to discourage nesting in areas where damage or threats of damage were occurring, primarily on bridges. WS anticipates removing primarily inactive nests but could occasionally remove the eggs and/or nestlings from active nests. When WS receives a request for assistance associated with cliff swallows nesting on a bridge or another structure, WS' personnel would survey the site to determine whether the nests were active (*i.e.*, contained eggs and/or nestlings). If active, personnel would remove the eggs and/or nestlings from the nest and then destroy the nest by hand or by using high-pressure water. Inactive nests would also be destroyed by hand or by using high-pressure water.

If nestlings were present in nests, WS' personnel would use euthanasia methods in accordance with WS Directive 2.505. This analysis considers the lethal removal of cliff swallow nestlings by WS as part of the potential annual take of up to 500 cliff swallows. Therefore, the annual take of cliff swallows by WS would not exceed 500 swallows, including the take of nestlings. An annual take by WS of up to 500 cliff swallows would represent 0.1% of the estimated statewide breeding population of 510,000 cliff swallows. If the annual take by other entities reached 100 cliff swallows per year and WS' annual take reached 500 cliff swallows, the cumulative take would continue to represent 0.1% of the estimated breeding population in the state. From 2014 through 2018, the highest annual reported take of cliff swallows occurred in 2015 when entities reported removing 294 cliff swallows to alleviate aircraft strike risks. If the annual take of cliff swallows by other entities reached 294 cliff swallows annually in the state, the cumulative take of WS and other entities would represent 0.2% of the estimated breeding population in the state.

After the initial removal of active or inactive nests, WS' personnel or the cooperating entity would attempt to survey a site at least once a week to monitor 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. WS' personnel or other entities could monitor known nesting 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. The goal would be to reduce the amount of take of adult swallows and the take of active nests. Based on the limited take of eggs and nestlings that could occur by WS, the permitting of the take by the USFWS, and the ability of cliff swallows to nest again after a failed nesting attempt, WS' removal of active nests would not adversely affect cliff swallow populations in the state.

Like many other bird species, the take of cliff swallows by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits, including the removal of active nests. In addition, the take of cliff 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 cliff swallows in the state.

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 2019). 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 2019). They build their cup-shaped mud nests almost exclusively on human-made structures.

According to BBS trend data, the breeding barn swallow population has increased at an annual rate of 2.4% in Mississippi since 1966. However, from 2007 through 2017, the breeding barn swallow population has declined at an annual rate of -0.9% in Mississippi (United States Geological Survey 2019). Partners in Flight (2019) estimated the breeding population in the state to be 820,000 barn swallows using data from the BBS. Barn swallows migrate further south after the breeding season and are infrequently observed in those areas surveyed in the state during the CBC (National Audubon Society 2010).

Table 3.14 shows the number of barn swallows addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi dispersed an average of 104 barn swallows per year in the state using vehicle presence, pyrotechnics, and the noise produced by a firearm. In addition, WS' personnel employed firearms to take an average of four barn swallows per year from FY 2014 through FY 2018. The highest annual take by WS occurred in FY 2016 when WS lethally removed 10 barn swallows (see Table 3.14). From 2014 through 2018, other entities reported the lethal take of 69 barn swallows, which is an average annual take of 14 barn swallows. The highest annual take by other entities was 31 barn swallows during 2017.

Based on the colonial nesting behavior of barn swallows, WS could lethally remove up to 100 barn swallows annually in the state to alleviate damage and to supplement non-lethal harassment methods. In addition, WS could destroy up to 100 nests (including eggs) annually in the state to discourage nesting in areas where damage or threats of damage were occurring. When WS receives a request for assistance associated with barn swallows nesting on a bridge or another structure, WS' personnel would survey the site to determine whether the nests were active (*i.e.*, contained eggs and/or nestlings). If active, WS' personnel would remove the eggs and/or nestlings from the nest and then destroy the nest by hand or by using high-pressure water. WS' personnel would also destroy inactive nests by hand or by using high-pressure water.

Table 3.14 – Barn swallows addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	72
2015	6	284
2016	10	142
2017	2	2
2018	1	20

After the initial removal of active or inactive nests, WS' personnel or the cooperating entity would attempt to survey a site at least once a week to monitor 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.

An annual take by WS of up to 100 barn swallows would represent 0.01% of the estimated statewide breeding population of 820,000 barn swallows. If the annual take by other entities reached 14 barn swallows per year and WS' annual take reached 100 barn swallows, the cumulative take would continue to represent 0.01% of the estimated breeding population in the state. WS expects the destruction of nests to have little adverse effect on the barn swallow population in Mississippi based on previous discussions.

Like many other bird species, the take of barn swallows by WS to alleviate damage can 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 the state.

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. 2016). 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. 2016). 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 Mississippi (Vanderhoff et al. 2016).

In Mississippi, the number of robins observed during the BBS has shown a decreasing trend estimated at -0.8% annually since 1966, with a -0.7% annual decline occurring from 2007 through 2017 (United States Geological Survey 2019). Partners in Flight (2019) estimated the breeding population in Mississippi to be 220,000 robins based on BBS data. The number of robins observed in areas surveyed during the CBC in the state has shown a cyclical pattern since 1966 (National Audubon Society 2010). Between 2008 and 2017, observers have counted an average of 6,629 robins per year in areas surveyed during the CBC in the state (National Audubon Society 2010). The range of robins observed in the state during the CBC conducted from 2008 through 2017 has been a low of 2,855 robins to a high of 18,952 robins.

Table 3.15 shows the number of American robins addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi dispersed an average of 308 American robins per year in the state to alleviate aircraft strike risks at airports using pyrotechnics, vehicle activities, and the noise associated with firearms. In addition, WS' personnel employed firearms to take an average of 16 American robins per year from FY 2014 through FY 2018. The highest annual take by WS occurred in FY 2016 when WS lethally removed 33 American robins (see Table 3.15). From 2014 through 2018, other entities reported the lethal take of 27 American robins, which is an average annual take of five American robins per year. The highest annual take by other entities was 21 American robins during 2014.

Table 3.15 – American robins addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	21	276
2015	20	722
2016	33	420
2017	1	0
2018	5	120

Based on requests for assistance previously received, WS could lethally remove up to 200 robins annually to alleviate damage or reduce threats in the state. As stated previously, large flocks of American robins are present in the state during the winter, as well as, during the migration periods and most requests for assistance are associated with large groups of robins at airports. Although WS could address robins during the breeding season, most activities would occur during the migration periods when robins occur in large flocks.

As stated previously, from 2008 through 2017, observers have counted an average of 6,629 American robins per year in areas of the state surveyed during the CBC. If WS' annual take reached 200 American robins, the annual take by WS would represent 3.0% of the average number of American robins observed in areas of the state surveyed during the CBC from 2008 through 2017. Data from the CBC provides an indication of long-term trends in the number of birds observed wintering in the state and is not representative of estimates for wintering bird populations. However, the analysis will use this information to evaluate the magnitude of lethal take that could occur by WS. The number of American robins observed in areas of the state surveyed during the CBC would be a minimum estimate given the survey parameters of the CBC and that it covers a small portion of the state.

The USFWS has received reports of other entities lethally removing American robins from 2014 through 2018. However, the reported take likely occurred by WS at an airport or airports that requested the assistance of WS where WS was operating as a subpermittee pursuant to a depredation permit issued to the air facility. For example, airport managers may request assistance from WS to address aircraft strike hazards associated with American robins at their air facility. If the USFWS has issued the airport a depredation permit to address strike hazards, the take of birds by WS would likely occur pursuant to the depredation permit issued to the airport. In those cases, WS would be a subpermittee designated by the airport pursuant to the depredation permit issued to the airport.

The take of 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 allow in those permits. Therefore, the cumulative take of 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.

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. Further 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, it had become one of the most common birds in North America (Feare 1984).

The first record of European starlings in Mississippi occurred on January 26, 1926 at the Vicksburg National Military Park (Turcotte and Watts 1999). Today, starlings occur throughout the state and are permanent residents within Mississippi (Turcotte and Watts 1999). However, some migration movements do occur within the state with large flocks often forming during winter (Turcotte and Watts 1999).

European starlings are highly adaptable and occur in a wide range of habitats; however, they are most often associated with disturbed areas created by people (Cabe 1993, Homan et al. 2017). European starlings prefer to forage in open country on mowed or grazed fields (Cabe 1993). Their diet consists of insects, fruits, berries, seeds, and spilled grain (Cabe 1993, Homan et al. 2017). European starlings are highly social birds; feeding, roosting, and migrating in flocks at all times of the year (Cabe 1993). European starlings are aggressive cavity nesters that can evict native cavity nesting species (Cabe 1993, Homan et al. 2017). In the absence of natural cavities, European starlings will nest in structures, such as streetlights, mailboxes, attics, and exhaust vents (Cabe 1993, Homan et al. 2017). Although few conclusive studies exist, evidence suggests European starlings can have a detrimental effect on native species (Cabe 1993, Homan et al. 2017).

From 1966 through 2017, the number of starlings observed along routes surveyed during the BBS has shown a decreasing trend in the state estimated at -2.1% annually, with a -0.4% decrease annually from 2007 through 2017 (United States Geological Survey 2019). Using data from the BBS, Partners in Flight (2019) estimated the statewide breeding population of starlings at 320,000 starlings. The number of starlings observed in those areas surveyed during the CBC in the state is showing a general declining trend (National Audubon Society 2010).

Table 3.16 shows the number of European starlings addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi dispersed European starlings using vehicle activities and the noise associated with firearms. In addition, WS' personnel employed firearms to take European starlings FY 2014 through FY 2018. Because the MBTA does not protect European starlings from take, entities are not required to report their take to the USFWS or the MDWFP. Therefore, the number of European starlings lethally removed by other entities in the state is unknown.

Based on previous requests for assistance and in anticipation of additional efforts to address requests associated with starlings, WS could lethally remove up to 10,000 European starlings and up to 200 European starling nests annually. The take of 10,000 starlings would represent less than 3.1% of the estimated breeding population in the state. However, most requests to address large roosts occur during migration periods and during the winter when the population in the state likely increases above the 300,000 starlings estimated to nest in the state. The increase in the statewide population is a result of migrants arriving in the state and the presence of juveniles in the population.

Table 3.16 – European Starlings addressed by WS in Mississippi, FY 2014 - FY 2018

Year	Take	Dispersed
2014	0	0
2015	0	0
2016	4	32
2017	4	6
2018	41	76

Starlings are not native to North America and any removal of starlings could improve conditions and reduce competition for food and habitat with native species. Pursuant to Executive Order 13112, 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 starlings would occur pursuant to Executive Order 13112, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

HOUSE SPARROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

People introduced house sparrows to North America from England in 1850 and the species has since spread throughout the continent (Fitzwater 1994). House sparrows occur in nearly every habitat, except dense forests, alpine, and desert environments. They prefer human-altered habitats and are abundant on farms and in cities and suburbs (Robbins et al. 1983). House sparrows are not migratory in North America and are year-round residents wherever they occur, including those sparrows found in Mississippi (Lowther and Cink 2006). 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 2006). Large flocks of sparrows can also occur in the winter as birds forage and roost together.

In Mississippi, the number of house sparrows observed in areas surveyed during the BBS has also shown a downward trend estimated at -4.5% annually since 1966 (United States Geological Survey 2019). From 2007 through 2017, the number of house sparrows observed along BBS routes in the state has also shown a declining trend estimated at -4.1% annually (United States Geological Survey 2019). Since 1966, the number of house sparrows observed in areas surveyed during the CBC annually has shown an overall declining trend but has shown a more stable trend since the early 1980s (National Audubon Society 2010). Partners in Flight (2019) estimated the breeding population of house sparrows in the state to be 370,000 birds.

Robbins (1973) suggested that declines in the sparrow population were occurring because of changes in farming practices, which resulted in cleaner operations with little waste grain. One aspect of changing farming practices that might have been a factor would be the considerable decline in small farms and associated disappearance of a multitude of small feedlots, stables, and barns, a primary source of food for house sparrows in the early part of the 20th century.

Table 3.17 shows the number of house sparrows addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi used vehicle activity and physical actions to disperse house sparrows. In addition, WS used firearms and euthanasia after live-capture in live-traps to take house sparrows. Because the MBTA does not protect house sparrows from take, entities are not required to report their take to the USFWS or the MDWFP. Therefore, the number of house sparrows lethally removed by other entities in the state is unknown.

Table 3.17 – House sparrows addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	25
2015	9	38
2016	0	0
2017	1	0
2018	0	0

Based on previous requests for assistance and in anticipation of additional efforts to address requests associated with house sparrows, WS could lethally remove up to 1,000 house sparrows and up to 100 house sparrow nests annually. The take of 1,000 house sparrows would represent 0.3% of the estimated breeding population in Mississippi. House sparrows are not native to North America and any removal of house sparrows could improve conditions and reduce competition for food and habitat with native species. Activities associated with house sparrows would occur pursuant to Executive Order 13112, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and the associated damages.

HOUSE FINCH POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Historically, the house finch favored the open desert habitats of the southwestern United States. However, people introduced house finches to eastern North America around 1940 when people brought individuals from California and released those finches onto Long Island, New York (Able and Belthoff 1998, Badyaev et al. 2012). In just a few decades, this predominately sedentary species expanded its' range across most of North America (Badyaev et al. 2012). House Finches occur throughout the year in Mississippi (Badyaev et al. 2012). Although people introduced house finches into the eastern United States, the species is native to the western United States; therefore, the MBTA protects house finches from take without a depredation permit issued by the USFWS.

In Mississippi, the number of finches observed in areas surveyed during the BBS shows an increasing trend estimated at 10.5% annually from 1966 through 2017. From 2007 through 2017, the number of house finches observed along BBS routes in the state has also shown an increasing trend estimated at 6.0% annually (United States Geological Survey 2019). The number of house finches observed in those areas surveyed during the CBC in the state is showing a cyclical, but relatively stable pattern (National Audubon Society 2010). Partners in Flight (2019) estimated the statewide breeding population to be 75,000 house finches based on data from the BBS.

From FY 2014 through FY 2018, the WS program in Mississippi only addressed house finches in FY 2015 and FY 2017. During FY 2015, WS' personnel dispersed 15 house finches and used lethal methods to remove 17 house finches. In FY 2017, WS lethally removed one house finch in the state to alleviate damage or threats of damage. Because of the gregarious behavior of this species and in anticipation of increasing requests for assistance, WS could take up to 50 house finches and up to 50 nests annually to alleviate damage and associated threats. From 2014 through 2018, those entities receiving a depredation permit from the USFWS reported the take of one house finch during 2017. However, the reported take occurred by WS at an airport that requested the assistance of WS where WS was operating as a subpermittee pursuant to a depredation permit issued to the air facility.

The take of up to 50 house finches would represent 0.07% of the estimated breeding population in Mississippi. Like other native bird species, the take of house finches by WS to alleviate damage would only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. Therefore, take by WS would only occur when the USFWS issues a depredation permit authorizing the take and take would only occur at levels authorized by USFWS. Therefore, the USFWS would have the opportunity to consider all take to achieve the desired population management levels of house finches in Mississippi.

SAVANNAH SPARROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Savannah sparrows are widespread and abundant across North America with breeding populations occurring throughout Canada, Alaska, and much of the northern half of the United States. After the nesting season, Savannah sparrows migrate southward and overwinter in the southern United States, Mexico, and parts of Central America (Wheelwright and Rising 2008). Savannah sparrows occur in agricultural fields, meadows, marshes, coastal grasslands, tundra, pastures, golf courses, roadsides, dumps, dune grass, and salt marshes during the breeding and wintering seasons (Wheelwright and Rising 2008).

In Mississippi, Savannah sparrows are present during the migration periods and during the winter months. No known breeding populations occur in Mississippi (Wheelwright and Rising 2008). During the migration periods and the winter months, Savannah sparrows can form loose groups of up to 60 individuals, but more commonly occur in smaller groups of 1 to 20 individuals. Some juvenile flocks of Savannah sparrows can range from 50 to 100 individuals. In areas of the state surveyed during the CBC, the number of Savannah sparrows observed has shown a general increasing trend since 1966 (National Audubon Society 2010). Like other bird species, the number of Savannah sparrows that migrate through and spend the winter in Mississippi is unknown but likely fluctuates throughout the migration periods and the winter. The number of Savannah sparrows present in the state also likely changes from year to year.

Table 3.18 shows the number of Savannah sparrows addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi used firearms to take Savannah sparrows and the noise associated with discharging a firearm to disperse Savannah sparrows. From 2014 through 2018, the USFWS did not receive reports of any entities other than WS taking Savannah sparrows pursuant to depredation permits.

