SUPPLEMENT TO THE ENVIRONMENTAL ASSESSMENT:
REDUCING BIRD DAMAGE IN THE STATE OF MISSOURI

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

In cooperation with the United States Fish and Wildlife Service

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INTRODUCTION

An environmental assessment (EA) was prepared by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program to analyze the potential impacts to the quality of the human environment from resolving or alleviating damage to agriculture, property, natural resources and threats to human health and safety caused by birds in the state of Missouri. The EA evaluated the need for bird damage management and assessed potential impacts on the human environment of three alternatives to address that need. WS' proposed action in the EA implements an integrated damage management program to fully address the need to manage bird damage and threats while minimizing impacts to the human environment. The EA analyzed the effects of WS' activities to reduce damage and threats associated with resident and migratory bird species (USDA 2015).

PURPOSE

The purpose of the EA will remain as addressed in section 1.2 of the EA (USDA 2015). This Supplement examines potential environmental impacts of WS' program as it relates to an increase in the number of requests for assistance to manage bird damage and threats from American coot (*Fulica americana*), double-crested cormorant (*Phalacrocorax auritus*), Eurasian collard dove (*Streptopelia decaocto),* mourning dove *(Zenaida macroura),* wood duck *(Aix sponsa),* merlin *(Falco columbarius),* American kestrel *(Falco sparverius),* peregrine falcon *(Falco peregrinus),* prairie falcon *(Falco mexicanus),* house finch *(Carpodacus mexicanus),* Canada goose (*Branta canadensis*), Ross's goose, (*Chen rossii*), snow goose (*Chen caerulescens*), white-fronted goose (*Anser albifrons*), Bonaparte's gull (*Larus Philadelphia*), herring gull (*Larus argentatus*), laughing gull (*Larus atricilla*), ring-billed gull (*Larus delawarensis*), Cooper's hawk (*Accipiter cooperii*), rough-legged hawk (*Buteo lagopus*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), killdeer (*Charadrius vociferous*), western kingbird (*Tyrannus verticalis*), western meadowlark (*Sturnella neglecta*), common nighthawk (*Chordeiles minor*), American robin (*Turdus migratorius*), sanderling (*Calidris alba*), buff-breasted sandpiper (*Tryngites subruficollis*), semipalmated sandpiper (*Calidris pusilla*), barn owl (*Tyto alba*), great-horned owl (*Bubo virginianus*), scissor-tailed flycatcher (*Muscivora forficate*), bank swallow (*Riparia riparia*), tree swallow (*Iridoprocne bicolor*), black tern (*Chlidonias niger*), Caspian tern (*Sterna caspia*), black vultures (*Coragyps atratus*), and cedar wax wing (*Bombycilla garrulous*). This Supplement will evaluate the potential environmental effects from an increase in management techniques to the above mentioned target species.

NEED FOR ACTION

A description of the need for action to reduce damage to resources and threats to human health and safety caused by birds in the state of Missouri is listed in Section 1.3 of the EA. The need for action addressed in the EA remains applicable to this Supplement; however, WS has received increased requests for

assistance and/or has experienced increased numbers of several species mentioned above causing damage and threats of damage since the completion of the EA.

Some species of wildlife have adapted to and have thrived in human altered habitats. Many different bird species create conflicts with people. Those conflicts often lead people to request assistance with reducing damage to resources and to reduce threats to human safety. The need for action to manage damage and threats associated with birds arises from requests for assistance received by WS to reduce and prevent damage from occurring to four major categories: agricultural resources, property, natural resources, and threats to human safety. The number of technical assistance projects involving bird damage or threats of bird damage to those four major resource types for the species addressed in this Supplement from fiscal year (FY) 2015 through (FY) 2016 is shown in Table 1.

Table 1 – Target species non-lethally dispersed, lethally removed, live captured and relocated, and nests destroyed by WS during bird damage management activities in Missouri, FY 2015 – FY 2016

	# Dispersed		# Killed		Relocated		Nests Destroyed	
Species	2015	2016	2015	2016	2015	2016	2015	2016
Coots, American	34	56	3	0	0	0	0	0
Double-crested Cormorant	85	978	0	26	0	0	0	0
Doves, Eurasian collared	0	0	7	25	0	0	0	0
Dove, Mourning	3,333	5,494	149	500	518	341	2	7
Ducks, Wood	69	37	9	5	0	0	0	0
Falcon, Merlin	0	0	0	0	0	0	0	0
Falcons, American Kestrels	40	62	1	4	41	6	0	0
Falcons, Peregrine	0	0	0	0	0	0	0	0
Falcons, Prairie	0	0	0	0	1	0	0	0
Finch, House	0	0	0	0	0	0	0	0
Geese, Canada	16,020	12,905	104	357	0	0	114	102
Geese, Ross	0	0	0	0	0	0	0	0
Geese, Snow	25,491	337,403	5	17	0	0	0	0
Geese, White-fronted	0	0	0	0	0	0	0	0
Gulls, Bonaparte's	0	1,300	0	22	0	0	0	0
Gulls, Herring	0	2	0	8	0	0	0	0
Gulls, Laughing	1	0	0	0	0	0	0	0
Gulls, Ring-billed	3,730	4,180	6	73	0	0	0	0
Hawk, Cooper's	3	3	1	5	6	40	0	0
Hawk, Rough-legged	0	0	0	0	0	0	0	0
Hawk, Sharp-shinned	0	0	0	0	2	0	0	0
Hawks, Red-tailed	397	623	116	114	363	387	1	0
Killdeer	662	1,217	219	408	0	0	0	0
Kingbird, Western	3	0	0	0	0	0	0	0
Meadowlark, Western	0	580	0	21	0	0	0	0
Nighthawks	0	5	0	0	0	0	0	0
Robins, American	17,777	252	16	9	0	0	1	0
Sanderlings	0	0	0	0	0	0	0	0
Sandpipers, Buff-breasted	0	0	0	0	0	0	0	0
Sandpiper, Semipalmated	0	0	0	0	0	0	0	0
Owl, Barn	0	0	0	0	1	0	0	0
Owl, Great-horned	0	0	4	0	52	48	0	0

Scissor-tailed flycatcher	0	0	0	0	0	0	0	0
Swallow, Bank	0	0	0	0	0	0	0	0
Swallow, Tree	110	0	0	0	0	0	0	0
Tern, Black	0	0	0	0	0	0	0	0
Tern, Caspian	0	0	0	0	0	0	0	0
Vultures, Black	1	4	0	1	0	0	0	0
Waxwing, Cedar	0	2	0	0	0	0	0	0
TOTAL	67,756	365,103	640	1,595	984	822	118	109

Black vultures

The need to address black vultures is based on the request of our state wildlife partners that report increasing conflicts with new born calves and property damage in the southern half of Missouri. WS-Missouri plans to start addressing issues involving black vultures in 2018. In FY 2017, WS' responded to a request from the Missouri State Park in Southern Missouri. The State park reported spending over one hundred thousand dollars to replace a roof at their lodge that was damaged by black vultures. The same park reported for the last several years black vultures harassing fisherman at their cleaning station. WS responded to the state park with recommendations on harassment methods, keeping the fish cleaning station clean and assisting them to apply for a USFWS depredation permit. The black vulture damage was reduced after all methods were followed as per WS recommendations.

WS received a call from a homeowner that reported black vultures roosting on their roof as well as the balcony rail creating a mess with their droppings and destroying singles. WS assisted with recommendations for a depredation permit from the USFWS and well as several harassment and exclusion methods.

WS has also started to receive requests for assistance with USFWS permits to protect new born calves. Several farmers reported loosing calves to black vultures. Vultures are known to prey upon newly born calves and harass adult cattle, especially during the birthing process. Vulture predation on livestock is distinctive. Black vultures attack young lambs and calves as well as cows giving birth by first pulling out their eyes and then directly attacking the rectal area and other vulnerable soft parts (Avery and Cummings 2004). During a difficult delivery, vultures will peck at the half-expunged calf and kill it. WS assisted farmers with recommendations for their USFWS depredation permit, methods available to harass vultures and changing culture practices.

Cooper's hawk

The need to address Cooper's hawks is based on the increased number of birds frequenting airports across Missouri. WS has been capturing more of this species recently within their raptor traps at airports and also within nuisance bird traps at other locations throughout the state. WS captured and relocated significantly more Cooper's hawks than normal at one western Missouri airport. During 2015 and 2016, 26 and 40 Cooper's hawks respectably were captured in traps placed by WS on the airport environment. Some of these bird traps are meant to capture raptors but another large issue that developed was the occasional capture of a Cooper's hawk within traps designed for the capturing of feral pigeons. WS has started to leg band Cooper's hawks since capture rates have recently increased for release away from nearby airports to determine how many return to the capture site.

In addition, private landowners are notifying WS personnel of depredation to their livestock (chickens). These requests have been from landowners and farmers requesting recommendations to address their problems and possibly lethally removing individual Cooper's hawks themselves via a USFWS

depredation permit.

Another recent indicator that Cooper's hawks are causing more conflicts in Missouri is several cases of the birds becoming trapped inside buildings. A business owner requested WS to capture a trapped hawk from inside their warehouse in FY16. The possible economic damages associated with this threat vary from a food safety aspect (i.e. both at human and pet food industry warehouses) and also rescuing a federally protected bird which is trapped and needs to be released safely back to its natural environment (i.e. as was the case for a local electric utility corporation liability).

Double-crested cormorant

On May 25, 2016, the United States District Court for the District of Columbia vacated the Public Resource Depredation Order for double-crested cormorants. The Court's vacatur of the Public Resource Depredation Order (PRDO) followed the Court's decision on the merits on March 29, 2016, concluding that the 2014 EA prepared by USFWS in renewing the PRDO was insufficient. Specifically, the Court found that USFWS failed to take a "hard look" at the effect of the PRDO on double-crested cormorant populations when it did not update previous population model estimates in its 2014 EA (see *Public Employees for Environmental Responsibility v. USFWS*, 177 F. Supp. 3d 146, 153 (D.D.C. 2016)).

Following the Court's decisions, all activities that result in take of double-crested cormorants for the protection of aquaculture or public resources now require a depredation permit issued by USFWS pursuant to the Migratory Bird Treaty Act (MBTA) (16 USC 703-712). WS-Missouri previously received a state-wide depredation permit from USFWS for the take of various species of birds.

WS-Missouri has determined that to the extent that its EA references the USFWS' 2009 EA and/or USFWS' 2003 Environmental Impact Statement, WS-Missouri will no longer rely on the analyses from those documents regarding the impacts on double-crested cormorant populations.

The current cormorant population estimate in central/eastern U.S. and Canada is 731,880 to 752,516 (USFWS 2017). Missouri is located between the Central Flyway and Mississippi Flyway, and is a known travel corridor for migrating double-crested cormorants. In addition, there have been instances of cormorant flocks wintering in southern portions of the state. The need to expand WS' proposed annual removal of double-crested cormorants is based on the request of our state wildlife partners that report increasing conflicts with human health and safety, aquaculture damage and property damage.

Collisions between aircraft and wildlife are a concern throughout the world because they threaten passenger safety (Thorpe 1996, Dolbeer et al. 2016). Cormorants are a particular hazard to aircraft because of their body size/mass, slow flight speeds, and their natural tendency to fly in flocks. Since 1990, aircraft collisions with double-crested cormorants have totaled more than $15 million of damage (Dolbeer et al. 2016). Where the potential for cormorants and aircraft collisions exist, there is a need to manage cormorant activity in and around airfields.

Adult cormorants eat an average of one pound of fish per day, which is typically comprised of small (less than 6 inch) size classes. Aquaculture producers often identify cormorants as causing the greatest predation threat to farm-raised aquaculture species (Stickley and Andrews 1989, Price and Nickum 1995, Dorr et al. 2012). In one national survey of catfish producers, 69% reported wildlife-caused losses of catfish with cormorants as the most frequently cited predator (Wywialowski 1999), and economic losses estimated greater than $4 million annually. When economic loss occurs, there is a need to protect aquaculture facilities from feeding cormorants.