Table 3.18 – Savannah sparrows addressed by WS in Mississippi, FY 2014 - FY 2018

Fiscal Year	Take	Dispersed
2014	0	0
2015	5	0
2016	0	1
2017	3	0
2018	5	14

WS anticipates continuing to receive requests for assistance associated with Savannah sparrows in Mississippi. WS anticipates that during activities to alleviate damage threats associated with Savannah sparrows in the state, WS could lethally remove up to 150 Savannah sparrows per year. As stated previously, the number of Savannah sparrows present in the state during the migration periods and overwintering in the state is unknown. The take of Savannah sparrows by WS to alleviate damage could only occur when permitted by the USFWS pursuant to the MBTA through the issuance of depredation permits. In addition, the take of Savannah sparrows 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 Savannah sparrows in the state.

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. 2012). Eastern meadowlarks occur throughout the eastern United States but their range can be highly dependent on habitat availability. Meadowlarks are associated with grassy fields, pastures, cultivated areas, groves, open pinewoods, and prairies (Jaster et al. 2012). In Mississippi, 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. 2012).

Since 1966, the number of eastern meadowlarks observed along routes surveyed in the state during the BBS has shown a declining trend estimated at -4.2% annually with a -3.3% annual decline occurring from 2007 through 2017 (United States Geological Survey 2019). Partners in Flight (2019) estimated the current statewide breeding population at 350,000 individuals. Since 1966, CBC data shows a general decreasing pattern for meadowlarks in Mississippi (National Audubon Society 2010).

Table 3.19 shows the number of eastern meadowlarks addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, WS dispersed an average of 674 eastern meadowlarks per year in Mississippi to reduce aircraft strike risks at airports. From FY 2014 through FY 2018, WS used firearms to remove an average of 49 eastern meadowlarks per year in Mississippi to alleviate damage or threats of damage. The highest annual take of eastern meadowlarks by WS occurred in FY 2015 when WS lethally removed 71 eastern meadowlarks in the state to alleviate damage or threats of damage (see Table 3.19). From 2014 through 2018, other entities reported lethally removing an average of 29 eastern meadowlarks per year in the state to alleviate damage or threats of damage. The highest reported annual take of eastern meadowlarks by other entities occurred in 2018 when other entities reported taking 72 eastern meadowlarks in the state.

Table 3.19 – Eastern meadowlarks addressed by WS in Mississippi, FY 2014 – FY 2018

Fiscal Year	Take	Dispersed
2014	14	86
2015	71	92
2016	48	1,189
2017	46	596
2018	68	1,407

Based on the number of requests received to alleviate the threat of damage associated with eastern meadowlarks and the number of eastern meadowlarks addressed previously to alleviate those threats, WS anticipates that personnel could lethally remove up to 500 eastern meadowlarks annually in the state and up to 20 nests could be destroyed to alleviate the threat of damage. WS also anticipates that meadowlarks will continue to be addressed using primarily non-lethal harassment methods, with lethal methods employed to reinforce the use of non-lethal methods to prevent habituation.

Based on the estimated breeding population, WS' take of up to 500 meadowlarks would represent 0.1% of the estimated breeding population in Mississippi. If additional entities in the state continued to remove an average of 29 eastern meadowlarks per year under depredation permits issued by the USFWS, the combined take by WS and by other entities would represent 0.2% of the estimated breeding population in the state. If take by other entities reached 72 eastern meadowlarks annually, which was the highest reported take from 2014 through 2018, the combined take by WS and the take by other entities would represent 0.2% of estimated breeding population in the state.

The take of eastern meadowlarks to alleviate damage or threats would not likely reach a magnitude where adverse effects to meadowlark populations would occur. The declining trends associated with the BBS and the CBC surveys are likely associated with habitat loss across the range of the meadowlark (Jaster et al. 2012). The International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as a species that is "*near threatened*" (BirdLife International 2018*b*). 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 2018*b*). 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 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 2019). 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 2019). 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 2019). Northern breeding populations of red-winged blackbirds migrate southward during the migration periods, but red-winged blackbirds are common throughout the year in most of the United States (Yasukawa and Searcy 2019). During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species.

In Mississippi, red-winged blackbirds are present in the state throughout the year (Turcotte and Watts 1999, Yasukawa and Searcy 2019) with a breeding population estimated at 1.6 million blackbirds (Partners in Flight 2019). Trend data from the BBS indicates the number of red-winged blackbirds observed in the state during the breeding season has shown a declining trend since 1966 estimated at -2.0% annually (United States Geological Survey 2019). More recent trend data from 2007 through 2017 also indicates a downward trend estimated at -2.0% annually (United States Geological Survey 2019). The number of red-winged blackbirds observed during the CBC in the state has shown a highly cyclical pattern since 1966 (National Audubon Society 2010).

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 Mississippi (Turcotte and Watts 1999, Yasukawa and Searcy 2019). 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 2019). Migratory red-winged blackbirds are present in their wintering areas until departing on their spring migration from early February through mid-May with the peak occurring from late February through late April (Yasukawa and Searcy 2019). 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, the locally breeding population of red-winged blackbirds is indistinguishable from the population that migrates into the state from other areas. During the migration periods and during the winter, red-winged blackbirds often form mixed species flocks with other blackbird species and starlings.

Table 3.20 shows the number of red-winged blackbirds addressed by WS from FY 2014 through FY 2018. WS addressed red-winged blackbirds using non-lethal harassment methods, such as pyrotechnics, vehicle activities, physical actions, and the noise produced from firearms. The WS program in Mississippi also used lethal methods to remove red-winged blackbirds that employees identified as causing damage or the threat of damage (see Table 3.20). From FY 2014 through FY 2018, the lethal take of red-winged blackbirds by WS occurred from the use of firearms.

Table 3.20 – Red-winged blackbirds addressed by WS in Mississippi, FY 2014 – FY 2018

Year	Take	Dispersed
2014	0	421
2015	5	627
2016	16	27
2017	27	454
2018	13	3,645

Based on the population data for Mississippi and previous management activity focused on relieving damage or threats from blackbirds, WS could lethally remove up to 7,500 red-winged blackbirds annually to alleviate damage or threats of damage. With an estimated statewide breeding population of 1.6 million blackbirds, the take of 7,500 red-winged blackbirds annually would represent 0.5% of the breeding red-winged blackbird population in Mississippi. However, most activities associated with red-winged blackbirds occur when large concentrations of red-winged blackbird are present in the winter. The number of red-winged blackbirds that winter in the state is unknown and likely fluctuates throughout the year and from year to year.

The numbers of blackbirds present in the state likely increases as migratory blackbirds begin arriving in the state during the fall and winter. From 2008 through 2017, surveyors have counted an average of 71,500 red-winged blackbirds per year in those areas of the state surveyed during the CBC (National Audubon Society 2010). The take of up to 7,500 red-winged blackbirds by WS would represent 10.5% of the average number of blackbirds observed in areas of the state surveyed during the CBC from 2008 and 2017. The areas surveyed during the CBC represent a small portion of the state. From 2014 through 2018, other entities reported removing 72 red-winged blackbirds pursuant to the blackbird depredation order. The highest reported take of red-winged blackbirds occurred in 2015 when other entities reported removing 40 red-winged blackbirds. If the annual take by other entities reached 40 red-winged blackbirds annually and if WS' take reached 7,500 red-winged blackbirds, the combined take of WS and other entities would be 7,540 red-winged blackbirds. The take of 7,540 red-winged blackbirds would represent 10.6% of the average number of blackbirds observed in areas of the state surveyed during the CBC from 2008 and 2017.

However, the number of blackbirds observed in those areas surveyed during the CBC only represent the number of blackbirds observed and does not represent statewide population estimates; therefore, WS' annual take would likely represent a much lower percentage of the actual number of red-winged blackbirds that winter within the state.

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. Brown-headed cowbirds are permanent residents of Mississippi with cowbirds present in the state throughout the year (Lowther 1993). Breeding populations 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 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds still commonly occur in open grassland habitats but also inhabit urban and residential areas.

Unique in their breeding habits, cowbirds are brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, 144 species of which have actually raised cowbird young (Lowther 1993). Cowbirds provide no parental care with the raising of cowbird young occurring by the host species. There has been some concern that brood parasitism by cowbirds may threaten the breeding populations of vulnerable species, although the effects of parasitism on those species are unknown.

The number of cowbirds observed in areas surveyed during the BBS throughout Mississippi has shown stable trend since 1966, with the number of cowbirds observed in the state from 2007 through 2017 showing a decreasing trend estimated at -0.8% annually (United States Geological Survey 2019). Partners in Flight (2019) estimated the statewide breeding population of cowbirds at 1.4 million cowbirds based on data from the BBS. Similar to other blackbird species, the number of cowbirds observed during the CBC conducted annually in the state has shown a cyclical pattern (National Audubon Society 2010).

Table 3.21 shows the number of brown-headed cowbirds addressed by WS from FY 2014 through FY 2018. WS addressed brown-headed cowbirds using non-lethal harassment methods, such as physical actions, pyrotechnics, vehicle presence, and the noise produced from firearms. The WS program in Mississippi also used lethal methods to remove brown-headed cowbirds that employees identified as causing damage or the threat of damage (see Table 3.21). From FY 2014 through FY 2018, the lethal take of brown-headed cowbirds by WS occurred from the use of firearms.

Table 3.21 – Brown-headed cowbirds addressed by WS in Mississippi, FY 2014 – FY 2018

Year	Take	Dispersed
2014	0	39
2015	0	948
2016	70	640
2017	13	125
2018	38	40

Based on the previous number of requests to manage damage and threats associated with cowbirds, and in an anticipation of additional efforts to address future damages and threats in the state, up to 500 cowbirds could be lethally removed by WS annually in Mississippi if WS implements Alternative 1. If WS lethally removed up to 500 cowbirds annually, the take would represent 0.04% of the estimated 1.4 million cowbirds breeding within the state.

From 2014 through 2018, other entities reported removing four brown-headed cowbirds in 2017 and 10 brown-headed cowbirds in 2018 pursuant to the blackbird depredation order. If the annual take by other entities reached 10 brown-headed cowbirds annually and if WS' take reached 500 brown-headed cowbirds, the combined take of WS and other entities would be 510 brown-headed cowbirds. The take of 510 brown-headed cowbirds would represent 0.04% of estimated breeding population in the state.

Most activities associated with brown-headed cowbirds occur when large concentrations of cowbirds are present in the winter. However, the number of brown-headed cowbirds that winter in the state is unknown and likely fluctuates throughout the year and from year to year. The numbers of cowbirds present in the state likely increases as migratory cowbirds 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 human activities. Characterized by yellow eyes and iridescent bronze or purple plumage, common grackles are a common, conspicuous bird species found in urban and residential environments (Peer and Bollinger 1997). The breeding range of the common grackle includes Canada and the United States east of the Rocky Mountains, with grackles found throughout the year in the United States except for the far northern and western portion of the species range in the United States (Peer and Bollinger 1997). Common grackles have likely benefited from human activities, such as the clearing of forests in the eastern United States, which has provided suitable nesting habitat for grackles. The planting of trees in residential areas has also likely led to an expansion of the species range into the western United States (Peer and Bollinger 1997).

The 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 (Bull and Farrand 1977, Peer and Bollinger 1997). 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 blackbirds (Peer and Bollinger 1997, Turcotte and Watts 1999). Common grackles are a permanent resident of Mississippi with grackles present in the state throughout the year (Peer and Bollinger 1997, Turcotte and Watts 1999). Large numbers of nesting grackles can occur in open woodlands, swamps, marshes, pine forests, hammocks, and suburban areas.

Partners in Flight (2019) estimated the breeding population of common grackles in the state at 510,000 grackles. The number of grackles observed along BBS routes surveyed in the state has shown a downward trend from 1966 through 2017 estimated at -4.5% annually. From 2007 through 2017, the number of grackles observed during the BBS has also shown a downward trend in the state estimated at -4.0% annually (United States Geological Survey 2019). The number of common grackles observed in areas of the state surveyed during the CBC has shown an overall declining trend since 1966 (National Audubon Society 2010).

Table 3.22 shows the number of common grackles addressed by WS from FY 2014 through FY 2018. From FY 2014 through FY 2018, the WS program in Mississippi used firearms to take common grackles and the noise associated with discharging a firearm to disperse common grackles. Based on the estimated population and the anticipation of additional efforts to manage damage associated with blackbirds, including grackles, WS could take up to 500 common grackles annually in the state.

Like other blackbird species, the take of common grackles can occur under the blackbird depredation order, which allows people to take blackbirds, including common grackles, when those species are committing damage without the need for a depredation permit from the USFWS. The take of up to 500 common grackles would represent 0.1% of the estimated breeding population in Mississippi.

Table 3.22 – Common grackles addressed by WS in Mississippi, FY 2014 – FY 2018

Year	Take	Dispersed
2014	0	0
2015	1	0
2016	6	12
2017	1	3
2018	3	0

From 2014 through 2018, other entities reported removing five common grackles in 2018 pursuant to the blackbird depredation order. Although private individuals are now required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. Some annual take is likely to occur by private individuals; however, it is likely to be of low magnitude. The take of common grackles by WS and other entities is likely of low magnitude when comparing the annual take to the statewide population in Mississippi.

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[14]. Appendix E also addresses the potential impacts associated with implementing Alternative 1 on the populations of those species.

AVIAN DISEASE SURVEILLANCE AND MONITORING

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen causing the disease. Effective implementation of a surveillance system requires planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. Partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups would also be necessary.[15] For example, information on disease distribution and knowledge of the mixing of birds in migratory flyways was used to develop a prioritized sampling approach for detecting avian influenza viruses based on the major North American flyways. Surveillance data from all of those areas was incorporated into national risk assessments and preparedness and response planning to reduce the adverse impacts of a disease outbreak in wild birds, poultry, or humans. Examples of strategies for collecting samples in birds that WS could implement include:

<u>Investigation of Illness/Death in Birds</u>: A systematic investigation of illness and death in wild birds may be conducted to determine the cause of the illness or the cause of death in birds. This strategy offers the best and earliest probability of detection if a disease is introduced by migratory birds into the United

[14]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.
[15]Data collected by organizations/agencies conducting research and monitoring would provide a broad species and geographic surveillance effort.

States. Illness and death involving wildlife are often detected by, or reported to natural resource agencies and entities. This strategy capitalizes on existing situations of birds without additional birds being handled or killed.

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

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

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

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

Under the disease sampling strategies listed above that could be implemented to detect or monitor avian diseases in the United States, WS' implementation of those sampling strategies would not adversely affect avian populations in the state. Sampling strategies that could be employed involve sampling live-captured birds that could be released on site after sampling occurs. The sampling (*e.g.*, drawing blood, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse effects because those birds are released unharmed on site. In addition, sampling of sick, dying, or hunter harvested birds would not result in the additive lethal take of birds that would not have already occurred in the absence of a disease sampling program. Therefore, the sampling of birds for diseases would not adversely affect the populations of any of the birds addressed in this EA nor would result in any take of birds that would not have already occurred in the absence of disease 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 exists is a positive benefit to many people. Esthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, esthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

The human attraction to animals likely started when people began domesticating animals. The public today share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals 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 that 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) determined nearly 1.4 million people participated in wildlife-associated recreation in Mississippi, including people that participated in hunting, fishing, and wildlife watching. In total, people spent over $2.6 billion on wildlife recreation in Mississippi 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. They are offended because they feel that those species proliferate in such numbers and appear to remain unbalanced.

In the wild, few animals in the United States have life spans approaching that 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 landowner or property manager signs a MOU, work plan, work initiation document, or a similar 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 alternatives by WS would occur on a relatively limited portion of the total area in Mississippi, 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 – The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi 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 Mississippi. 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 to monitor and track birds in Mississippi.

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 2014 through FY 2018, the WS program in Mississippi used non-lethal methods to disperse an average of 385 killdeer per year in the state to alleviate damage or threats of damage (see Table 3.3). 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 harassment, 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 harassment 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 immediately after capture can reduce the likelihood of injuries and death. In addition, making appropriate modification to live-capture methods can reduce injuries.

However, 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. Similarly, the use of aircraft 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. 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 then attach leg bands or other identifying markers (*e.g.*, patagial tags) for identification purposes. 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. When using leg bands, WS would use those 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*".

The WS program in Mississippi 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 Mississippi 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, indirect 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 in Mississippi 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 Mississippi. 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 by other entities. Although non-lethal methods 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 any 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 MDWFP from continuing to issue depredation permits or other authorizations for the take of birds in Mississippi 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 could continue to issue a depredation permit that allows 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. Similarly, 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, brown-headed cowbirds, and American 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 - The WS program would recommend an integrated methods approach to managing bird damage in Mississippi 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. 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 persons receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from other entities, or take no further action. 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 MDWFP from authorizing the lethal take of birds in the state. The take of red-winged blackbirds, Brewer's blackbirds, common grackles, brown-headed cowbirds, and American 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 MDWFP. 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 Mississippi has occurred and would continue to occur by entities other than WS.

With the oversight of the USFWS and the MDWFP, 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 – The WS program would not provide any assistance with managing damage caused by birds in Mississippi

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, MDWFP, 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 alternatives, 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 MDWFP from continuing to authorize the take of birds in Mississippi. The take of red-winged blackbirds, Brewer's blackbirds, common grackles, brown-headed cowbirds, and American 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 MDWFP. Take of certain harvestable bird species would continue to occur during the hunting season for those species. 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 alternatives because other entities would continue to use non-lethal and lethal methods to alleviate bird damage.