Double-crested cormorants may cause ecological and economic damage to property. Cormorants are known to nest and roost on artificial structures and within the human environment (Wires 2014). Nesting colonies and roost sites can have a negative impact on vegetation by both chemical (cormorant feces) and physical means (stripping leaves and breaking tree branches) (Boutin et al. 2011, Koh et al. 2012, McGrath and Murphy 2012, Ayers et al. 2015, Lafferty et al. 2016). Further corrosion caused by fecal uric acid from nesting or roosting congregations of cormorants may damage vegetation, vehicles, and structures (Dorr et al. 2014). Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Where cormorants cause economic damage to property there may be a need to manage the species to minimize their negative impacts.

Bonaparte's Gulls

The need to address Bonaparte's gulls is based on the request of our coopering partners that report increasing conflicts with aviation, primarily in northwest Missouri. WS has been addressing gull issues for many years, but has recently began receiving an increased number or requests to deal with Bonaparte's gulls specifically. WS has also received an increased number of requests for technical assistance from the aquaculture industry. The 2015 Missouri bird current EA does not address Bonaparte's gulls.

WS received numerous requests for assistance in dealing with Bonaparte's gulls at an airport in northwest Missouri in 2016. A large flock of Bonaparte's gulls had begun utilizing a nearby oxbow lake as a feeding area. WS used harassment with boats and pyrotechnics as the primary dispersal tool with limited lethal removal to reinforce the harassment. Given the proximity of large bodies of water to this airport, it is likely that these issues will arise again in the future.

Gulls as a group are known to be hazardous to aircraft. Gulls have a tendency to fly low to the ground and can be attracted to the large paved areas on airfields after rain events due to worms on the pavement. Harassment with pyrotechnics is often ineffective at dispersing the birds. From January 1991- May 1998, gulls were responsible for more reported strikes and reported damaging strikes than any other wildlife group, causing $6.94 million in damages (Dolbeer, et. al. 2000).

Canada geese

The need to address Canada geese is based on the request of our coopering partners that report increasing conflicts in Missouri. This need is directly related to their expanding local urban populations.

Most WS requests for assistance pertain to property damaged. There are varying types of damage, but most commonly it pertains to their feces and nuisance issues. Droppings cause damage to property, lower water quality and decrease aesthetics of an area. In the past, cooperators would have to power wash areas of fecal buildup, adding to local nutrient loads within storm water drainages and excess costs of labor and equipment upon maintenance departments. Canada geese also depredate turf grasses and agricultural crops causing a direct loss to individual farm incomes and increased soil erosion issues.

The increased local urban populations have caused issues at a number of major airports within Missouri. In FY 2017, WS' responded to two requests from each side of the state to reduce the amount of Canada geese using areas nearby airport runways to roost, loaf, feed and nest. WS removed several birds that resulted in a notable decrease in goose presence at the airports.

Herring gulls

The need to address herring gulls is based on requests from our coopering partners that report increasing conflicts in Missouri. WS anticipates the number of airports and landfills requesting assistance with managing damage and threats associated with herring gulls to increase. This need is directly related to herring gulls around the airport environment as they are the most commonly struck bird group nationwide and a major threat to aviation industry, both from a human safety aspect and property damage. Their large body size, flocking behavior, and behavioral tendency to loaf in open areas, including on airport runways and taxiways, makes them a primary hazard during rainy events.

Herring gulls also pose potential issues at landfill sites. WS was recently asked to investigate a better means to reduce the damage caused by gulls using a local landfill site near Kansas City. The gulls were attracted to the site each morning when the dump was exposed and learned to feed and loaf during the day, as they would cover the site each evening with soil to reduce scavengers. The waste company was in need of a solution to prevent gulls carrying pieces of garbage off-site, as there were a number of housing developments and a school nearby that were complaining of the excess mess being created.

Aviation Safety

The 2015 EA described the general hazards and threats that birds cause to aviation safety and operations. Since then, WS has observed and received reports of additional species and greater numbers of certain species on Missouri airfields and surrounding environments. These observations are the primary purpose for the expanded analysis of WS potentially removing more birds during airport projects. For example, WS recently observed 800 American coots loafing in a large water body during the spring migration near a Kansas City airport creating a significant strike risk. WS had only analyzed the removal of 20 coots in the EA; however, these large migratory populations have warranted the analysis of removing up to 200 coots annually. Additionally, WS harassed over 377,000 snow geese in FY16, mostly from airport properties. While the 2015 EA analyzed a lethal removal of 20 snow geese, these figures warrant the expanded analysis of removing up to 400 geese annually. Other species included in this Supplement due to their increased presence at airports include: American coot, double-crested cormorant, Eurasian collared dove, mourning dove, wood duck, merlin, American kestrel, peregrine falcon, prairie falcon, Canada goose, Ross's goose, snow goose, white-fronted goose, Bonaparte's gull, herring gull, laughing gull, ring-billed gull, Cooper's hawk, rough-legged hawk, sharp-shinned hawk, red-tailed hawk, killdeer, western kingbird, western meadowlark, common nighthawk, American robin, sanderlings, buff-breasted sandpiper, semi-palmated sandpiper, barn owl, scissor-tailed flycatcher, bank swallow, tree swallow, black tern, Caspian tern, and cedar waxwing.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) AND WS DECISION-MAKING:

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows CEQ regulations implementing the NEPA (40 CFR 1500 et seq.). In addition, WS follows the USDA (7 CFR 1b), and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities to be accomplished as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. Federal activities affecting the physical and biological environment are regulated in part by the CEQ through regulations in 40 CFR 1500-1508. In accordance with the CEQ and USDA regulations, APHIS guidelines concerning the implementation of the NEPA, as published in the Federal Register (44 CFR 50381-50384) provide guidance to WS regarding the NEPA process.

Pursuant to the NEPA and the CEQ regulations, this EA supplement documents the analyses of potential federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing significant effects, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. This EA supplement was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the alternatives. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

DECISIONS TO BE MADE

Based on the scope of the EA and this supplement, the decisions to be made are: 1) How can WS best respond to the need to reduce bird damage in Missouri; 2) Do the alternatives have significant cumulative impacts meriting an Environmental Impact Statement (EIS)?

SCOPE OF ANALYSIS

The EA and this Supplement evaluate additional bird damage management in order to eliminate or alleviate damage and threats to agriculture, property, natural resources, and human health and safety. Unless otherwise discussed in this Supplement, the scope of analysis remains valid as addressed in section 1.5 of the EA (USDA 2015).

Federal, State, County, City, and Private Lands

Under two of the alternatives analyzed in detail, WS could continue to provide assistance on federal, state, county, municipal, and private land when a request was received for such services from the appropriate resource owner or manager. Actions taken on federal lands have been analyzed in the scope of this EA and Supplement.

AUTHORITY AND COMPLIANCE

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

RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

WS' Environmental Assessments - *Environmental Assessment- Reducing Bird Damage in the state of Missouri*: WS had previously developed an EA that analyzed the need for action to manage damage associated with resident and migratory bird species within Missouri. The EA identified issues associated with bird damage management and analyzed alternatives to address those issues. After review of the analyses in the EA, a FONSI was signed on October 19, 2016, selecting the proposed action to implement an integrated approach to managing bird damage.

Changes in the need for action and the affected environment have prompted WS to initiate this new analysis for several species into this Supplement addressing the need for bird damage management. This Supplement will address more recently identified changes and will assess the potential environmental impacts of program alternatives based on a new need for action. Since activities conducted under the previous EA related to several species will be re-evaluated under this Supplement to address the new need

for action and the associated affected environment, the previous analysis within the EA that addressed those species will be superseded by this analysis and the outcome of the Decision issued based on the analyses in this Supplement.

RELATIONSHIPS OF AGENCIES DURING PREPARATION OF THIS EA SUPPLEMENT

Based on agency relationships, Memorandums of Understanding (MOUs), and legislative authorities, WS was the lead agency during the development of the EA and the Supplement to the EA, and therefore, was responsible for the scope, content, and decisions made.

Public Involvement

Issues and alternatives related to bird damage management conducted by WS in Missouri were initially developed by WS. Issues were defined and preliminary alternatives were identified through the scoping process. Notice of the proposed action and invitation for public involvement on the pre-decisional EA was placed in the *News Tribune* newspaper with statewide circulation. There was a 30-day comment period for the public to provide input on the pre-decisional EA. No comments were received from the public after review of the pre-decisional EA. A Decision and FONSI was signed for the EA on October 19, 2016.

This Supplement, along with the EA (USDA 2015), and the associated Decisions and FONSI will be made available for public review and comment through the publication of a legal notice announcing a minimum of a 30-day comment period. The legal notice will be published at a minimum in the *News Tribune*, sent to interested parties via the APHIS stakeholder registry, and posted on the APHIS website. Comments received during the public involvement process will be fully considered for new substantive issues and alternatives.

ISSUES ADDRESSED IN DETAIL

The issues analyzed in detail are discussed in Chapter 2 of the EA. Alternatives developed and identified during the development of the EA to address those issues are discussed in Chapter 3 of the EA. The following issues were identified during the scoping process for the EA:

- Effects of Damage Management Activities on Target Bird Populations
- Effects on Non-target Wildlife Species Populations, Including T&E Species
- Effects of Damage Management Methods on Human Health and Safety

Based on those damage management activities conducted previously by WS since the Decision and FONSI were signed in 2016, no additional issues have been identified that require detailed analyses. Those issues identified during the development of the EA remain applicable and appropriate to resolving damage and threats of damage associated with birds.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

The alternatives considered and evaluated using the identified issues are described and discussed in detail in Chapter 3 of the EA. In addition, Chapter 4 of the EA analyzes the environmental consequences of each alternative as those alternatives relate to the issues identified. Appendix B of the EA provides a description of the methods that could be used or recommended by WS under each of the alternatives. The EA describes three potential alternatives that were developed to address the issues identified above. Alternatives analyzed in detail include:

- Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)
- Alternative 2 - Bird Damage Management by WS using only Non-lethal Methods
- Alternative 3 - No Bird Damage Management Conducted by WS

STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT TECHNIQUES

SOPs improve the safety, selectivity, and efficacy of wildlife damage management activities. The WS program uses many such SOPs which are discussed in detail in Chapter 3 of the EA. Those SOPs would be incorporated into activities conducted by WS when addressing bird damage management.

ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

Potential impacts of Alternative 2 and Alternative 3 on the human environment related to the major issues have not changed from those described and analyzed in the EA and thus do not require additional analyses in this Supplement. Chapter 4 of the EA contains a detailed discussion and comparison of the identified alternatives and the major issues. The issues were identified as important to the scope of the analysis in the EA (40 CFR 1508.25). Alternative 1 (proposed action/no action), as described in the EA, addresses requests for bird damage management using an integrated damage management approach by WS. The following is an analysis of potential impacts for each of the major issues analyzed in the EA since the completion of the EA as related to Alternative 1 (proposed action/no action alternative):

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

A common concern when addressing damage associated with bird species are the effects on the populations of those species from methods used to manage damage. The integrated approach of managing damage associated with wildlife described in the EA under the proposed action alternative uses both non-lethal and lethal methods to resolve requests for assistance. Although non-lethal methods can disperse wildlife from areas where application occurs, wildlife is generally unharmed. Therefore, adverse effects are not often associated with the use of non-lethal methods. However, methods used to lethally remove birds can result in local reductions in those species' populations in the area where damage or threats of damage were occurring.

Magnitude can be described as a measure of the number of animals killed in relation to their abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest data when available. Generally, WS only conducts damage management on species whose population densities are high. WS' take is monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of take is maintained below the level that would cause significant adverse impacts to the viability of native species populations. All lethal removal of birds by WS occurs at the requests of a cooperator seeking assistance and only after the appropriate permit has been issued by the USFWS, when appropriate.