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

As discussed previously, a concern would be the potential impacts to non-target species, including T&E 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 T&E species, occurs below for each of the alternatives identified in Section 2.2.2.

Alternative 1 – The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi (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, employees of WS 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 regards 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 by 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)*

As discussed in Appendix B, 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. 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 bait that has been treated.

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 uneaten bait must be picked up 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.

WS would only use those formulations of 4-Aminopyridine that the EPA has approved for use in accordance with the FIFRA and that the MDAC has approved for use in Mississippi. WS will reduce risks to non-target species by following the label requirements of the products WS' personnel use in Mississippi. From FY 2014 through FY 2018, the WS program in Mississippi did not use 4-Aminopyridine and WS does not anticipate using 4-Aminopyridine frequently.

- *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.

WS has registered two formulations of DRC-1339 with the EPA that would be available for WS to register with the MDAC to use in Mississippi. One formulation of DRC-1339 would be available to manage crows causing damage to livestock, crows causing damage to silage/fodder bags, and crows feeding on the eggs or young of federally designated threatened or endangered species (Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder Depredations; EPA Reg. #56228-29). The other formulation of DRC-1339 would be available to manage blackbirds, 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 (Compound DRC-1339 Concentrate – Bird Control; EPA Reg. #56228-63). The WS program in Mississippi has infrequently used the avicide DRC-1339. From FY 2009 through FY 2018, WS has only used DRC-1339 during FY 2010 to manage damage caused by pigeons in an urban setting. WS anticipates continuing to use DRC-1339 on a limited basis and primarily in urban/industrial areas.

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

[16]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.

In a cage study, Cummings et al. (1992) found that 75 (79%) of 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 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).

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

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment was established by the EPA to provide guidance on ecological risk assessment methods (EPA 1999). The committee report recommended to the EPA that only one definitive LD_{50} be used in toxicity screening either on the mallard or northern bobwhite and recommended further testing be conducted using the up-and-down method (EPA 1999). Many of the screening methods used for DRC-1339 prior to the establishment of EPA guidelines in 1982 used the up-and-down method of screening (Eisemann et al. 2003). A review of the literature shows that LD_{50} research using smaller sample sizes conducted prior to EPA established guidelines are good indicators of LD_{50} derived from 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 use of the location. In addition, label requirements of DRC-1339 may restrict where WS' personnel could apply treated bait. For example, the label may prohibit 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. It addition, the label may restrict 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 abandoned 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 bait placed, 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 occurs 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 feeding activity. If WS' personnel observe non-target animals feeding on bait, WS' personnel would abandoned 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 nor found 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, Linz et al. 1999, 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. 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 wildlife associated with crows caching bait treated with DRC-1339. Crows may cache surplus food. 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 2002). 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 non-target animals finding bait treated with DRC-1339 that a crow cached a non-target animal would have to locate the cached bait and the bait-type used would have to be palatable or selected for by the non-target wildlife. 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 unlikelihood 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 likelihood 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 Mississippi to be extremely low to non-existent. WS would continue to monitor the activities conducted to ensure program 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 MDWFP any non-target bird take to ensure those agencies have the opportunity to consider take by WS as part of management objectives.

WS' impact on biodiversity

The WS program does not attempt to eradicate any species of native wildlife in the state. WS operates in accordance with 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 frequently 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 Mississippi 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 alternatives 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.

Potential effects of implementing alternative 1 on eagles

The Bald and Golden Eagle Protection Act and the MBTA protect the bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) 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 and golden eagles is prohibited without a permit from the USFWS. Under the Bald and Golden Eagle Protection Act, the definition of "*take*" includes actions that may "*disturb*" eagles. Disturb has been defined under 50 CFR 22.3 as those actions that cause, or are likely to cause, injury to an eagle, a decrease in productivity, or nest abandonment by substantially interfering with their normal breeding, feeding, or sheltering behavior.

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 (see USFWS 2007). A variety of human activities can potentially interfere with bald eagles and golden eagles, affecting their ability to forage, nest, roost, breed, or raise young. The USFWS developed the bald eagle management guidelines to help people minimize such impacts to eagles, particularly where they may constitute "*disturbance*".

In Mississippi, bald eagles may occur statewide throughout the year (Buehler 2000). In the southeastern United States, bald eagles may build nests from September through February and egg laying, incubation, hatching, and young rearing may occur from early October through the end of April. Fledging young may be present at or near nests from late January through the end of May (USFWS 2007). The breeding range of golden eagles occurs mainly in western North America from Alaska to central Mexico with small numbers breeding in northeastern Canada and isolated breeding pairs occurring in the eastern United States (Kochert et al. 2002). The winter range of golden eagles is similar to their breeding range, but golden eagles also occur locally throughout the eastern United States, including Mississippi, during the migration and winter (Kochert et al. 2002). Kochert et al. (2002) indicated that golden eagles are "*scarce*" in Mississippi during the non-breeding season. Turcotte and Watts (1999) described golden eagles as "*occasional winter visitors*" in Mississippi.

WS would only conduct limited activities near active eagle nests and Important Eagle Use Areas[17] in accordance with the National Bald Eagle Management Guidelines (USFWS 2007). 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 Mississippi but may be present during the migration periods and during the winter. WS does not expect activities 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 cause 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).

Analysis of risks to threatened and endangered species

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 Services pursuant to Section 7 of the ESA to ensure compliance. The WS program 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*

[17] Pursuant to 50 CFR 22.3, the definition of an Important Eagle-use Area is "…*an eagle nest, foraging area, or communal roost site that eagles rely on for breeding, sheltering, or feeding, and the landscape features surrounding such nest, foraging area, or roost site that are essential for the continued viability of the site for breeding, feeding, or sheltering eagles*."

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 Mississippi 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 Mississippi 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 Mississippi 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 (S. Ricks, USFWS, pers. comm. 2019).

The USFWS has also designated critical habitat in Mississippi 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 Mississippi along with WS' effects determination. 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 Mississippi (S. Ricks, USFWS pers. comm. 2019). WS would continue to review the species listed as threatened or endangered by the USFWS and the National Marine Fisheries Service and would continue to consult with the USFWS and/or the National Marine Fisheries Service as appropriate.

Appendix D shows those species designated by the MDWFP as threatened or endangered within the state. The WS program in Mississippi has also reviewed the list of species the MDWFP has designated as threatened or endangered. Based on the review of species listed in the state, WS has determined that the proposed activities would have no effect on those species currently listed as threatened or endangered by the MDWFP. WS would continue to review the species listed as threatened or endangered by the MDWFP. As appropriate, the WS program would consult with the MDWFP when WS determines activities may affect a threatened or endangered species designated by the MDWFP.

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

Implementation of Alternative 2 would require the WS program 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 of concern, which could reduce the fitness or ability of a non-target animal to survive, especially if the exposure to the stressor were 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 received no reports or documented any cumulative effects associated with the use of non-lethal methods from previous activities associated with managing damage caused by target bird species in the state that WS conducted.

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*

For the effects analysis, 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 the threat 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 the threat 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 the threat 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 are likely to occur in areas already modified for agriculture production.

- *Exclusion 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 threat to aircraft from a bird strike. Exclusion 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 the 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, exclusion 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 exclusion devices would primarily occur by the entity experiencing damage or threats of damage. In addition, exclusion methods may also have limited application because their use could restrict people's access to the resource. For example, netting erected to prevent swallows from nesting under bridges 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 erected to prevent access of target species also potentially excludes other 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.

- *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 the use of 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 WS' personnel 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, producing a novel noise, or producing an 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 use those methods 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 Material 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).

➢ *High-pressure Water Spray*

WS would primarily use high-pressure water spray to remove inactive nests on bridges, buildings, and other structures. WS could also 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 the 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. During activities, water would soak into the soil, runoff into nearby streams, enter a municipal sewer system, and/or enter into a municipal storm water system.

WS has occasionally used high-pressure water to remove inactive swallow nests under bridges. Swallow nests consist of mud and other debris (*e.g.*, grass, feathers), which, when washed, could fall into the water under a bridge or wash away in runoff. Therefore, using water to remove nests could cause sediments and other debris to enter water under bridges or water in nearby areas. 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 into the water. WS does not anticipate removing nests using high-pressure water spray with any frequency or intensity that would result in effects. 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.

➢ *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 and 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 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 21.43(f)). Therefore, WS' personnel could release any non-target animals captured in live-traps.

- *Nets*

Nets (*e.g.*, cannon nets, mist nets, bow nets, dipping nets) restrain birds once captured and are live-capture methods. 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 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 using in such a manner as to ensure the survivability of the animal if released. Even though live-capture does occur from those methods, the potential for death of a target or non-target animal while being restrained or released does exist, primarily from being struck by cannon or rocket assemblies during deployment. The likelihood of cannon or rocket assemblies striking a non-target animal is extremely low. The risk is likely 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.

- *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.

- *Nest Destruction*

WS' personnel would remove nests by hand, 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.

- *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, including the use of unmanned aerial vehicles, have the potential to disturb wildlife. Aerial operations could be an important method for surveying, monitoring, and tracking birds in Mississippi. 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 (Bellrose 1976), 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 (*Chen 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 even 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 Unmanned Aerial Vehicles (UAVs) (*e.g*., drones) 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. 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 company. 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 MDAC 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 wildlife. 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 threatened or endangered species.

➢ *Mesurol*

Mesurol is the commercial name of a product that contains the active ingredient methiocarb. The EPA has approved the use of mesurol to condition crows not to feed on the eggs of threatened or endangered species or other species designated to be in need of special protection. However, WS has not registered mesurol with the MDAC for use in Mississippi. WS would not use mesurol until and unless the MDAC approved the use of mesurol in the state.

Mesurol is a powder that WS' personnel would mix with water and the liquid contents of eggs. Once mixed, WS' personnel would inject the mixture inside raw eggs that are similar in size and appearance to the eggs of the threatened or endangered species that WS is trying to protect from predation by crows. WS' personnel would place treated eggs inside "*dummy*" nests (*i.e*., nests created by WS' personnel or others that are similar in appearance to nests constructed by the threatened or endangered species). WS would place treated eggs in the area where the protected species nests approximately three weeks prior to the onset of egg laying to condition crows to avoid feeding on eggs.

Mesurol has a high acute toxicity to birds, mammals, fish, and aquatic invertebrates. Applying mesurol directly inside eggs that are of a similar appearance to eggs that crows are feeding on would primarily restrict risks to non-target animals that select for the egg baits. Use requirements of mesurol limit the number of treated eggs per acre that WS could use. WS' personnel must check treated eggs at intervals of 24 hours or less and WS' personnel must periodically observe the treated area to monitor for responses of target crow species, nesting birds, and non-target species. WS' personnel would set up an observation blind and/or video monitoring equipment near each treatment area to monitor the responses of target crow species, nesting birds, and non-target species. In addition, WS' personnel would follow the removal and disposal process for unconsumed or unused treated eggs. Adherence to the label requirements of mesurol would ensure threats to non-target animals would be minimal.

➢ *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 Mississippi by the MDAC. In Mississippi, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons, European starlings, red-winged blackbirds, common grackles, Brewer's blackbirds, 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 MDAC for use in Mississippi.

Exposure of non-target wildlife to nicarbazin could occur from direct ingestion of the bait by non-target wildlife or from secondary hazards associated with wildlife consuming birds that have eaten treated bait. Several label restrictions of 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 abandoned the site. In addition, applicators can only apply nicarbazin using an automatic wildlife feeder that the applicator has programmed to release bait once a day. Applicators must monitor baiting locations periodically for non-target animal activity. The label also requires applicator ensure the 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 in pigeons (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 occurs 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). 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 Mississippi 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 cause 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).

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

Under a technical assistance alternative, WS would have no direct impact on non-target species, including T&E 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 methods that would not be available under a technical assistance only alternative would include some formulations of DRC-1339 and mesurol, which are 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 provided technical assistance did not use the recommended methods and techniques correctly or people used methods that WS did not recommend, the potential impacts on non-target species, including T&E species, would likely be higher when compared to Alternative 1.

The potential impacts of harassment and exclusion methods on non-target species would be similar to those described for Alternative 1. Harassment and exclusion 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 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 T&E species, would be variable under a technical assistance only alternative. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of birds, which could lead to unknown effects on local non-target species populations, including some T&E species. When the damage caused by wildlife reaches a level where assistance does not adequately reduce damage or where no assistance is available, people have resorted to using chemical toxicants that are illegal for use on the intended target species, which can result 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 those persons frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate take of wildlife species.

Those persons requesting assistance are those likely to use lethal methods because a damage threshold has been met for that individual requester that has triggered seeking assistance to reduce damage. The potential impacts on non-target animals by those persons experiencing damage would be highly variable. People with 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 T&E 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 – The WS program would not provide any assistance with managing damage caused by birds in Mississippi

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 T&E species would occur by WS under this alternative. Risks to non-target animals and T&E 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 that 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 alternatives.

The ability to reduce damage and threats of damage caused by birds would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to non-target animals and T&E species would be similar across the alternatives because most of those methods described in Appendix B would be available to use by people if WS implements this alternative. If people apply those methods available as intended, risks to non-target animals would be minimal to non-existent. If people apply those methods available incorrectly or without knowledge of animal behavior, risks to non-target animals would 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 that have 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).

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

A common concern is the potential adverse effects methods available could have on human health and safety. An evaluation of the threats to human health and safety associated with methods available under the alternatives occurs below for each of the four alternatives carried forward for further analysis.

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

If WS implements Alternative 1, WS' personnel would assess the damage or threat occurring, would evaluate the management methods available, and would 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 2.601, 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 2.601. In addition, WS' personnel would also follow WS Directive 2.635 that establishes guidelines and standard training requirement 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, the 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 MOU, work initiation document, or a similar document that would indicate the methods the cooperating entity agrees to allow WS to use on the property they own or property they 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 MDWFP for activities associated with birds. WS' personnel would also make the cooperator requesting assistance aware 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 alternatives 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 2014 through FY 2018. The risks to human safety from the use of non-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, the use of non-chemical would comply with Executive Order 12898 and Executive Order 13045.

- *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 2.601, 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 the 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.

- *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 2.601. WS' personnel who use pyrotechnics would follow the guidelines for using pyrotechnics in accordance with WS Directive 2.627.

- *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.

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 using UAVs, 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 that 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 MDWFP 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 the WS program conducts aerial operations, the risk to the public from aviation operations or accidents would be minimal. The WS program aircraft-use policy helps ensure the program uses aircraft in a safe and environmentally sound manner in accordance with federal and state laws.

- *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 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 and to remain certified for firearm use, WS' employees must attend a re-certification safety-training course in accordance with WS Directive 2.615. WS' employees who carry and use firearms as a condition of employment are 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). 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 alternatives unless otherwise prohibited by the USFWS in a depredation permit, depredation order, or a control order. 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 alternatives 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 alternatives.

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 MDWFP 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. 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.

➢ *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 list cervical dislocation as conditionally acceptable methods of euthanasia for free-ranging birds that can lead to a humane death (AVMA 2013). 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 MDWFP for activities associated with birds.

SAFETY OF CHEMICAL METHODS EMPLOYED

In addition to non-chemical methods, chemical methods could also 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 mesurol (crows), nicarbazin (rock pigeons, European starlings, red-winged blackbirds, Brewer's blackbirds, common grackles, brown-headed cowbirds), carbon dioxide for euthanasia, egg oiling, Avitrol (pigeons, crows, blackbirds, grackles, cowbirds, starlings, house sparrows), the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, gulls 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 administered chemical methods would receive appropriate training to use those methods. WS would dispose of carcasses in accordance with WS Directive 2.515.

No adverse effects to human safety have occurred from WS' use of chemical methods to alleviate bird damage in the state from FY 2014 through FY 2018. 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 non-chemical would comply with Executive Order 12898 and Executive Order 13045.

➢ *Mesurol*

The EPA has approved the use of mesurol to condition crows not to feed on the eggs of threatened or endangered species. Mesurol is a powder that WS' personnel would mix with water and the liquid contents of eggs. Once mixed, WS' personnel would inject the mixture inside raw eggs that are similar in size and appearance to the eggs of the threatened or endangered species that WS is trying to protect from predation by crows. WS' personnel would mark each treated egg with the word "*POISON*" according to label requirements. WS' personnel would place treated eggs inside "*dummy*" nests (*i.e.*, nests created by WS' personnel or others that are similar in appearance to nests constructed by the threatened or endangered species).

In accordance with label requirements, WS would post all treated areas with warning signs requiring exclusion of children, pets, and livestock from these areas. WS would post signs at logical points of access and far enough away from nesting sites so that signs are noticeable and remote to minimize unauthorized approaches to nesting areas. Therefore, human safety risks associated with the use of mesurol occur primarily to the mixer and handler during preparation and application. WS' personnel would follow all label requirements, including the personal protective equipment required to handle and mix bait. When used according to label requirements, the risks to human safety from the use of mesurol would be minimal. As discussed previously, WS has not registered mesurol for use in Mississippi; however, this EA evaluates the use of mesurol as a repellent that WS could employ if WS implements this alternative. WS would not use mesurol until and unless the MDAC approved the use of mesurol in the state.

➢ *Nicarbazin*

In Mississippi, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons, European starlings, red-winged blackbirds, common grackles, and brown-headed cowbirds, which is available as a general use commercial product 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. Use restrictions of nicarbazin for pigeons limit its use to rooftops or other flat paved or concrete surfaces and limited to use 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 MDAC for use in Mississippi.

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 a tolerance of nicarbazin residues of four parts per million allowed in uncooked chicken muscle, skin, liver, and kidney (21 CFR 556.445). The EPA characterized the risks of human exposure as low when used to reduce egg hatch in Canada geese. The EPA also concluded that if human consumption occurred, 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 (2013) guidelines on euthanasia list carbon dioxide as conditionally acceptable methods of euthanasia for free-ranging birds that can lead to a humane death. 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 carbon dioxide from the release of carbon dioxide would not occur. Based on the use patterns from the use of carbon dioxide in sealed chamber to euthanize animals, the risks to human safety is 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 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.

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 personnel 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) further 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 of Avitrol, risks to human health and safety associated with the use of Avitrol should be minimal.

➢ *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 that 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. Therefore, risks to handlers and mixers that 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, would broadcast the bait using mechanical methods (ground-based equipment or hand spreaders), or would 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 (MDWFP 2018*b*). 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. Although baiting could occur in rural areas of 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 in Section 3.2.2).

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. Secondly, 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 Mississippi, 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. Thirdly, 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, the WS program in Mississippi rarely uses DRC-1339 to alleviate damage or threats of damage associated with crows. From FY 2014 through FY 2018, no take of crows occurred by the WS program in Mississippi 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. 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 pig skin, dipropylene glycol, mineral oil, and dye as the colorant (Donaldson 2003). Paintballs are considered non-toxic to people and do not pose an environmental hazard, as described on product labeling and Material Safety Data Sheets.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

Section 1.4.3 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. Mesurol and DRC-1339 would generally be the methods 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 the WS program in Mississippi 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 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 the WS program 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 – The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi using only non-lethal methods

Implementation of this alternative would require the WS program 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, exclusion 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 2014 through FY 2018. The risks to human safety from the use of non-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 and Executive Order 13045.

Other entities could and would likely continue to use non-chemical lethal methods if WS implements this alternative, such as firearms. 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 the personnel of the WS program 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, mesurol (crows), 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 2014 through FY 2018. 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 and Executive Order 13045.

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 1.4.3 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 disease 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 - The WS program would recommend an integrated methods approach to managing bird damage in Mississippi 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 methods described in Appendix B that would not be available for use by other entities, would be mesurol and 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 that request assistance from WS could conduct activities and use methods recommended by WS' personnel, they could implement other methods, they could seek further assistance from other entities, or they 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, mesurol and the avicide DRC-1339 would not be methods that WS could recommend because those methods are 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. Mesurol would also not be available for WS to recommend through technical assistance because mesurol is only available to prevent egg predation of threatened or endangered species by crows and would not be available to reduce threats to human health and safety if WS implements any of the alternatives. 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, starlings, 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 – The WS program would not provide any assistance with managing damage caused by birds in Mississippi

If WS implements Alternative 4, the WS program in Mississippi would not provide assistance 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, MDWFP, 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 MDWFP.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people experiencing bird damage could conduct activities themselves, they could seek assistance from other entities, or they could take no action. The requester and/or other entities would be responsible for using those methods available. 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 harassment 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.

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, 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 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, mesurol and the avicide DRC-1339 would not be available for the public to use if WS implements this alternative because those methods are 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. Mesurol would also not be available for the public to use; however, mesurol is only available to prevent egg predation of threatened or endangered species by crows and would not be available to reduce threats to human health and safety if WS implements any of the alternatives.

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.

3.2.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

As discussed previously, a common issue often raised is concerns about the humaneness and animal welfare concerns of methods available under the alternatives for resolving damage and threats. Discussion of method humaneness and animal welfare concerns for those methods available under the alternatives occurs below.

Alternative 1 - The WS program would continue the current integrated methods approach to managing damage caused by birds in Mississippi (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 methods would be checked frequently to ensure birds captured are addressed 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 birds be harvested 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' directives (WS Directive 2.505) and recommended by the AVMA for use on free-ranging wildlife under field conditions (AVMA 2013).

The euthanasia methods being considered for use under the proposed action for live-captured birds are cervical dislocation and carbon dioxide. The AVMA guideline on euthanasia lists cervical dislocation and carbon dioxide as an acceptable method of euthanasia for free-ranging birds, which can lead to a humane death (AVMA 2013). 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 2013). WS' personnel that employ firearms to address bird damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

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

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 which 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 merely dispersed. In experiments to determine suffering, stress, or pain in affected animals, Rowsell et al. (1979) tested Avitrol on pigeons and observed subjects for clinical, pathological, or neural changes indicative of pain or distress but none were observed. Conclusions of the study were that the chemical met the criteria for a humane pesticide.

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 that 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 methods that would not be available for the public to use if WS implemented the other alternatives would be DRC-1339 and mesurol. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives 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 alternatives.

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

If WS implemented this alternative, the WS program 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 - The WS program would recommend an integrated methods approach to managing bird damage in Mississippi 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 – The WS program would not provide any assistance with managing damage caused by birds in Mississippi

WS would not provide any assistance if the WS program in Mississippi 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.

3.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Based on the best available information, the analyses in Section 3.2.1 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 for other entities to take many of the bird species addressed in this EA and the lethal take of birds in Mississippi has occurred by entities other than WS. The USFWS could continue to issue depredation permits 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 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 2014 through FY 2018. Based on the use patterns of methods available to address damage caused by birds, implementation of Alternative 1 would comply with Executive Order 12898 and Executive Order 13045. Other entities have and would 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 methods that would not be available for use by the public would be the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, gulls only) and mesurol (crows only). Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives 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 alternatives. 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: RESPONSES TO PUBLIC COMMENTS

WS made the EA available to the public for review and comment by a legal notice published in the *Clarion Ledger* newspaper from November 23, 2019 through November 25, 2019. WS and the TVA also made the EA available to the public for review and comment on the APHIS website on December 2, 2019 and on the federal e-rulemaking portal at the regulations.gov website beginning on November 20, 2019. WS also sent out direct mailings to local known stakeholders and an electronic notification to stakeholders registered through the APHIS Stakeholder Registry. The public involvement process ended on January 10, 2020.

4.1 SUMMARY OF PUBLIC COMMENTS AND WS' RESPONSES TO THE COMMENTS

During the public comment period, WS and the TVA received four comment responses on the draft EA. Section 4.1 summarizes the comments received and provides WS' responses to the comments.

Comment – Agriculture producers in Mississippi cause harm to the soil, water, and air through their use of chemicals

Response: The farming practices that agriculture producers in Mississippi, including their use of chemicals, is outside the authority of the WS program. Section 1.2 of the EA discusses the primary statutory authority of the WS program.

Comment – Agriculture producers should use humane non-lethal methods to keep birds away from their fields

Response: Agriculture producers often use non-lethal methods to manage bird damage. For example, Stickley and Andrews (1989) found that catfish farms in Mississippi spent an average of 2.6 hours per day harassing waterbirds from aquaculture ponds. In 1988, 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 (Stickley and Andrews 1989). 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).

Comment – WS sneaks into areas with no notice to anyone

Response: The WS program only provides assistance after receiving a request for such assistance and only after the entity requesting assistance and WS sign a MOU, work initiation document, or another similar document. Therefore, the decision-maker for what activities WS conducts is the entity that owns or manages the affected property. The decision-makers have the discretion to involve others as to what occurs or does not occur on property they own or manage. Therefore, in the case of an individual property owner or manager, the involvement of others and to what degree they involve others in the decision-making process would be a decision made by that individual. Section 2.2.1 in the EA discusses WS' co-managerial approach to making decisions.

Comment – Commenter wanted to know if the proposed activities would increase hunting opportunities and increase harvest limits for birds

Response: Establishing hunting seasons and the number of animals that people can harvest during those seasons are outside the authority of the WS program. Section 1.2 of the EA discusses the primary statutory authority of the WS program. The USFWS establishes frameworks for the migratory bird hunting seasons that the MDWFP implements in the state. As discussed in the EA, WS could recommend that a person allow sport hunting on their property when people can legally harvest the target species during a hunting season.

Comment – WS should receive no taxpayer funding; WS should shutdown

Response: WS identified an alternative approach that would require cooperators completely fund activities (see Section 2.2.3). However, WS did not consider the alternative in detail for the reasons provided in Section 2.2.3. In those cases where WS receives federal and/or state funding to conduct activities, federal, state, and/or local officials have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility.

Comment – WS should leave birds alone; no punishment for birds

Response: Implementation of Alternative 4 would preclude any activities by WS to alleviate damage or threats of damage associated with those bird species addressed in the EA. Therefore, WS considered this alternative approach.

Comment – Birds have lost habitat because of human activities

Response: As discussed in the EA, 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 program effects occurred within the limits of evaluated 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. Because habitat 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. Through monitoring, WS can evaluate and adjust activities as changes occur over time. Managing human activities to limit habitat loss is outside the authority of the WS program. Section 1.2 of the EA discusses the primary statutory authority of the WS program.

Comment – WS should not use net guns to capture birds

Response: If WS implemented Alternative 1 or Alternative 2, net guns are a method that WS could consider when using the WS Decision Model to evaluate management methods. WS could use net guns to capture individual birds or a small number of birds that WS was unable to capture using other methods. As indicated in the EA, WS does not anticipate using net guns frequently.

CHAPTER 5 - LIST OF PREPARERS, REVIEWERS, AND PERSONS CONSULTED

5.1 LIST OF PREPARERS

Kristina Casscles Godwin, State Director	USDA-APHIS-Wildlife Services
Ryan Wimberly, Environmental Coordinator	USDA-APHIS-Wildlife Services

5.2 LIST OF PERSONS CONSULTED AND REVIEWERS

Charles Knight, Director	Mississippi Museum of Natural Sciences
Chris McDonald, Director of Federal Affairs	MDAC
Russ Walsh, Wildlife Executive Staff Officer	MDWFP
Stephen Ricks, Field Supervisor	USFWS
Elizabeth Smith, NEPA Specialist	TVA
Mitzi Reed, Director of Wildlife	Mississippi Band of Choctaw Indians

APPENDIX A
LITERATURE CITED

Able K. P., and J. R. Belthoff. 1998. Rapid "evolution" of migratory behaviour in the introduced house finch of eastern North America. Proceedings of the Royal Society 265:2063-2071.

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.

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

Alexander, D. J. 2000. A review of avian influenza in different bird species. Veterinary Microbiology 74:3–13.

Alexander, D. J., and D. A. Senne. 2008. Newcastle disease and other avian paramyxoviruses, and pneumovirus infections. Pages 75–141 *in* Y. M. Saif, editor. Diseases of Poultry, Twelfth Edition. Blackwell Publishing, Ames, Iowa, USA.

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.

Allen, R. W., and M. M. Nice. 1952. A study of the breeding biology of the Purple Martin (*Progne subis*). American Midland Naturalist 47:606–665.

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

AVMA. 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. American Veterinary Medical Association. https://www.avma.org/KB/Policies/Pages/Euthanasia-Guidelines.aspx. Accessed July 5, 2017.

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.

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

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.

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

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

Avery, M. L., E. C. Greiner, J. R. Lindsay, J. R. Newman, and S. Pruett-Jones. 2002*a*. Monk parakeet management at electric utility facilities in south Florida. Proceedings of the Vertebrate Pest Conference 20:140–145.

Avery, M. L., J. W. Nelson, and M. A. Cone. 1991. Survey of bird damage to blueberries in North America. Proceedings of the Fifth Eastern Wildlife Damage Control Conference 5:105-110.

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

Avery, M. L., J. S. Humphrey, E. A. Tillman, K. O. Phares, and J. E. Hatcher. 2002*b*. Dispersing vulture roosts on communication towers. Journal of Raptor Research 36:45–50.

Avery, M. L., 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.

Badyaev, A. V., V. Belloni, and G. E. Hill. 2012. House Finch (*Haemorhous mexicanus*). Issue No. 046 in A. Poole, editor. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. <http://bna.birds.cornell.edu/bna/species/046>. Accessed August 26, 2016.

Barnes, T. G. 1991. Eastern bluebirds, nesting structure design and placement. College of Agric. Ext. Publ. FOR-52. Univ. of Kentucky, Lexington, Kentucky. 4 pp.

Bateson, P. 1991. Assessment of pain in animals. Animal Behaviour 42:827-839.

Beaver, B. V., W. Reed, S. Leary, B. McKiernan, F. Bain, R. Schultz, B. T. Bennett, P. Pascoe, E. Shull, L. C. Cork, R. Franis-Floyd, K. D. Amass, R. Johnson, R. H. Schmidt, W. Underwood, G.W.

Thorton, and B. Kohn. 2001. 2000 Report of the American Veterinary Association Panel on Euthanasia. Journal of the American Veterinary Association 218:669–696.

Bechard, M. J., and J. M. Bechard. 1996. Competition for nestboxes between American kestrels and European starlings in an agricultural area of southern Idaho. Pp. 155–162 *in* D. M. Bird, D. E. Varland, J. J. Negro. Raptors in human landscapes: adaptations to built and cultivated environments. Academic Press, San Diego, CA, USA.

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. American Midland Naturalist 134:30-40.

Bellrose, F. C. 1976. Ducks, geese and swans of North America. Stackpole, Harrisburg, Pennsylvania.

Berryman, J. H. 1991. Animal damage management: Responsibilities of various agencies and the need for coordination and support. Proceedings of the Eastern Wildlife Damage Control Conf. 5:12-14.

Besser, J. F. 1964. Baiting starlings with DRC-1339 at a large cattle feedlot, Ogden, Utah, January 21 - February 1, 1964. U. S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado. Supplementary Technical Report Work Unit F9.2.

Besser, J. F. 1985. A grower's guide to reducing bird damage to U.S. agricultural crops. Bird Damage Research Report No. 340. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado, USA.

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

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

Bevins, S. N., R. J. Dusek, C. L. White, T. Gidlewski, B. Bodenstein, K. G. Mansfield, P. DeBruyn, D. Kraege, E. Rowan, C. Gillin, and B. Thomas. 2016. Widespread detection of highly pathogenic

H5 influenza viruses in wild birds from the Pacific Flyway of the United States. Scientific Reports 6:1-9.

BirdLife International. 2016*a*. *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 August 1, 2019.

BirdLife International. 2016*b*. *Ardea alba*. The IUCN Red List of Threatened Species 2016: e.T22697043A86468751. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22697043A86468751.en. Accessed March 14, 2019.

BirdLife International. 2016*c*. *Progne subis*. The IUCN Red List of Threatened Species 2016: e.T22712098A94319217. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22712098A94319217.en. Accessed April 17, 2018.

BirdLife International. 2017. *Egretta caerulea* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T22696944A118857172. http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696944A118857172.en. Accessed April 17, 2018.

BirdLife International. 2018*a*. *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. Accessed November 12, 2019.

BirdLife International. 2018*b*. *Sturnella magna*. The IUCN Red List of Threatened Species 2018: e.T22735434A131853051. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22735434A131853051.en. Accessed December 6, 2018.

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

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

Blancher, P. J., K. V. Rosenberg, A. O. Panjabi, B. Altman, A. R. Couturier, W. E. Thogmartin, and the Partners in Flight Science Committee. 2013. Handbook to the Partners in Flight Population Estimates Database, Version 2.0. PIF Technical Series No 6.

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.

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. 2013. State of the climate in 2012. Bulletin of the American Meteorological Society 94:S1-S238.

Bomford, M. 1990. Ineffectiveness of a sonic device for deterring European Starlings. Wildlife Society Bulletin 18:151-156.

Bonner, B. M., W. Lutz, S. Jager, T. Redmann, B. Reinhardt, U. Reichel, V. Krajewski, R. Weiss, J. Wissing, W. Knickmeier, H. Gerlich, U. C. Wend, and E. F. Kaleta. 2004. Do Canada geese (*Branta canadensis* Linnaeus, 1758) carry infectious agents for birds and man? European Journal of Wildlife Research 50:78–84.

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.

Bradshaw, J. E., and D. O. Trainer. 1966. Some Infectious Diseases of Waterfowl in the Mississippi Flyway. Journal of Wildlife Management 30:5705–76.

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

Brough, T. 1969. The dispersal of starlings from woodland roosts and the use of bio-acoustics. Journal of Applied Ecology 6:403-410.

Brown, C. R., and S. Tarof. 2013. Purple Martin (*Progne subis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/purmar. Accessed July 17, 2017.

Brown, C. R., M. B. Brown, P. Pyle, and M. A. Patten. 2017. Cliff Swallow (*Petrochelidon pyrrhonota*), version 3.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.cliswa.03. Accessed July 17, 2017.