The issue of the effects on target bird species arises from the use of non-lethal and lethal methods identified in the EA to address the need for reducing damage and threats associated with those bird species addressed in the EA. The EA found that when WS' activities are conducted within the scope

analyzed in the EA, those activities would not adversely impact bird populations. WS' SOPs are designed to reduce the effects on bird populations and are discussed in section 3.3 and 3.4 of the EA.

WS has provided direct damage management and technical assistance in response to requests for assistance in Missouri since the completion of the EA. Descriptions and application of direct damage management and technical assistance projects are discussed in detail in Chapter 3 of the EA. All bird damage management activities conducted by WS were pursuant to applicable federal, state, and local laws and regulations.

Information on bird populations and trends are often derived from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population database, published literature, and harvest data. These methods remain applicable as described in the 2015 EA. Unless noted otherwise, the state population estimate listed for each species analyzed below was obtained from PFSC (2013). Breeding Bird Survey (BBS) population trends from 1966 to 2015 for Missouri and the region that the state falls within (Appalachian Mountains) are listed for each species when available. The statistical significance of a trend for a given species that is determined by the BBS data is color coded: a black percentage indicates a statistically non-significant positive or negative trend, a red percentage indicates a statistically significant negative trend, and a blue percentage indicates a statistically significant positive trend (Sauer et al. 2017).

Population Impact Analysis from WS' activities in Missouri from FY 2015 through FY 2016

WS has provided direct damage management and technical assistance in response to requests for assistance with bird damage and threats since the completion of the EA and the Decision/FONSI signed in 2015. All bird damage management activities conducted by WS were pursuant to relevant federal, state, and local laws and regulations, and were conducted within the parameters analyzed in the EA. Direct operational assistance provided by WS included both non-lethal harassment techniques and the lethal removal of target bird species.

Since the competition of the EA and the Decision/FONSI, the PRDO has been vacated. The analyses in the EA relied upon a previous analysis conducted by the USFWS that evaluated the cumulative effects associated with the take of cormorants pursuant to the vacated depredation orders and under depredation permits. In the decision to vacate the depredation orders, the Court concluded the analysis of cumulative impacts on the cormorant population conducted in the NEPA analysis prepared by the USFWS was insufficient. Therefore, double-crested cormorant are being analyzed in this supplement.

Red-tailed Hawk Biology and Population Impacts

MO population estimate: 38,000
BBS Eastern Tall Grass Prairie, 1966-2015: 2.07%
BBS Eastern Tall Grass Prairie, 2005-2015: 0.61%
BBS Central Hardwoods, 1966-2015: 1.80%
WS proposed take as % of state population: 1.05 %

WS proposed take: 400
WS proposed relocation: 600
BBS Missouri, 1966-2015: 1.79%
BBS Missouri, 2005-2015: 1.62%
BBS Central Hardwoods, 2005-2015: 0.82%

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

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

From FY 2015 through FY 2016, WS employed non-lethal methods to disperse an average 510 red-tailed hawks and employed live-traps to capture and relocate an average 375 red-tailed hawks from airports. Red-tailed hawks were live-captured using bal-chatri traps, pole traps or Swedish Goshawk traps and relocated to an area not less than 50 miles away and released into appropriate habitat with landowner permission. In addition, red-tailed hawks captured and relocated were banded for identification purposes using USGS approved leg-bands appropriate for the species. WS is authorized to band captured raptor species with auxiliary plastic colored leg bands under a Federal Bird Banding Permit (No. 23999) issued by the U.S. Geological Survey (USGS) Bird Banding Laboratory. Per WS' raptor relocation protocol, banded raptors that return to the same airport environment once may be euthanized to protect aviation safety. In addition, when a red-tailed hawk is creating an immediate risk to aviation safety (e.g., perching along an active runway, flying into aircraft approach space) and after aggressive harassment has proven ineffective, lethal removal may be deemed necessary.

Direct, Indirect, and Cumulative Effects:
Although the live-capture and relocation of red-tailed hawks would be a non-lethal method of reducing damage or threats of damage, red-tailed hawks could be relocated during their nesting season which could potentially lower nesting success. During FY 2015 and FY 2016, 97 and 74 red-tailed hawks respectively were captured for relocation between March 15 and July 15 in Missouri which represents 23% of the relocated hawks that were removed during the nesting season. Eggs are generally observed in nests of red-tailed hawks as early as mid to late March (Preston and Beane 2009). Nestlings are generally present in nests from late-May through early-July (Preston and Beane 2009). Incubation of eggs can occur by either the male or female; however, incubation occurs primarily by the female while the male contributes a shorter amount of time to incubation each day (Preston and Beane 2009). Both the male and female red-tailed hawks feed the young once hatched; however, the female actually feeds the young more often while the male does more of the hunting (Preston and Beane 2009).

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

Based on previous requests received by WS, as well as anticipated requests, up to 400 red-tailed hawks could be lethally removed by WS to alleviate damage. This level of take is considered to be of low magnitude and unlikely to result in any cumulative adverse impacts. Furthermore, the increasing population trend indicates that prior removal and relocation of red-tailed hawks has had no adverse effects on statewide populations.

Table 2 – Number of Red-tailed hawk addressed in Missouri from FY 2015 to FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	WS Relocated
2015	397	116	363
2016	623	114	387

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

Based on the best scientific data, WS proposed take level will have no adverse direct effects on red-tailed hawk populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. The permitting of the take by the USFWS pursuant to the MBTA ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for red-tailed hawks.

Killdeer Biology and Population Impacts

WS proposed take: 500
BBS Eastern Tall Grass Prairie, 1966-2015: 2.05%
BBS Eastern Tall Grass Prairie, 2005-2015: 0.36%
BBS Missouri, 1966-2015: 1.65%
BBS Missouri, 2005-2015: 1.69%
BBS Central Hardwoods, 1966-2015: 0.03%
BBS Central Hardwoods, 2005-2015: -1.14%

The killdeer is by far the most wide-spread and familiar of North American plovers because of its habitat, its tolerance of humans, its easily observed parental care, and its distinct vocalizations. Killdeer are more common today than at any time in its history as a result of habitat changes brought on by humans. It breeds in Missouri and generally migrates during the winter months but some populations may reside in southern Missouri, and thus can be found year-round (Jackson and Jackson 2000). The number of killdeer addressed in Missouri by all entities to alleviate damage is shown in Table 3.