Brown, J. D., D. E. Stallknecht, J. R. Beck, D. L. Suarez, and D. E. Swayne. 2006. Susceptibility of North American ducks and gulls to H5N1 highly pathogenic avian influenza viruses. Emerging Infectious Diseases 12:1663–1670.

Brown, M. B., and C. R. Brown. 2019. Barn Swallow (*Hirundo rustica*), version 2.0. In The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.barswa.02. Accessed November 15, 2019.

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.

Brown, T. J., M. J. Donaghy, E. A. Keys, G. Ionas, J. J. Learmonth, P. A. McLenachan, and J. K. Clarke. 1999. The Viability of *Giardia intestinalis* and *Giardia muris* cysts in seawater. International Journal of Environmental Health Research 9:157–161.

Bruce, R. D. 1985. An Up-and-Down procedure for acute toxicity testing. Fundamentals of Applied Toxicology 5:151-157.

Bruce, R. D. 1987. A confirmatory study of the up-and-down method for acute oral toxicity testing. Fundamentals of Applied Toxicology 8:97-100.

Bruggers, R. L., J. E. Brooks, R. A. Dolbeer, P. P. Woronecki, R. K. Pandit, T. Tarimo, All-India, and M. Hoque. 1986. Responses of pest birds to reflecting tape in agriculture. Wildlife Society Bulletin 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. 1999. Black Vulture (*Coragyps atratus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/blkvul. Accessed July 17, 2017.

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

Bull, J., and J. Farrand, Jr. 1977. The Audubon Society Field Guide to North American Birds, Eastern Region. Alfred A. Knopf, Inc., New York, New York.

Burger, J. 1978. Competition between Cattle Egrets and native North American herons, egrets, and ibises. Condor 80:15–23.

Burger, J. 2015. Laughing Gull (*Leucophaeus atricilla*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/laugul. Accessed July 17, 2017.

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

Cabe, P. R. 1993. European Starling (*Sturnus vulgaris*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/eursta. Accessed July 17, 2017.

California Department of Fish and Game. 1991. Final environmental document , Sections 265, 365, 366, 367, 367.5 Title 14, California Code of Regulations regarding bear hunting. State of California, Department of Fish and Game, Sacramento, California, USA.

California Department of Pesticide Regulation. 2007. California Department of Pesticide Regulation Public Report 2007-8. http://www.cdpr.ca.gov/docs/registration/ais/publicreports/5944.pdf.

Campbell, J. M., L. P. Gauriloff, H. M. Domske , and E. C. Obert. 2001. Environmental Correlates with Outbreaks of Type E Avian Botulism in the Great Lakes. Botulism in Lake Erie, Workshop Proceedings, 24–25 January 2001, Erie, Pennsylvania, USA.

Carlson, J. C., A. B. Franklin, D. R. Hyatt, S. E. Pettit, 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., 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 coccidia within concentrated animal feeding operations. Veterinary Parasitology 180:340–343.

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. 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.

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. 2019. *Campylobacter* (Campylobacteriosis). Centers of Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, Division of Foodborne, Waterborne, and Environmental Diseases. < https://www.cdc.gov/campylobacter/faq.html>. Accessed November 15, 2019.

Center for Food Safety and Applied Nutrition. 2012. Bad Bug Book: Foodborne Pathogenic Microorganisms and Natural Toxins Handbook. Second edition. U.S. Food and Drug Administration, Washington, D.C., USA.

Cernicchiaro, N., D. L. Pearl, S. A. McEwen, L. Harpster, H. J. Homan, G. M. Linz, and J. T. LeJeune. 2012. Association of Wild Bird Density and Farm Management Factors with the Prevalence of *E. coli* O157 in Dairy Herds in Ohio (2007–2009). Zoonoses and Public Health 59:320–329.

Chipman, R. B., T. L. Devault, D. Slate, K. J. Preusser, M.S. Carrara, J. W. Friers, and T. P. Alego. 2008. Non-lethal methods to reduce to reduce conflicts with winter urban crow roosts in New York: 2002-2007. Proceedings of the 23rd Vertebrate Pest Conference 23:88-93.

Ciaranca, M. A., C. C. Allin, and G. S. Jones. 1997. Mute Swan (*Cygnus olor*). Issue No. 273 in A. Poole, editor. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. <http://bna.birds.cornell.edu/bna/species/273>. Accessed December 6, 2016.

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. Pp. 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.

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. Dubovsky, J. A. Collazo, and W. J. Fleming. 1998. Do black ducks and wood ducks habituate to aircraft disturbance? Journal of Wildlife Management 62:1135-1142.

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. 2002. Resolving human-wildlife conflicts: the science of wildlife-damage management. Lewis Publishers, Washington, D.C., USA.

Conover, M. R., and G. Chasko. 1985. Nuisance Canada geese problems in the eastern United States. Wildlife Society Bulletin 13:228–232.

Conover, M. R., and R. A. Dolbeer. 1989. Reflecting tapes fail to reduce blackbird damage to ripening cornfields. Wildlife Society Bulletin 17:441-443.

Conover, M. R., 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. Proc. Vert. Pest Conf. 18:18-25.

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

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.

CEQ. 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, J. R., J. D. Rimstidt, C. A. Bonnaffon, T. K. Collins, and P. F. Scanlon. 1999. Surface water transport of lead at a shooting range. Bulletin of Environmental Contamination and Toxicology 63:312–319.

Craven, S., T. Barnes, and G. Kania. 1998. Toward a professional position on the translocation of problem wildlife. Wildlife Society Bulletin 26:171-177.

Craven, S. E., N. J. Stern, E. Line, J. S. Bailey, N. A. Cox and P. Fedorka-Cray. 2000. Determination of the incidence of *salmonella* spp., c*ampylobacter jejuni*, and *clostridium perfringens* in wild birds near broiler chicken houses by sampling intestinal droppings. Avian Diseases 44:715–720.

Crisley, R. D., V. R. Dowell, and R. Angelotti. 1968. Avian botulism in a mixed population of resident ducks in an urban river setting. Bulletin Wildlife Disease Association 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 nontarget 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 8:31–37.

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.

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.

Depenbusch, B. E., J. S. Drouillard, and C. D. Lee. 2011. Feed depredation by European starlings in a Kansas feedlot. Human–Wildlife Interactions 5:58–65.

DeVault, T. L., J. L. Belant, B. F. Blackwell, and T. W. Seamans. 2011. Interspecific variation in wildlife hazards to aircraft: implications for wildlife hazard management. Wildlife Society Bulletin 35:394-402.

Dill, H. H. and W. H. Thornberry. 1950. A cannon-projected net trap for capturing waterfowl. Journal of Wildlife Management 14:132-137.

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

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

Docherty, D. E., and M. Friend. 1999. Newcastle disease. Pages 175–179 *in* M. Friend and J. C. Franson, editors. Field Manual of Wildlife Diseases: general field. U.S. Department of the Interior, U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin, USA.

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

Dolbeer, R. A. 2000. Birds and aircraft: Fighting for airspace in crowded skies. Proceedings of the Vertebrate Pest Conference 19:37–43.

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

Dolbeer, R. A., 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 M. J. Begier. 2019. Wildlife strikes to civil aircraft in the United States, 1990-2017. Federal Aviation Administration National Wildlife Strike Database Serial Report No. 24. 113 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., 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. Proceeding of the Eastern Wildlife Damage Control Conference 5:112-116.

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 Bulletin 28:372-378.

Dolbeer, R. A., S. E. Wright, J. R. Weller, A. L. Anderson, and M. J. Begier. 2015. Wildlife strikes to civil aircraft in the United States 1990–2014, Serial report 21. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Washington, D.C., USA.

Dolbeer, R. A., S. E. Wright, J. Weller, and M. J. Begier. 2013. Wildlife strikes to civil aircraft in the United States, 1990–2012, Serial report 19. Federal Aviation Administration, National Wildlife Strike Database, Office of Airport Safety and Standards, Washington, D.C., USA.

Donaldson, C. W. 2003. Paintball toxicosis in dogs. Veterinary Medicine 98: 995-997.

Dove, C. J., N. F. Dahlan, and M. Heacker. 2009. Forensic bird-strike identification techniques used in an accident investigation at Wiley Post Airport, Oklahoma, 2008. Human Wildlife Conflicts 3:179–185.

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.

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

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.

EPA. 1982. Avian single-dose oral LD_{50} test, Guideline 71-1. Pp. 33-37 *in* Pesticide assessment guidelines, subdivision E, hazard evaluation wildlife and aquatic organisms. U. S. Environmental Protection Agency PB83-153908, Washington, D.C.

EPA. 1995. R.E.D. Facts - Starlicide (3-chloro-p-toluidine hydrochloride). US EPA, Prevention, Pesticides and Toxic Substances. EPA-738-F-96-003.

EPA. 1998. Anthraquinone (122701) Fact Sheet. https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_PC-122701_01-Dec-98.pdf. Accessed July 17, 2017.

EPA. 1999. ECOFRAM terrestrial draft report. Ecological Committee on FIFRA Risk Assessment Methods. U. S. Environmental Protection Agency, Washington, D. C. https://www.epa.gov/sites/production/files/2015-08/documents/terrreport.pdf. Accessed July 17, 2017.

EPA. 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 October 11, 2016.

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

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

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. Proceedings of the Fifteenth Vertebrate Pest Conference 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.

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. 2019. National Wildlife Strike Database. http://wildlife.faa.gov/default.aspx. Accessed May 16, 2019.

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, Gainsville, Florida, USA.

Fraser, E., and S. Fraser. 2010. A review of the potential health hazards to humans and livestock from Canada geese (*Branta Canadensis*) and cackling geese (*Branta hutchinsii*). Canadian Cooperative Wildlife health Centre, Saskatoon, Saskatchewan, Canada.

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, 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.

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.

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.

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*c*. 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 a DRC- 1339 baiting program to reduce sprouting rice damage caused by spring roosting blackbirds. National Wildlife Research Control Report 448. 25 pp.

Glahn, J. F., E. S. Rasmussen, T. Tomsa, and K. J. Preusser. 1999*a*. Distribution and relative impact of avian predators at aquaculture facilities in the northeast United States. North American Journal of Aquaculture 61:340–348.

Glahn, J. F., G. Ellis, P. Fioranelli, and B. S. Dorr. 2000. Evaluation of moderate and low-powered lasers for dispersing double-crested cormorants from their night roosts. Proceedings of the ninth Wildlife Damage Management Conference 9:34-35.

Glahn, J. F., T. Tomsa, and K. J. Preusser. 1999*b*. Impact of great blue heron predation at trout-rearing facilities in the Northeastern United States. North American Journal of Aquaculture 61:349–354.

Glaser, L. C., I. K. Barker, D. V C. Weseloh, J. Ludwig, R. M. Windingstad, D. W. Key, and T. K. Bollinger. 1999. The 1992 epizootic of Newcastle disease in double-crested cormorants in North America. Journal of Wildlife Diseases 35:319–330.

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 nationwide phenomenon? Proceedings of the Wildlife Damage Management Conference 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.

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.

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.

Hansen, D. L., S. Ishii, M. J. Sadowsky, and R. E. Hicks. 2009. *Escherichia coli* populations in Great Lakes waterfowl exhibit spatial stability and temporal shifting. Applied Environmental Microbiology 75:1546–1551.

Hansen, J. S., and J. E. Ongerth. 1991. Effects of time and watershed characteristics on the concentration of *Cryptosporidium* oocysts in river water. Applied Environmental Microbiology 57:2790–2795.

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

Haselow, D. T., H. Safi, D. Holcomb, N. Smith, K. D. Wagner, B. B. Bolden, and N. S. Harik. 2014. Histoplasmosis associated with a bamboo bonfire — Arkansas, October 2011. Centers for Disease Control and Prevention MMWR, February 28, 2014. 63:165-168.

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

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

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.

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. 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.

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.

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.

Jackson, B. J., and J. A. Jackson. 2000. Killdeer (*Charadrius vociferus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/killde. Accessed July 17, 2017.

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

Jaster, L. A., W. E. Jensen, and W. E. Lanyon. 2012. Eastern Meadowlark (*Sturnella magna*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/easmea. Accessed July 17, 2017.

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. Environmental Toxicology and Chemistry 18:2533-2537.

Johnston, W. S., G. K. MacLachlan, and G. F. Hopkins. 1979. The possible involvement of seagulls (*Larus* sp) in the transmission of salmonella in dairy cattle. Veterinary Record 105:526–527.

Johnston, W. B., M. Eidson, K. A. Smith, and M. G. Stobierski. 2000. Compendium of Measures To Control *Chlamydia psittaci* Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), Morbidity, Mortality Report July 14, 2000. National Association of state Public Health Veterinarians 49(RR08):1–17.

Jones, F., P. Smith, and D. C. Watson. 1978. Pollution of a water supply catchment by breeding gulls and the potential environmental health implications. Journal of the Institute of Water Engineering Science 32:469-482.

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.

Keller, J. I., W. G. Shriver, J. Waldenström, P. Griekspoor, and B. Olsen. 2011. Prevalence of *Campylobacter* in Wild Birds of the Mid-Atlantic Region, USA. Journal of Wildlife Disease 47: 750–754.

Kendall, R. J., T. E. Lacher, Jr., C. Bunck, B. Daniel, C. Driver, C. E. Grue, F. Leighton, W. Stansley, P.G. Watanabe, and M. Whitworth. 1996. An ecological risk assessment of lead shot exposure in non-waterfowl avian species: Upland game birds and raptors. Environmental Toxicology and Chemistry 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, D. T., and D. W. Anderson. 2005. Recent population status of the American white pelican: a continental perspective. Waterbirds 28 (Special Publication 1):48-54.

King, D.T., and T. C. Michot. 2002. Distribution, abundance and habitat use of American white pelicans in the Delta Region of Mississippi and along the western Gulf of Mexico coast. Waterbirds 25:410-416.

Kirk, D. A. and M. J. Mossman. 1998. Turkey Vulture (*Cathartes aura*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/turvul. Accessed July 17, 2017.

Klett, B. R., D. F. Parkhurst, and F. R. Gaines. 1998. The Kensico Watershed Study: 1993–1995. Pages 563–566 *in* Proceedings Watershed '96. 8–12 June 1996, Baltimore, Maryland, USA.

Knittle, C. E., and J. L. Guarino. 1976. Reducing a local population of European Starlings with nest-box traps. Proceedings of the Bird Control Seminars 7:65-66.

Knittle, C. E., E. W. Schafer, Jr., and K. A. Fagerstone. 1990. Status of compound DRC-1339 registration. Proceedings of the Fourteenth Vertebrate Pest Conference 14:311-313.

Knopf, F. L., and R. M. Evans. 2004. American White pelican (*Pelecanus erythrorhynchos*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/057.

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.

Kochert, M. N., K. Steenhof, C. L. Mcintyre, and E. H. Craig. 2002. Golden eagle (*Aquila chrysaetos*). Issue No. 684 in A. Poole, editor. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. <http://bna.birds.cornell.edu/bna/species/684>.

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.

Kreps, L. B. 1974. Feral pigeon control. Proceedings of the Sixth Vertebrate Pest Conference 6:257-262.

Kuhn, R. C., C. M. Rock, and K. H. Oshima. 2002. Occurrence of *Cryptosporidium* and *Giardia* in wild ducks along the Rio Grande River valley in southern New Mexico. Applied and Environmental Microbiology 68:161–165.

Kullas, H., M. Coles, J. Rhyan and L. Clark. 2002. Prevalence of *Escherichia coli* serogroups and human virulence factors in feces of urban Canada geese (*Branta canadensis*). International Journal of Environmental Health Research 12:153–162.

Kushlan, J. A. 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.

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 23rd Vertebrate Pest Conference 23:31–34.

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.

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

Lipnick, R., J. A. Cotrouvo, R. N. Hill, R. D. Bruce, D. A. Stitzel, A. P. Walker, I. Chu, M. Goddard, L. Segal, J. A. Springer, and R. C. Meyers. 1995. Comparison of the Up-and-Down, conventional LD_{50}, and Fixed-Dose Acute Toxicity procedure. Food Chemistry and Toxicology 33:223-331.

Locke, L. N. 1987. Chlamydiosis. Pages 107–113 *in* M. Friend and C. J. Laitman, editors. Field Guide to Wildlife Diseases: General Field Procedures and Diseases Migratory Birds, Resource Publication 167. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C., USA.

Lovell, H. B. 1947. Black vultures kill young pigs in Kentucky. Auk 64:131–132.

Lovell, H. B. 1952. Black vulture depredations at Kentucky woodlands. Auk 64:48–49.

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. Proceedings of the Sixth Eastern Wildlife Damage Control Conference 6:85-88.

Lowney, M. S. 1999. Damage by black and turkey vultures in Virginia, 1990–1996. Wildlife Society Bulletin 27:715–719.

Lowther, P. E. 1993. Brown-headed Cowbird (*Molothrus ater*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/bnhcow. Accessed July 17, 2017.

Lowther, P. E. and C. L. Cink. 2006. House Sparrow (*Passer domesticus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/houspa. Accessed July 17, 2017.

Lowther, P. E. and R. F. Johnston. 2014. Rock Pigeon (*Columba livia*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/rocpig. Accessed July 17, 2017.

Luechtefeld, N. W., M. J. Blaser, L. B. Reller, and W. L. L. Wang. 1980. Isolation of *Campylobacter fetus* subsp. *jejuni* from migratory waterfowl. Journal of Clinical Microbiology 12:406–408.

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. Accessed November 14, 2019.

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. 80 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.

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

Marks, S. G., J. E. Koepke, and C. L. Bradley. 1994. Pet attachment and generativity among young adults. Journal of Psychology 128:641-650.

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 ONE 7(6): e38882. doi:10.1371/journal.pone.0038882.

Mason, J. R. 1989. Avoidance of methiocarb-poisoned apples by red-winged blackbirds. Journal of Wildlife Management 53:836-840.

Mason, J. R., A. H. Arzt, and R. F. Reidinger. 1984. Evaluation of dimethylanthranilate as a nontoxic starling repellent for feedlot settings. Proceeding of the Eastern Wildlife Damage Control Conference 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 (*Nyctalus noctula*) and European starlings (*Sturnus vulgaris*) 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.

McCrimmon Jr., D. A., J. C. Ogden, and G. T. Bancroft. 2011. Great Egret (*Ardea alba*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/greegr. Accessed July 17, 2017.

McGilvrey, F. B., and F. M. Uhler. 1971. A starling deterrent wood duck nest box. Journal of Wildlife Management 35:793-797.

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.

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.

Mid-Atlantic/New England/Maritimes 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, 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 a Florida ranchers. Proceedings of the 22nd Vertebrate Pest Conference 22:231-238.

MDWFP. 2018*a*. Administration. Mississippi Department of Wildlife, Fisheries, and Parks website. https://www.mdwfp.com/administration/. Accessed August 10, 2018.

MDWFP. 2018*b*. 2018-2019 hunting seasons. https://www.mdwfp.com/media/253620/18-2018-19-wtd-hunting-season-flyer-4-individual-pages.pdf. Accessed December 7, 2018.

Mississippi Museum of Natural Science. 2015. Mississippi State Wildlife Action Plan 2015-2025. Mississippi Department of Wildlife, Fisheries, and Parks, Mississippi Museum of Natural Science, Jackson, Mississippi. 704 pp.

Mississippi State University Extension Service. 2017. Other aquaculture species. http://extension.msstate.edu/agriculture/catfish/other-aquaculture-species. Accessed January 23, 2017.

Mitterling, L. A. 1965. Bird damage on apples. Proceedings of the American Society for Horticultural Science 87:66–72.

Monaghan, P., C. B. Shedden, C. R. Fricker, and R. W. A. Girdwood. 1985. Salmonella carriage by herring gulls in the Clyde area of Scotland in relation to their feeding ecology. Journal of Applied Ecology 22:669–680.

Moore, A. C., B. L. Herwaldt, G. F. Craun, R. L. Calderon, A. K. Highsmith, and D. D. Juranek. 1994. Waterborne disease in the United States, 1991 and 1992. Journal of the American Water Works Association 86:87–99.

Mott, D. F. 1985. Dispersing blackbird-starling roosts with helium-filled balloons. Proceedings of the Eastern Wildlife Damage Control Conference 2:156-162.

Mott, D. F., and C. P. Stone. 1973. Bird damage to blueberries in the United States, special scientific report-Wildlife No. 172. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado, USA. http://hdl.handle.net/2027/mdp.39015001470163?urlappend=%3Bseq=279. Accessed July 17, 2017.

Mott, D. F., and S. K. Timbrook. 1988. Alleviating nuisance Canada goose problems with acoustical stimuli. Proceedings of the Thirteenth Vertebrate Pest Conference 13:301–305.

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

Muller, L. I., R. J. Warren, and D. L. Evans. 1997. Theory and practice of immunocontraception in wild animals. Wildlife Society Bulletin 25:504-514.

National Audubon Society. 2010. The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org. Accessed July 10, 2017.

National Park Service. 1995. Report of effects of aircraft overflights on the National Park System. USDI-NPS D-1062, July, 1995.

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. 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.

Nisbet, I. C., D. V. Weseloh, C. E. Hebert, M. L. Mallory, A. F. Poole, J. C. Ellis, P. Pyle, and M. A. Patten. 2017. Herring Gull (*Larus argentatus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/hergul. Accessed July 17, 2017.

Norton, R. L. 1986. Case of botulism in laughing gulls at a landfill in the Virgin Islands, Greater Antilles. Florida Field Naturalist 14:97-98.

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. 2008. Mourning Dove (*Zenaida macroura*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/moudov. Accessed July 17, 2017.

Pacha, R. E., G. W. Clark, E. A. Williams, and A. M. Carter. 1988. Migratory birds of central Washington as reservoirs of *Campylobacter jejuni*. Canadian Journal of Microbiology 34:80–82.

Palmer, S. F., and D. O. Trainer. 1969. Serologic study of some infectious diseases of Canada Geese. Proceedings of the Annual Conference. Bulletin of the Wildlife Disease Association 5:260–266.

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.

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. 2000. Snowy Egret (*Egretta thula*), version 2.0. In The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.489. Accessed December 6, 2018.

Partners in Flight. 2019. Population Estimates Database, version 3.0. Available at http://pif.birdconservancy.org/PopEstimates. Accessed March 5, 2019.

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. 1997. Common Grackle (*Quiscalus quiscula*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/comgra. Accessed July 17, 2017.

Peiris, J. S. M., M. D. de Jong, and Y. Guan. 2007. Avian Influenza Virus (H5N1): A threat to human health. Clinical Microbiology Reviews 20:243–267.

Peoples, S. A., and A. Apostolou. 1967. A comparison between the metabolism of DRC-1339 in rabbits and in starlings. Progress report on starling control. University of California, Davis.

Peters, F., and M. Neukirch. 1986. Transmission of some fish pathogenic viruses by the heron, *Ardea cinerea*. Journal of Fish Diseases 9:539–544.

Pimentel, D., 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.

Pollet, I. L., D. Shutler, J. W. Chardine, and J. P. Ryder. 2012. Ring-billed Gull (*Larus delawarensis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/ribgul. Accessed July 17, 2017.

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

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, 2019. Migratory bird hunting activity and harvest during the 2017-18 and 2018-19 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/ (VERSION: March 2005). Accessed June 19, 2013.

Robbins, C. S. 1973. Introduction, spread, and present abundance of the house sparrow in North America. Ornithological Monographs 14:3-9.

Robbins, C. S., B. Bruun, and H. S. Zim. 1983. A guide to field identification birds of North America. Golden books publ. Co., Inc., Racine, Wisconsin. 360 pp.

Robinson, M. 1996. The potential for significant financial loss resulting from bird strikes in or around an airport. Proceedings of the International Bird Strike Committee 23:353–367.

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.

Rodgers Jr., J. A., and H. T. Smith. 2012. Little Blue Heron (*Egretta caerulea*), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.145. Accessed December 6, 2018.

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. 2012. Eurasian Collared-Dove (*Streptopelia decaocto*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/eucdov. Accessed July 17, 2017.

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.

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.

Schafer, E. W., Jr. 1972. The acute oral toxicity of 369 pesticidal, pharmaceutical, and other chemicals to wild birds. Toxicology and Applied Pharmacology 21:315-330.

Schafer, E. W., Jr. 1981. Bird control chemicals - nature, modes of action, and toxicity. Pp. 129-139 *in* CRC handbook of pest management in agriculture. Vol. 3. CRC Press, Cleveland, Ohio.

Schafer, E. W., Jr. 1984. Potential primary and secondary hazards of avicides. Proceedings of the Eleventh Vertebrate Pest Conference 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 Wildlife Service, 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. Animal welfare and wildlife management. 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, M. E. 2019. Mourning dove population status, 2019. U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, Maryland.

Seamans, T. W. 2004. Response of roosting turkey vultures to a vulture effigy. Ohio Journal of Science 104:136–138.

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.

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.

Shirota, Y., M. Sanada, and S. Masaki. 1983. Eyespotted balloons as a device to scare gray starlings. Appl. Ent. Zool. 18:545-549.

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., 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.

Sovada, M. A., P. J. Pietz, K. A. Converse, D. T. King, E. K. Hofmeister, P. Scherr, and H. S. Ip. 2008. Impact of West Nile virus and other mortality factors on American white pelicans at breeding colonies in the northern plains of North America. Biological Conservation 141:1021-1031.

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.

Stallknecht, D. E. 2003. Ecology and epidemiology of avian influenza viruses in wild bird populations: Waterfowl, shorebirds, pelicans, cormorants, etc. Avian Diseases 47:61–69.

Stansley W., L. Widjeskog, and D. E. Roscoe. 1992. Lead contamination and mobility in surface water at trap and skeet ranges. Bulletin of Environmental Contamination and Toxicology 49:640–647.

Sterner, R. T., D. J. Elias, and D. R. Cerven. 1992. The pesticide reregistration process: collection of human health hazards data for 3-chloro-p-toluidine hydrochloride (DRC-1339). Pp. 62-66 *in* J. E. Borrecco and R. E. Marsh, eds., Proceedings 15th Vertebrate Pest Conference, March 3-5, 1992, Newport Beach, California.

Sterritt, R. M., and J. N. Lester. 1988. Microbiology for environmental and public health engineers. E. & F. N. Spon, Ltd., New York.

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.

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 Protection 4:520-528.

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, P. W. 1992. Fish-eating birds as potential vectors of *Edwardsiella ictaluri*. Journal of Aquatic Animal Health 4:240–243.

Telfair II, R. C. 2006. Cattle Egret (*Bubulcus ibis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/categr. Accessed July 17, 2017.

Telfair II, R. C., and T. J. Bister. 2004. Long-term breeding success of the cattle egret in Texas. Waterbirds 27:69-78.

TVA. 2011*a*. Tennessee Valley Authority: Natural resources plan. https://www.tva.gov/Environment/Environmental-Stewardship/Environmental-Reviews/Natural-Resource-Plan. Accessed August 16, 2018.

TVA. 2011*b*. Final Environmental Impact Statement: Natural Resources Plan-Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia. https://www.tva.gov/Environment/Environmental-Stewardship/Environmental-Reviews/Natural-Resource-Plan. Accessed August 16, 2018.

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

The Wildlife Society. 2015. Standing position statement: wildlife damage management. The Wildlife Society, Washington., D.C. 2 pp.

Thomas, N. J., D. B. Hunter, C. T Atkinson. 2007. Infectious Diseases of Wild Birds. Blackwell Publishing, Ames, Iowa, USA.

Thorpe, J. 1996. Fatalities and destroyed civil aircraft due to bird strikes: 1912–1995. Proceedings of the International Bird Strike Committee 23:17–31.

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.

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.

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.

Turcotte, W. H., and D. L. Watts. 1999. Birds of Mississippi. University Press of Mississippi. 432 pp.

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.

United States Census Bureau. 2010. 2010 census state area measurements and internal point coordinates. http://www.census.gov/geo/www/2010census/statearea_intpt.html. Accessed January 10, 2012.

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*. Environmental Assessment: Managing damage caused by Canada geese in the State of Mississippi. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Mississippi State, Mississippi. 130 pp.

USDA. 2015*b*. Final Environmental Impact Statement: Feral swine damage management: A national approach. USDA/APHIS/WS, Riverdale, Maryland, USA.

USDA. 2015*c*. 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. 2017. Death loss in U.S. cattle and calves due to predator and nonpredator causes, 2015. United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, National Animal Health Monitoring System. 85 pp.

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: Mississippi state and county data. United States Department of Agriculture, National Agricultural Statistics Service. Volume 1, Geographic Area Series, Part 24, AC-17-A-24. 804 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.

USFWS. 2001. Inside Region 3: Ohio man to pay more than $11,000 for poisoning migratory birds. Volume 4(2):5.

USFWS. 2005. Final Environmental Impact statement, Resident Canada goose Management. U.S. Department of the Interior, Washington, D.C., USA. http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/cangeese/finaleis.htm. Accessed February 4, 2013.

USFWS. 2007. National bald eagle management guidelines. https://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Accessed December 1, 2016.

USFWS. 2018. About the U.S. Fish and Wildlife Service. https://www.fws.gov/help/about_us.html. Accessed August 9, 2018.

USFWS and the United States Department of Commerce. 2011. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. 172 pp.

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 January 18, 2012.

United States Geological Survey. 2013. Highly pathogenic avian influenza H5N1 frequently asked questions. U.S. Department of the Interior, Washington D.C., USA. http://www.nwhc.usgs.gov/disease_information/avian_influenza/frequently_asked_questions.jsp. Accessed July 17, 2017.

United States Geological Survey. 2015*a*. 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. 2019. Breeding Bird Survey website. https://www.mbr-pwrc.usgs.gov/. Accessed October 30, 2019.

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 August 1, 2019.

Vanderhoff, N., P. Pyle, M. A. Patten, R. Sallabanks, and F. C. James. 2016. American Robin (*Turdus migratorius*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amerob. Accessed July 17, 2017.

Vennesland, R. G. and R. W. Butler. 2011. Great Blue Heron (*Ardea herodias*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/grbher3. Accessed July 17, 2017.

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

Verbeek, N. A. and C. Caffrey. 2002. American Crow (*Corvus brachyrhynchos*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amecro. Accessed July 17, 2017.

VerCauteren, K. C., and D. R. Marks. 2004. Movements of urban Canada geese: implications for nicarbazin treatment programs. Pages 151–156 *in* Proceedings of the 2003 International Canada Goose Symposium. T. J. Moser, R. D. Lien, K. C. VerCauteren, K. F. Abraham, D. E. Anderson, J. G. Bruggink, J. M. Coluccy, D. A. Graber, J. O. Leafloor, D. R. Luukkonen,and R. E. Trost, editors. 19–21 March 2003, Madison, Wisconsin, USA.

VerCauteren, K. C., M. M. McLachlan, D. R. Marks, and T. W. Baumann. 2003. Effectiveness of spotlights for hazing Canada geese from open water. International Canada Goose Symposium. Abstract only.

Vermeer, K., D. Power, and G. E. J. Smith. 1988. Habitat selection and nesting biology of roof-nesting glaucous-winged gulls. Colonial Waterbirds 11:189–201.

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

von Jarchow, B. L. 1943. European starlings frustrate sparrow hawks in nesting attempt. Passenger Pigeon 5:51.

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.

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.

West, R. R., J. F. Besser, and J. W. DeGrazio. 1967. Starling control in livestock feeding areas. Proceedings of the Third Vertebrate Pest Conference 3:89-93.

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. 2019. Waterbird Population Estimates. wpe.wetlands.org. Accessed April 2, 2019.

Wheelwright, N. T., and J. D. Rising. 2008. Savannah Sparrow (*Passerculus sandwichensis*), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.45. Accessed December 7, 2018.

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, D. H., L. E. Hayes, and P. B. Bush. 1989. Case histories of wild birds killed intentionally with famphur in Georgia and West Virginia. Journal of Wildlife Diseases 25:144-188.

Whitford, P. C. 2003. Use of alarm/alert call playback and human harassment to end Canada goose problems at an Ohio business park. Pp 245-255 *in* K. A. Fagerstone and G.W. Wtimer, eds. Proceedings of the 10th Wildlife Damage Management Conference.

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. 2018. Handbook to the Partners in Flight Population Estimates Database, Version 3.0. PIF Technical Series No 7. pif.birdconservancy.org/popest.handbook.pdf. Accessed May 21, 2019.

Williams, B. M., D. W. Richards, D. P. Stephens, and T. Griffiths. 1977. The transmission of *S. livingstone* to cattle by the herring gull (*Larus argentatus*). Veterinary Record 100:450–451.

Williams, D. E., and R. M. Corrigan. 1994. Pigeons (rock doves). Pages E87–96 *in* S. E. Hygnstrom, R. E. Timm, and G. E. Larson, editors. Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln, Nebraska, USA. http://digitalcommons.unl.edu/icwdmhandbook/. Accessed July 17, 2017.

Williams, R. E. 1983. Integrated management of wintering blackbirds and their economic impact at south Texas feedlots. Dissertation, Texas A&M University, College Station, Texas, USA.

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., 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 U. S. 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. Accessed July 17, 2017.

World Health Organization. 2005. Responding to the avian influenza pandemic threat: recommended strategic actions. Communicable Disease Surveillance and Response Global Influenza Programme, World Health Organization, Geneva, Switzerland.

Woronecki, P. P. 1992. Philosophies and methods for controlling nuisance waterfowl populations in urban environments (abstract only). Joint Conf. Am. Assoc. Zoo. Vet./Am. Assoc. Wildl. Vet. 51 pp.

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. 2019. Red-winged Blackbird (*Agelaius phoeniceus*), version 2.0. In the Birds of North America (P. G. Rodewald, Ed.). The Birds of North America (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.rewbla.02.