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

From FY 2015 through FY 2016, WS has lethally removed an average of 314 killdeer at airports. The highest level of killdeer removal by WS occurred in FY 2016 when 408 killdeer were lethally removed. WS has also employed non-lethal methods to harass 1,879 killdeer at airports from FY 2015 through FY 2016.

Table 3 – Number of Killdeer addressed in Missouri from FY 2015 to FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	
2015	662	219	
2016	1217	408	

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

Direct, Indirect, and Cumulative Effects:

The removal of 500 killdeer would represent 0.025% of the national population. Based on the best scientific data, WS proposed removal level will have no adverse direct effects on killdeer populations. If habitat modification and non-lethal harassment methods occur within airport property to minimize the

attraction of killdeer on the property, then there could be an indirect impact on the nesting and/or breeding success of individuals that originally nested on the airport property; this localized indirect impact would be minimal and therefore would not cause significant effects on the state killdeer populations. The potential authorized removal from all non-WS entities combined with WS proposed removal is also not expected to create adverse cumulative impacts. All removal of killdeer would occur within the levels permitted by the USFWS and the MDC pursuant to the MBTA.

American Coot Biology and Population Impacts

WS proposed take: 200

BBS Eastern Tall Grass Prairie, 1966-2015: -10.56%
BBS Eastern Tall Grass Prairie, 2005-2015: -10.71%
BBS Central Mixed Grass Prairie, 1966-2015: -3.43%
BBS Central Mixed Grass Prairie, 2005-2015: 4.99%
Central BBS, 1966-2015: 1.98%
Central BBS, 2005-2015: 13.99%

American coots can be found across the majority of the United States. Coots are opportunistic feeders and are highly adaptable towards any habitat (Audubon 2014, Ehrlich et al. 1988). American coot flocks may number up to 1,500 individuals and can be a threat towards aviation safety and human health. American coots can be harvested within Missouri between October and January. The annual harvest numbers in Missouri in 2015 are shown in Table 4 (USFWS 2016).

Although a population estimate is not available for Missouri, the number of American coots observed during the CBC has shown a general increasing trend in Missouri from 2011 through 2013 (Beveroth 2014). Additionally, survey data from the CBC indicates that the number of American coots within the state has shown a generally stable to increasing trend since 1966 (NAS 2010).

Table 4 – Number of American coots addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	Harvest take
2015	30	3	2,660
2016	24	0	not available

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

Direct, Indirect, and Cumulative Effects:

Based on the best scientific data, WS' proposed take level will have no adverse direct or indirect effects on American coot populations. The potential authorized take from all non-WS entities combined with WS proposed take and the annual harvest is not expected to create adverse cumulative impacts. The take of coots by WS would only occur at levels authorized by the USFWS, which ensures WS' take and take by all entities, including hunter harvest, would be considered to achieve the desired population management levels of coots. WS' proposed take is only a small percentage of the annual harvest, and therefore is not expected to hinder the ability of those interested persons in harvesting American coots during the hunting season.

Eurasian Collared-Dove Biology and Population Impacts

MO population estimate: 8,000 WS proposed annual take: 750
BBS Central Mixed Grass Prairie, 1966-2015: 40.75% BBS MO, 1966-2015: 40.49%
BBS Central Hardwoods, 2005-2015: 27.55% BBS MO, 2005-2015: 43.58%
WS take as % of state population: 9.4%

Eurasian collared-doves are nonnative to the United States and, as such, are not afforded protection under the MBTA (70 FR 12710-12716). However, their strong increasing trend proves that they are a highly adaptable species. Eurasian collared-doves range throughout much of North America with the exception of the far northeast and breeding populations are showing significant increasing trends across the U.S. (estimated at 29.13% annually since 1966) and in the Central BBS region (estimated at 30.29% annually since 1966) (Sauer et al. 2017). The BBS has also shown an increasing trend in Missouri, estimated at 40.49% since 1966 (Sauer et al. 2017). In addition to the BBS, the number of Eurasian collared-doves observed during the CBC shows an increasing trend throughout Missouri from 2006-2016 (National Audubon Society 2016). Eurasian collared-doves are often found with mourning doves and feral pigeons in damage situations. They are managed as a game species in Missouri with no limit on recreational harvest (MDC 2017). WS has lethally removed 32 Eurasian collared-doves in the past two years.

Direct, Indirect, and Cumulative Effects:

Given the low magnitude of WS' proposed removal along with the rapidly growing regional population of this species, WS removal will not have a direct or indirect impact on Eurasian collared-dove populations. WS' proposed Eurasian collared-dove damage management activities would be conducted pursuant to Executive Order 13112. The Executive Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species. WS has concluded that the proposed level of Eurasian collared-dove removal will not have an adverse cumulative impact to the state, regional, or national population.

Double-crested Cormorant Biology and Population Impacts

WS proposed annual take: 200
BBS Central Mixed Grass Prairie, 1966-2015: 3.21% BBS MO, 1966-2015: 8.40%
BBS Central Hardwoods, 2005-2015: 14.03% BBS MO, 2002-2015: 6.48%

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Hatch and Weseloh 1999). Wires et al. (2001) and Jackson and Jackson (1995) have suggested that the current cormorant resurgence may be, at least in part, a population recovery following years of DDT-induced reproductive suppression and unregulated take prior to protection under the MBTA. The number of double crested cormorants addressed in Missouri by all entities to alleviate damage is shown in Table 5.