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. Measuring attachment to companion animals: A dog is not a cat is not a bird. Applied Animal Behaviour Science 47: 43-48.

Zucchi, J., and J. H. Bergman. 1975. Long-term habituation to species-specific alarm calls in a songbird (*Fringilla coelebs* L.). 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 the WS program in Mississippi relative to the management or reduction of damage from birds. Various federal, state, and local statutes and regulations and WS directives would govern WS' use of damage management methods. WS would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach there may be available a number of specific methods or techniques. The following methods could be recommended or used by the WS program in Mississippi. 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. 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.

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 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. 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 peopled 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 place those methods in areas 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, Dolbeer 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*b*) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Avery et al. (2008*a*) found that effigies could be effective at dispersing crows. 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 harassing 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 recommended and encourage the use of dogs where appropriate.

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). 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 harassment methods. Paintballs consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. A paintball marker (or gun) uses compressed CO_2 to propel paintballs an average of 280 feet per second 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 harassment 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 a number of 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. 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 1984, 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 hand held panels. As the bird or birds enter the "U", the hand held 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 MDWFP. WS' personnel would only release birds on properties where the appropriate landowner 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.

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, 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. Unmanned aircraft generally produce less noise, use less fuel, and are generally less expensive to operate than manned aircraft (Watts et al. 2010). 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 Mississippi by the MDAC. In Mississippi, 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, and brown-headed cowbirds. Nicarbazin is available as a general use commercial product available to the public under the trade name OvoControl® P (Innolytics, LLC, San Clemente, 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).

Mesurol: Mesurol is the commercial name of a product that contains the active ingredient methiocarb and is available for use by WS to discourage crows from feeding on the eggs of threatened or endangered species. Methiocarb is a carbamate pesticide that acts as a cholinesterase inhibitor. When crows ingest methiocarb, they become sick (*e.g.*, regurgitate, become lethargic) but they generally recover, which can condition crows to avoid feeding on the eggs of threatened or endangered bird species because they associated those eggs with becoming sick. Upon ingestion, birds develop post-ingestional malaise (Mason 1989) and crows develop an aversion to consuming similar looking eggs (Dimmick and Nicolaus 1990, Avery and Decker 1994). To condition crows not to feed on the eggs of threatened or endangered bird species, WS' personnel would use raw eggs of domestic bird species that are similar in size and appearance to the eggs of the threatened or endangered bird species. WS would only use raw eggs from those bird species allowed on the label for mesurol. Currently, the label for mesurol requires the use of raw eggs from Japanese quail (*Coturnix japonica*), chickens, ducks, or geese.

Mesurol is a powder that WS' personnel would mix with water and the liquid contents of eggs. Once mixed, WS' personnel would inject the mixture inside raw eggs that are similar in size and appearance to the eggs of the threatened or endangered species that WS is trying to protect from predation by crows. WS' personnel would place treated eggs inside "*dummy*" nests (*i.e*., nests created by WS' personnel or others that are similar in appearance to nests constructed by the threatened or endangered species). WS would place treated eggs in the area where the protected species nests approximately three weeks prior to the onset of egg laying to condition crows to avoid feeding on eggs.

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). 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. 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.

II. LETHAL METHODS

In addition to the use of non-lethal methods, WS' personnel could also use lethal methods. The lethal removal of birds by WS would only occur when authorized by the USFWS and/or the MDWFP (when required) and only at levels authorized. In addition, WS would only use those lethal methods authorized by the USFWS and/or the MDWFP.

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 as 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 (2013) 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 2013).

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, common grackles, brown-headed cowbirds, European starlings, rock pigeons, American crows, laughing gulls, ring-billed gulls, and herring gulls.

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 Mississippi, the MDAC has also 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, starlings, 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. During the development of this EA, the only formulations of DRC-1339 registered for use in the state were for blackbird species and starlings at feedlots (EPA Reg. # 56228-10), for gulls (EPA Reg. # 56228-17), for pigeons (EPA Reg. # 56228-28), and for starlings and blackbird species at staging areas (EPA Reg. # 56228-30). However, WS is phasing out the use of those formulations of DRC-1339 and consolidating many of the previous labels into a single label (Compound DRC-1339 Concentrate – Bird Control; EPA Reg. #56228-63).

WS has registered two formulations of DRC-1339 with the EPA and, if the MDAC approves their use in Mississippi, would be available for WS to use. Those formulations restrict the use of DRC-1339 to certain areas where certain bird species are causing damage or posing a threat of damage. One formulation of DRC-1339 would be available to manage crows causing damage to livestock, crows causing damage to silage/fodder bags, and crows feeding on the eggs or young of federally designated threatened or endangered species (Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder

Depredations; EPA Reg. #56228-29). 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. In addition, WS can use DRC-1339 formulated under the Livestock, Nest, and Fodder Depredations label at refuges or other areas where crows prey upon the eggs and/or young of federally designated threatened or endangered species or other species designated to be in need of special protection. WS can also use DRC-1339 formulated under the Livestock, Nest, and Fodder Depredations label within 25 feet of silage/fodder bags that crows have damaged or are likely to damage. WS has not registered the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 for use in the state. Therefore, WS would not use the Livestock, Nest, and Fodder Depredations formulation of DRC-1339 until WS submitted an application to the MDAC to register the formulation in the state and the MDAC 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 (Compound DRC-1339 Concentrate – Bird Control; EPA Reg. #56228-63) would be available to manage blackbirds, 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 people confine cattle, swine, sheep, goats, poultry, game birds, or furbearers for the primary 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 WS cannot readily resolve by other means. Because the Bird Control formulation of DRC-1339 is replacing the formulations currently registered for use in state, WS anticipates registering the Bird Control formulation with the MDAC on an annual basis; however, WS would only use the Bird Control formulation if the MDAC approves the use of the Bird Control formulation for use in the state.

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 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).

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. Once WS' personnel determine a location to be appropriate to place treated baits based on the pre-treatment observations section of the label, they would place bait (treated bait and untreated bait mixed) in feeding stations, would broadcast the bait using mechanical methods (ground-based equipment or hand spreaders), or would 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.

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, a non-target animal would have to approach a bait site and consume 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 for non-target animals to find and consume.

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

Table C.1 – Federal list of threatened or endangered species in Mississippi

Common Name	Scientific Name	Status†	Determination‡
Animals			
Clams			
Inflated Heelsplitter	*Potamilus inflatus*	T	NE
Black Clubshell	*Pleurobema curtum*	E	NE
Ovate Clubshell	*Pleurobema perovatum*	E	NE
Oyster Mussel	*Epioblasma capsaeformis*	E	NE
Southern Clubshell	*Pleurobema decisum*	E	NE
Cumberlandian Combshell	*Epioblasma brevidens*	E	NE
Southern Combshell	*Epioblasma penita*	E	NE
Fat Pocketbook	*Potamilus capax*	E	NE
Rabbitsfoot	*Quadrula cylindrica cylindrica*	T	NE
Alabama Moccasinshell	*Medionidus acutissimus*	T	NE
Orangenacre Mucket	*Lampsilis perovalis*	T	NE
Sheepnose Mussel	*Plethobasus cyphyus*	E	NE
Snuffbox Mussel	*Epioblasma triquetra*	E	NE
Heavy Pigtoe	*Pleurobema taitianum*	E	NE
Slabside Pearlymussel	*Pleuronaia dolabelloides*	E	NE
Insects			
Mitchell's Satyr Butterfly	*Neonympha mitchellii mitchellii*	E	NE
Reptiles			
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	MANLAA
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	MANLAA
Leatherback Sea Turtle	*Dermochelys coriacea*	E	MANLAA
Loggerhead Sea Turtle	*Caretta caretta*	T	MANLAA
Green Sea Turtle	*Chelonia mydas*	T	MANLAA
Gopher Tortoise	*Gopherus polyphemus*	T	MANLAA
Ringed Map Turtle	*Graptemys oculifera*	T	MANLAA
Yellow-blotched Map Turtle	*Graptemys flavimaculata*	T	MANLAA
Alabama Red-bellied Turtle	*Pseudemys alabamensis*	E	MANLAA
Black Pine Snake	*Pituophis melanoleucus lodingi*	T	MANLAA
Amphibian			
Dusky Gopher Frog	*Rana sevosa*	E	NE
Fish			
Atlantic Sturgeon	*Acipenser oxyrinchus desotoi*	T	NE
Pallid Sturgeon	*Scaphirhynchus albus*	E	NE
Pearl Darter	*Percina aurora*	T	NE
Snail Darter	*Percina tanasi*	T	NE
Bayou Darter	*Etheostoma rubrum*	T	NE
Mammals			
West Indian Manatee	*Trichechus manatus*	T	NE
Gray Bat	*Myotis grisescens*	E	NE
Indiana Bat	*Myotis sodalist*	E	NE

Northern Long-eared Bat	*Myotis septentrionalis*	T	MANLAA
Birds			
Piping Plover	*Charadrius melodus*	T	MANLAA
Least Tern	*Sterna antillarum*	E	MANLAA
Red-cockaded Woodpecker	*Picoides borealis*	E	MANLAA
Mississippi Sandhill Crane	*Grus canadensis pulla*	E	MANLAA
Wood Stork	*Mycteria americana*	T	MANLAA
Eastern Black Rail	*Laterallus jamaicensis* ssp. *jamaicensis*	PT	MANLAA
Red Knot	*Calidris canutus rufa*	T	MANLAA
Plants			
Price's Potato-bean	*Apios priceana*	T	NE
Louisiana Quillwort	*Isoetes louisianensis*	E	NE
Pondberry	*Lindera melissifolia*	E	NE
White Fringeless Orchid	*Platanthera integrilabia*	T	NE
Whorled Sunflower	*Helianthus verticillatus*	E	NE

†T=Threatened; E=Endangered; PT=Proposed Threatened

‡NE=No effect; MANLAA=May affect, not likely to adversely affect

Table C.2 – Critical habitats designated in Mississippi

Common Name	Scientific Name	Status†	Determination‡
Animals			
Clams			
Alabama Moccasinshell	*Medionidus acutissimus*	CH	NE
Cumberlandian Combshell	*Epioblasma brevidens*	CH	NE
Orangenacre Mucket	*Lampsilis perovalis*	CH	NE
Ovate Clubshell	*Pleurobema perovatum*	CH	NE
Oyster Mussel	*Epioblasma capsaeformis*	CH	NE
Rabbitsfoot	*Quadrula cylindrica cylindrica*	CH	NE
Slabside Pearlymussel	*Pleuronaia dolabelloides*	CH	NE
Southern Clubshell	*Pleurobema decisum*	CH	NE
Fish			
Atlantic Sturgeon	*Acipenser oxyrinchus desotoi*	CH	NE
Amphibians			
Dusky Gopher Frog	*Rana sevosa*	CH	NE
Reptiles			
Loggerhead Sea Turtle	*Caretta caretta*	CH	NE
Birds			
Mississippi Sandhill Crane	*Grus canadensis pulla*	CH	NE
Piping Plover	*Charadrius melodus*	CH	NE

APPENDIX D
STATE THREATENED AND ENDANGERED SPECIES IN MISSISSIPPI

MISSISSIPPI NATURAL HERITAGE PROGRAM
<u>LISTED SPECIES OF MISSISSIPPI</u>
- 2018 -

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
ANIMALIA					
BIVALVIA					
UNIONOIDA					
<u>UNIONIDAE</u>					
ACTINONAIAS LIGAMENTINA	MUCKET	G5	S1		LE
CYCLONAIAS TUBERCULATA	PURPLE WARTYBACK	G5	S1		LE
ELLIPTIO ARCTATA	DELICATE SPIKE	G2G3Q	S1		LE
EPIOBLASMA BREVIDENS	CUMBERLANDIAN COMBSHELL	G1	S1	LE	LE
EPIOBLASMA PENITA	SOUTHERN COMBSHELL	G1	S1	LE	LE
EPIOBLASMA TRIQUETRA	SNUFFBOX	G3	S1	LE	LE
EURYNIA DILATATA	SPIKE	G5	S1		LE
HAMIOTA PEROVALIS	ORANGE-NACRE MUCKET	G2	S1	LT	LE
MEDIONIDUS ACUTISSIMUS	ALABAMA MOCCASINSHELL	G2	S1	LT	LE
PLETHOBASUS CYPHYUS	SHEEPNOSE	G3	S1	LE	LE
PLEUROBEMA CURTUM	BLACK CLUBSHELL	GH	SX	LE	LE
PLEUROBEMA DECISUM	SOUTHERN CLUBSHELL	G2	S1	LE	LE
PLEUROBEMA MARSHALLI	FLAT PIGTOE	GX	SX	LE	LE
PLEUROBEMA OVIFORME	TENNESSEE CLUBSHELL	G2G3	SX		LE
PLEUROBEMA PEROVATUM	OVATE CLUBSHELL	G1	S1	LE	LE
PLEUROBEMA RUBRUM	PYRAMID PIGTOE	G2G3	S2		LE
PLEUROBEMA TAITIANUM	HEAVY PIGTOE	G1	SX	LE	LE
PLEURONAIA DOLABELLOIDES	SLABSIDE PEARLYMUSSEL	G2	S1	LE	LE
POTAMILUS CAPAX	FAT POCKETBOOK	G2	S1	LE	LE
POTAMILUS INFLATUS	INFLATED HEELSPLITTER	G1G2Q	SH	LT	LE
PTYCHOBRANCHUS FASCIOLARIS	KIDNEYSHELL	G4G5	S1		LE
THELIDERMA CYLINDRICA CYLINDRICA	RABBITSFOOT	G3G4T3	S1	LT	LE
THELIDERMA METANEVRA	MONKEYFACE	G4	SX		LE
THELIDERMA STAPES	STIRRUPSHELL	GH	SX	LE	LE
MALACOSTRACA					
DECAPODA					
<u>CAMBARIDAE</u>					
CREASERINUS GORDONI	CAMP SHELBY BURROWING CRAWFISH	G1	S1		LE
INSECTA					
COLEOPTERA					
<u>SILPHIDAE</u>					
NICROPHORUS AMERICANUS	AMERICAN BURYING BEETLE	G2G3	SX	LE	LE
LEPIDOPTERA					
<u>NYMPHALIDAE</u>					
NEONYMPHA MITCHELLII MITCHELLII	MITCHELL'S SATYR	G2T2	S1	LE	LE

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
ACTINOPTERYGII					
ACIPENSERIFORMES					
ACIPENSERIDAE					
ACIPENSER OXYRINCHUS DESOTOI	GULF STURGEON	G3T2	S1	LT	LE
SCAPHIRHYNCHUS ALBUS	PALLID STURGEON	G2	S1	LE	LE
SCAPHIRHYNCHUS PLATORYNCHUS	SHOVELNOSE STURGEON	G4	S3?	SAT	
SCAPHIRHYNCHUS SUTTKUSI	ALABAMA STURGEON	G1	SH	LE	LE
CYPRINIDAE					
CHROSOMUS ERYTHROGASTER	SOUTHERN REDBELLY DACE	G5	S2		LE
NOTROPIS BOOPS	BIGEYE SHINER	G5	S1		LE
NOTROPIS CHALYBAEUS	IRONCOLOR SHINER	G4	S1		LE
PHENACOBIUS MIRABILIS	SUCKERMOUTH MINNOW	G5	S1		LE
PERCIDAE					
CRYSTALLARIA ASPRELLA	CRYSTAL DARTER	G3	S1		LE
ETHEOSTOMA BLENNIOIDES	GREENSIDE DARTER	G5	S1		LE
ETHEOSTOMA RUBRUM	BAYOU DARTER	G1	S1	LT	LE
PERCINA AURORA	PEARL DARTER	G1	S1	LT	LE
PERCINA PHOXOCEPHALA	SLENDERHEAD DARTER	G5	S1		LE
PERCINA TANASI	SNAIL DARTER	G2G3	S1	LT	
SILURIFORMES					
ICTALURIDAE					
NOTURUS EXILIS	SLENDER MADTOM	G5	SH		LE
NOTURUS GLADIATOR	PIEBALD MADTOM	G3	S1		LE
NOTURUS MUNITUS	FRECKLEBELLY MADTOM	G3	S2		LE
AMPHIBIA					
ANURA					
RANIDAE					
RANA SEVOSA	DUSKY GOPHER FROG	G1	S1	LE	LE
CAUDATA					
AMBYSTOMATIDAE					
AMBYSTOMA TIGRINUM	TIGER SALAMANDER	G5	SH	PS	
AMPHIUMIDAE					
AMPHIUMA PHOLETER	ONE-TOED AMPHIUMA	G3	S1		LE
CRYPTOBRANCHIDAE					
CRYPTOBRANCHUS ALLEGANIENSIS	HELLBENDER	G3G4	S1	PS	LE
PLETHODONTIDAE					
ANEIDES AENEUS	GREEN SALAMANDER	G3G4	S1		LE
EURYCEA LUCIFUGA	CAVE SALAMANDER	G5	S1		LE
GYRINOPHILUS PORPHYRITICUS	SPRING SALAMANDER	G5	S1		LE
REPTILIA					
SQUAMATA					
COLUBRIDAE					
DRYMARCHON COUPERI	EASTERN INDIGO SNAKE	G3	SX	LT	LE
FARANCIA ERYTROGRAMMA	RAINBOW SNAKE	G4	S2		LE
HETERODON SIMUS	SOUTHERN HOGNOSE SNAKE	G2	SX		LE
PITUOPHIS MELANOLEUCUS LODINGI	BLACK PINE SNAKE	G4T2T3	S2	LT	LE

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
TESTUDINES					
CHELONIIDAE					
CARETTA CARETTA	LOGGERHEAD SEA TURTLE	G3	S1B,SNA	LT	LE
CHELONIA MYDAS	GREEN SEA TURTLE	G3	SNA	LT	LE
ERETMOCHELYS IMBRICATA	HAWKSBILL SEA TURTLE	G3	SNA	LE	LE
LEPIDOCHELYS KEMPII	KEMP'S RIDLEY SEA TURTLE	G1	S1B,S1N	LE	LE
DERMOCHELYIDAE					
DERMOCHELYS CORIACEA	LEATHERBACK SEA TURTLE	G2	SNA	LE	LE
EMYDIDAE					
GRAPTEMYS FLAVIMACULATA	YELLOW-BLOTCHED MAP TURTLE	G2	S2	LT	LE
GRAPTEMYS NIGRINODA	BLACK-KNOBBED MAP TURTLE	G3	S2		LE
GRAPTEMYS OCULIFERA	RINGED MAP TURTLE	G2	S2	LT	LE
PSEUDEMYS ALABAMENSIS	ALABAMA RED-BELLIED TURTLE	G1	S1	LE	LE
TESTUDINIDAE					
GOPHERUS POLYPHEMUS	GOPHER TORTOISE	G3	S2	LT	LE
AVES					
CHARADRIIFORMES					
CHARADRIIDAE					
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2N	LT	LE
CHARADRIUS NIVOSUS	SNOWY PLOVER	G3	S2	PS:LT	LE
LARIDAE					
STERNULA ANTILLARUM	LEAST TERN	G4	S3B,S3N	PS:LE	
STERNULA ANTILLARUM ATHALASSOS	INTERIOR LEAST TERN	G4T2Q	S2B	PS:LE	LE
RECURVIROSTRIDAE					
HIMANTOPUS MEXICANUS	BLACK-NECKED STILT	G5	S1B	PS	
SCOLOPACIDAE					
CALIDRIS CANUTUS	RED KNOT	G5	S2N	LT	
CICONIIFORMES					
CICONIIIDAE					
MYCTERIA AMERICANA	WOOD STORK	G4	S2N	LT	LE
COLUMBIFORMES					
ACCITRIPIFORMES					
ACCIPITRIDAE					
ACCIPITER STRIATUS	SHARP-SHINNED HAWK	G5	S1?B	PS	
ELANOIDES FORFICATUS	SWALLOW-TAILED KITE	G5	S2B		LE
FALCONIFORMES					
FALCONIDAE					
FALCO PEREGRINUS	PEREGRINE FALCON	G4	S1N		LE
GALLIFORMES					
ODONTOPHORIDAE					
COLINUS VIRGINIANUS	NORTHERN BOBWHITE	G4G5	S3S4	PS	
GRUIFORMES					
GRUIDAE					
GRUS CANADENSIS PULLA	MISSISSIPPI SANDHILL CRANE	G5T1	S1	LE	LE
PASSERIFORMES					
EMBERIZIDAE					
AMMODRAMUS MARITIMUS	SEASIDE SPARROW	G4	S2	PS	
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW	G5	S3B,S3N	PS	

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
PARULIDAE					
VERMIVORA BACHMANII	BACHMAN'S WARBLER	GH	SXB	LE	LE
TROGLODYTIDAE					
THRYOMANES BEWICKII	BEWICK'S WREN	G5	S1B,S1N		LE
PELECANIFORMES					
PELECANIDAE					
PELECANUS OCCIDENTALIS	BROWN PELICAN	G4	S1N		LE
PICIFORMES					
PICIDAE					
CAMPEPHILUS PRINCIPALIS	IVORY-BILLED WOODPECKER	G1	SX	LE	LE
PICOIDES BOREALIS	RED-COCKADED WOODPECKER	G3	S1	LE	LE
MAMMALIA					
CARNIVORA					
FELIDAE					
PUMA CONCOLOR CORYI	FLORIDA PANTHER	G5T1	SX	LE	LE
URSIDAE					
URSUS AMERICANUS	BLACK BEAR	G5	S1		LE
URSUS AMERICANUS LUTEOLUS	LOUISIANA BLACK BEAR	G5T2	S1		LE
CHIROPTERA					
VESPERTILIONIDAE					
LASIURUS CINEREUS	HOARY BAT	G3G4	S2?	PS	
MYOTIS GRISESCENS	GRAY MYOTIS	G4	SH	LE	LE
MYOTIS SEPTENTRIONALIS	NORTHERN LONG-EARED MYOTIS	G1G2	SH	LT	
MYOTIS SODALIS	INDIANA OR SOCIAL MYOTIS	G2	S1B	LE	LE
RODENTIA					
DIPODIDAE					
ZAPUS HUDSONIUS	MEADOW JUMPING MOUSE	G5	S1	PS	
MURIDAE					
PEROMYSCUS POLIONOTUS	OLDFIELD MOUSE	G5	S2	PS	
SIRENIA					
TRICHECHIDAE					
TRICHECHUS MANATUS	MANATEE	G2	S1N	LT	LE
PLANTAE					
ISOETOPSIDA					
ISOETACEAE					
ISOETES LOUISIANENSIS	LOUISIANA QUILLWORT	G2G3	S2	LE	
DICOTYLEDONEAE					
FABACEAE					
APIOS PRICEANA	PRICE'S POTATO-BEAN	G3	S1	LT	
LAURACEAE					
LINDERA MELISSIFOLIA	PONDBERRY	G2G3	S2	LE	
OROBANCHACEAE					
SCHWALBEA AMERICANA	CHAFFSEED	G2G3	SH	LE	
MONOCOTYLEDONEAE					
ORCHIDACEAE					
PLATANTHERA INTEGRILABIA	WHITE FRINGELESS ORCHID	G2G3	S1	LT	

Rank & Status Definitions

The Mississippi Natural Heritage Program uses the Heritage ranking system developed by The Nature Conservancy and maintained by NatureServe. Each species is assigned two ranks; one representing its range wide or global status (GRANK), and one representing its status in the state (SRANK). In addition, certain species may possess a legal protection status.

State Ranks

State ranks denote a species' conservation status in Mississippi on a five-point scale from critically imperiled (1) to secure (5). They are assigned by Heritage Program Staff and are denoted by an "S" followed by a number or character. These ranks should not be interpreted as legal designations.

SX – **Presumed Extirpated** – Species or ecosystem is believed to be extirpated from Mississippi. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

SH – **Possibly Extirpated** – Known from only historical records in Mississippi, but still some home of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty.

S1 – **Critically Imperiled** in Mississippi because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation.

S2 – **Imperiled** in Mississippi because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it vulnerable to extirpation.

S3 – **Vulnerable** in Mississippi due to a restricted range (on the order of 21 to 100 occurrences), relatively few populations or occurrences, recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 – **Apparently Secure** – Uncommon but not rare in Mississippi; some cause for long-term concern due to declines or other factors (more than 101 occurrences).

S5 – **Secure** – Common, widespread, and abundant in Mississippi.

SU – **Unrankable** – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

SNR – **Unranked** – Conservation status not yet assessed.

SNA – **Not Applicable** – A conservation status rank is not applicable because the species or ecosystem is not a suitable target for conservation activities (e.g., long distance aerial and aquatic migrants, hybrids without conservation value, and non-native species or ecosystems.

S#S# – **Range Rank** - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community.

S#? – **Inexact Numeric Rank** – Denotes inexact numeric rank.

S#B – **Breeding** – Conservation status refers to the breeding population of the species in Mississippi.

S#N – **Non-breeding** – Conservation status refers to the non-breeding population of the species in Mississippi.

S#M – **Migrant** species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in Mississippi.

Global ranks

Global ranks follow the same principle as state ranks, but refer to a species' rarity throughout its total range. They are assigned by the NatureServe Network and are denoted with a "G" followed by a number or character as described above. However, there are two additional definitions:

G#Q – **Questionable taxonomy that may reduce conservation priority** – Distinctiveness of this entity as a species, subspecies, or ecosystem is questionable. Resolution of this uncertainty may result in the change from a species to a subspecies or vice versa.

G#T# – **Infraspecific Taxon** (trinomial) – The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" which is appended to the species' global rank. It denotes the rarity of the subspecies. For example, a critically imperiled subspecies of an otherwise widespread and common species would be a G5T1.

Source: NatureServe Conservation Status Assessment

Federal and State Statuses

Federal and State statuses are legal protection designations for certain species. A federal listing status is determined by U.S. Fish & Wildlife as part of the 1974 Endangered Species Act while a state listing status is determined by the Mississippi Commission on Wildlife, Fisheries, & Parks. Note that plants receive no formal legal protection by state law in Mississippi other than that provided for in the trespass laws. Abbreviations used are defined below.

LE – **Listed Endangered** - A species which is in danger of extinction throughout all or a significant portion of its range.

LT – **Listed Threatened** - A species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

SAE – **Endangered due to similarity of appearance** - A species that is endangered due to similarity of appearance with another listed species and is listed for its protection.

SAT – **Threatened due to similarity of appearance** - A species that is threatened due to similarity of appearance with another listed species and is listed for its protection.

PS – **Partial Status** - A species is listed in parts of its range and not in others; or, one or more subspecies or varieties are listed, while the others are not listed.

PE – **Proposed Endangered** – Species proposed for official listing as endangered.

PT – **Proposed Threatened** – Species proposed for official listing as threatened.

C – **Candidate Species** - A species under consideration for official listing for which there is sufficient information to support proposing to list as endangered or threatened.

SC – **Species of Concern** – A species that has not been petitioned or been given LE, LT, or C status but has been identified as important to monitor and in need of conservation actions.

APPENDIX E
ADDITIONAL TARGET BIRD SPECIES THAT WS COULD ADDRESS IN MISSISSIPPI

In addition to the bird species identified in Section 1.2, WS could also 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. Damages and threats of damages 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 program in Mississippi could address in low numbers and/or infrequently when those species cause damage or pose a threat of damage include snow geese (*Anser caerulescens*), greater white-fronted geese (*Anser albifrons*), wood ducks (*Aix sponsa*), blue-winged teal (*Spatula discors*), gadwalls (*Mareca strepera*), mallards (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), ring-necked ducks (*Aythya collaris*), greater scaup (*Aythya marila*), hooded mergansers (*Lophodytes cucullatus*), common mergansers (*Mergus merganser*), northern bobwhite (*Colinus virginianus*), wild turkeys (*Meleagris gallopavo*), pied-billed grebes (*Podilymbus podiceps*), eared grebes (*Podiceps nigricollis*), chimney swifts (*Chaetura pelagica*), American coots (*Fulica americana*), semipalmated plovers (*Charadrius semipalmatus*), upland sandpipers (*Bartramia longicauda*), least sandpipers (*Calidris minutilla*), Wilson's snipe (*Gallinago delicata*), spotted sandpipers (*Actitis macularius*), lesser yellowlegs (*Tringa flavipes*), Neotropic cormorants (*Phalacrocorax brasilianus*), anhingas (*Anhinga anhinga*), little blue herons (*Egretta caerulea*), green herons (*Butorides virescens*), ospreys (*Pandion haliaetus*), Mississippi kites (*Ictinia mississippiensis*), northern harriers (*Circus hudsonius*), sharp-shinned hawks (*Accipiter striatus*), Cooper's hawks (*Accipiter cooperii*), red-shouldered hawks (*Buteo lineatus*), red-tailed hawks (*Buteo jamaicensis*), great horned owls (*Bubo virginianus*), barred owls (*Strix varia*), American kestrels (*Falco sparverius*), Eastern kingbirds (*Tyrannus tyrannus*), Eastern phoebes (*Sayornis phoebe*), loggerhead shrikes (*Lanius ludovicianus*), blue jays (*Cyanocitta cristata*), horned larks (*Eremophila alpestris*), tree swallows (*Tachycineta bicolor*), Northern rough-winged swallows (*Stelgidopteryx serripennis*), bank swallows (*Riparia riparia*), Eastern bluebirds (*Sialia sialis*), Northern mockingbirds (*Mimus polyglottos*), cedar waxwings (*Bombycilla cedrorum*), grasshopper sparrows (*Ammodramus savannarum*), field sparrows (*Spizella pusilla*), song sparrow (*Melospiza melodia*), bobolinks (*Dolichonyx oryzivorus*), rusty blackbirds (*Euphagus carolinus*), Brewer's blackbirds (*Euphagus cyanocephalus*), pine warblers (*Setophaga pinus*), and yellow-rumped warblers (*Setophaga coronata*).

Many of those bird species can cause damage to or pose threats to a variety of resources. The bird species associated with requests for assistance that WS could receive and the resource types those bird species primarily damage in Mississippi occur in Table E-1.

Table E-1: Additional bird species that WS could address in Mississippi and the resource types damaged by those species

Species	Resource*				Species	Resource*			
	A	N	P	H		A	N	P	H
Snow Goose	X		X	X	Mississippi Kite			X	X
Greater White-fronted Goose	X		X	X	Northern Harrier			X	X
Wood Duck			X	X	Sharp-shinned Hawk	X	X	X	X
Blue-winged Teal			X	X	Cooper's Hawk	X	X	X	X

Gadwall			X	X	Red-shouldered Hawk	X	X	X	X
Mallard			X	X	Red-tailed Hawk	X	X	X	X
Green-winged Teal			X	X	Great Horned Owl	X	X	X	X
Ring-necked Duck			X	X	Barred Owl	X	X	X	X
Greater Scaup			X	X	American Kestrel	X	X	X	X
Hooded Merganser	X		X	X	Eastern Kingbird			X	X
Common Merganser	X		X	X	Eastern Phoebes			X	X
Northern Bobwhite			X	X	Loggerhead Shrike			X	X
Wild Turkey	X		X	X	Blue Jay			X	X
Pied-billed Grebe			X	X	Horned Lark			X	X
Eared Grebe			X	X	Tree Swallow			X	X
Chimney Swift			X	X	Northern Rough-winged Swallow			X	X
American Coot			X	X	Bank Swallow			X	X
Semiplamated plover			X	X	Eastern Bluebird			X	X
Upland Sandpiper			X	X	Northern mockingbird			X	X
Least Sandpiper			X	X	Cedar Waxwing			X	X
Wilson's Snipe			X	X	Grasshopper Sparrow			X	X
Spotted Sandpiper			X	X	Field Sparrow			X	X
Lesser Yellowleg			X	X	Song Sparrow			X	X
Neotropic Cormorant	X		X	X	Bobolink			X	X
Anhinga	X		X	X	Rusty Blackbird	X		X	X
Little Blue Heron	X		X	X	Brewer's Blackbird	X		X	X
Green Heron	X		X	X	Pine Warbler			X	X
Osprey	X		X	X	Yellow-rumped Warbler			X	X

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

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 for snow geese, greater white-fronted geese, wood ducks, blue-winged teal, gadwall, mallards, green-winged teal, ring-necked ducks, greater scaup, and American coots.

People can harvest snow geese, greater white-fronted geese, wood ducks, blue-winged teal, gadwall, mallards, green-winged teal, ring-necked ducks, greater scaup, and American coots in the state during annual hunting seasons. 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. Most requests for assistance associated with waterfowl species occur near airports where waterfowl and other waterbirds may aggregate in large numbers in wet areas or on large bodies of water in close proximity to active runways, posing a strike risk and threat to human safety. 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 these reasons, WS could potentially take up to 100 individuals of each of those waterfowl species annually. When compared to the annual harvest levels of these species, WS' take of up to 100 individuals a year would be a minor component of the annual harvest of those species and would have little impact on the populations of those species or hunter harvest.

In addition, to alleviate damage or discourage nesting in areas where damages were 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 birds, the destruction of nests can only occur when authorized by the USFWS; therefore, the number of nests taken by WS annually would occur at the discretion of the USFWS.

WS does not expect the annual take of those species identified in Table E-1 to occur at any level that would adversely affect populations of those species. Take would be limited to those individuals deemed causing damage or posing a threat. The MBTA protects most of those bird species from take unless the USFWS permits the take pursuant to the MBTA. The MDWFP manages non-migratory bird species, such as wild turkeys and northern bobwhite, in the state and the take of those species may require authorization from the MDWFP. If the USFWS and/or the MDWFP did not issue a permit or did not authorize take, no take would occur by WS. In addition, take could 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 MDWFP permitting processes. The USFWS and/or the MDWFP, 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 MDWFP any take of the bird species listed in Table E-1 in accordance with a federal permit and/or state authorization.