The double-crested cormorant is one of six species of cormorants breeding in North America and has the widest range (Hatch 1995). Double-crested cormorants are showing statistically significant increasing trends across the U.S. (estimated at 3.9% annually since 1966), and in the Central BBS region (estimated at 4.2% annually since 1966) (Sauer et al. 2017). The BBS and CBC have also shown an increasing trend in Missouri, estimated at 8.4% since 1966 (Sauer et al. 2017) and 25.96% since 2006 (National Audubon Society 2010). The population (breeding and non-breeding birds) in the United States was estimated to be greater than one million birds in the 1990's (Tyson et al. 1999). From 2007 through 2013 a Colonial Waterbird Survey estimated that 38,269 nests occurred just along Lake Michigan. This survey covers shoreline and islands of the Great Lakes and some inland colonies near the shores of the Great Lakes, but

it does not account for the birds that might have been nesting on inland lakes and rivers. The cormorant's range has expanded in the Great lakes and this survey documented an 8% increase in the number of nesting cormorants since the third survey that was conducted in 1997-1999 (Wires et al. 2001).

Table 5 – Number of Double Crested Cormorants addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits
		WS Removal[1,3]
2015	85	0
2016	978	26

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

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS proposed take level will have no adverse direct or indirect effects on cormorant populations. The permitting of take by the USFWS ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for double-crested cormorants. WS' proposed take of 200 double-crested cormorants annually is anticipated to have minimal effects on the regional or continental cormorant populations.

Bonaparte's Gull Biology and Population Impacts
WS proposed removal: 75

Bonaparte's gulls breed throughout the taiga and boreal forests of Canada and Alaska (Burger and Gochfeld 2002). They require large lakes, bogs, muskegs, and marshes within arboreal and subarctic habitats for breeding (Burger and Gochfeld 2002). Due to the breeding habits of Bonaparte's gulls, surveys such as the U.S. Geological Survey's Breeding Bird Survey, do not reliably account for the breeding population (Burger and Gochfeld 2002). The Bonaparte's gull population is estimated at 85,000 – 175,000 pairs globally (Burger and Gochfeld 2002). However, based on observations of flocks with more than 100,000 individuals on Lake Erie, the population is likely larger (Burger and Gochfeld 2002). Bonaparte's gulls are migrants and winter visitors throughout much of the United States during the nonbreeding season, including the Upper Mississippi Valley/Great Lakes region (Burger and Gochfeld 2002, Wires et al. 2010). According to the UMVGL Waterbird Conservation Plan, Bonaparte's gulls are considered a species of moderate concern in North America (Wires et al. 2010). The number of Bonaparte's gulls addressed in Missouri by all entities to alleviate damage is shown in Table 6.

Table 6 – Number of Bonaparte's gull addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits
		WS Removal[1,3]
2015	0	0
2016	1,263	27

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

Direct, Indirect, and Cumulative Effects:
The best available data estimates the population of Bonaparte's gulls to be at least 85,000 breeding pairs globally (Burger and Gochfeld 2002). Based on this estimate, the annual removal of up to 75 Bonaparte's gulls by WS would represent 0.09% of the population. WS proposed removal level will not have

significant adverse direct or indirect effects on Bonaparte's gull populations. The removal of Bonaparte's gulls by WS to alleviate damage will only occur under depredation permits. The permitting of lethal removal by USFWS would ensure the cumulative take of Bonaparte's gulls occurs within the allowable levels to achieve the desired population objectives for the species. Therefore, WS proposed removal is not expected to have adverse cumulative impacts on Bonaparte's gull populations.

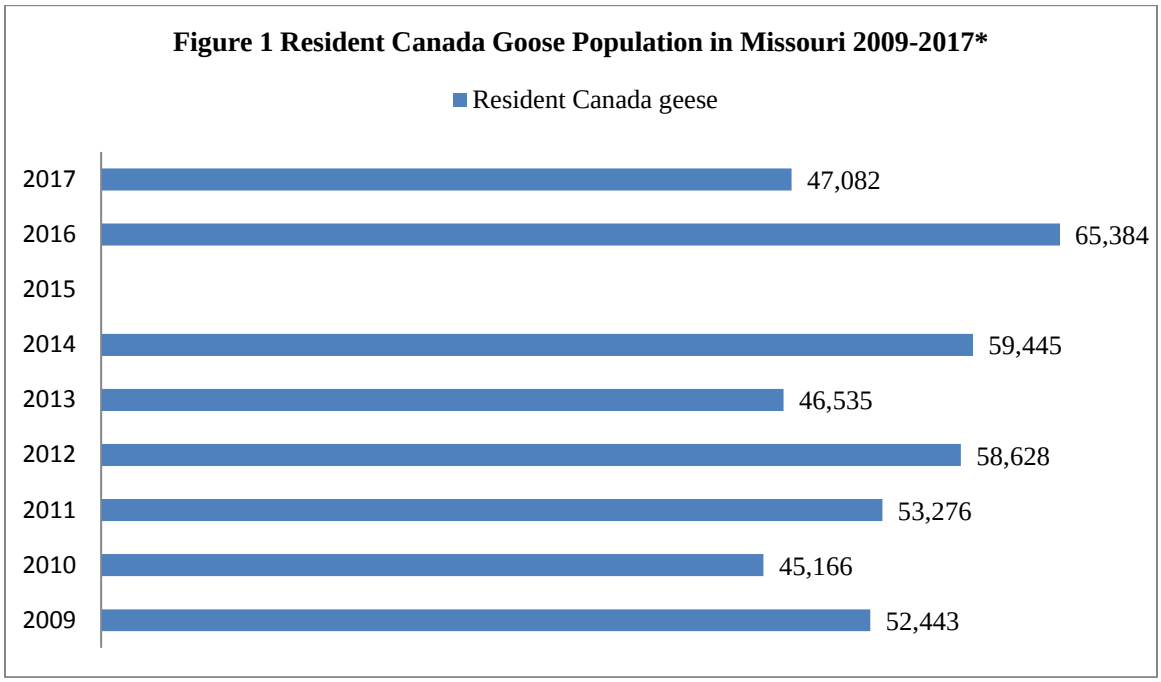
Canada Goose Biology and Population Impacts

MO resident goose population estimate: 47,082
BBS Eastern Tall Grass Prairie, 1966-2015: 16.34%
BBS Eastern Tall Grass Prairie, 2005-2015: 9.25%
BBS Central Hardwoods, 1966-2015: 14.84%
WS proposed take as % of state population: 1.70%

WS proposed take: 800 + 500 nests
BBS Missouri, 1966-2015: 11.97%
BBS Missouri, 2005-2015: 8.80%
BBS Central Hardwoods, 2005-2015: 15.45%

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

In the winter, resident geese may move south during cold weather. Additionally, resident geese from states further north may move into Missouri at these times. Resident geese are found throughout Missouri year-round and their populations have been estimated as low as 45,166 and as high as 64,384 between 2009 and 2017 (per communications, Doreen Mengel, 2018) (Figure 1). The Missouri resident Canada goose population objective is 40,000 to 60,000. No population estimate was taken in 2015.



Migratory geese pass through or remain in Missouri from October through March. The total population estimate for the Mississippi Flyway Giant Canada geese in 2017 was 1,776,000 which was 16% greater than in 2016 (USFWS 2017). Missouri's migratory Canada geese belong to the Mississippi Flyway Population.

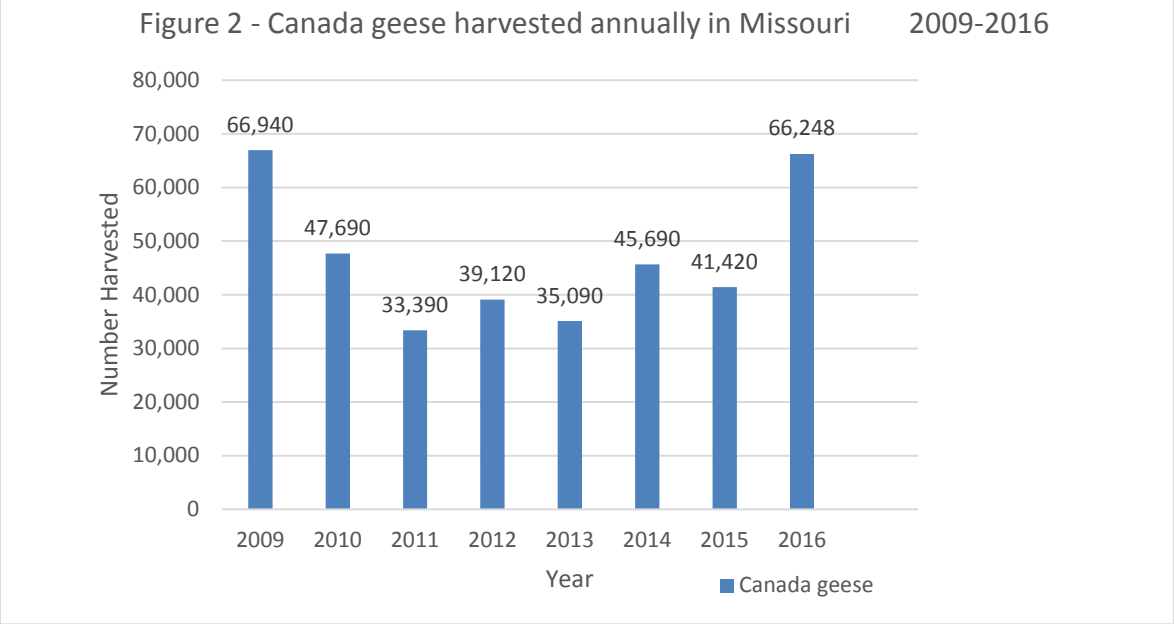
Goose populations are managed by the USFWS and the MDC pursuant to the MBTA, federal regulations (50 CFR 10, 13, 20 & 21), Wildlife Code of Missouri and other federal and state laws, regulations, policies, and court rulings. Procedures, such as handling nests and eggs, capturing and relocating birds, capturing and euthanizing birds, shooting birds to reduce damage, and any other activity that includes handling birds, their parts, and/or their nests and eggs requires compliance with these laws. A depredation permit is generally required to conduct any of these activities. Table 7 addresses the number of Canada geese removed under depredation permits in Missouri from FY 2015-FY 2016.

Table 7 – Number of Canada geese addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	WS Transfer of Custody
2015	16,020	104	13
2016	12,905	357	100

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

Like many waterfowl species in Missouri, Canada geese can be harvested during a regulated hunting season that traditionally occurs from late October through January. Canada geese can also be harvested during a special "Resident Canada goose Hunting Season" that occurs during the month of October. Since migrant geese do not arrive in Missouri until November, this hunt targets the resident goose population in Missouri. Figure 2 depicts the total number of hunter harvested geese between 2009 and 2016 (2017 Missouri Canada Goose Survey).



Direct, Indirect, and Cumulative Effects:
WS does not typically remove geese during the migratory period; however, occasionally minimal numbers of geese are removed during this period at airports for the protection of human safety. This minimal removal is not expected to adversely affect migratory goose populations.

Canada goose nests are authorized to be destroyed (which may involve treatment of eggs by oiling, puncturing, or addling to inhibit reproduction) by the USFWS through the Resident Canada Goose Registration. Between 2015 and 2016, the number of goose nests destroyed in Missouri was 48 nests in 2015 and 68 nests in 2016. The destruction/treatment of up to 500 Canada goose nests annually by WS would occur in localized areas where nesting takes place. As with the lethal take of geese, the take of nests must be authorized by the USFWS and or the MDC. Therefore, the number of geese lethally removed and the number of nests taken by WS annually would occur at the discretion of the USFWS and the MDC. Provided that the goose population allows for an annual hunting harvest, and WS' take is a fraction of a percent of the annual harvest, the cumulative take will not adversely affect Canada goose populations. WS' take could be considered of low magnitude when compare to the number of geese observed in Missouri annually and will not hinder the ability of those interested persons to harvest geese during the hunting season.

Based on the best scientific data, WS proposed take level will have no adverse direct effects on Canada geese populations. The potential authorized take from all non-WS entities combined with WS proposed take is not expected to create adverse cumulative impacts. The permitting of the take by the USFWS pursuant to the MBTA ensures take by WS and by other entities occurs within allowable take levels to achieve the desired population objectives for Canada geese in Missouri.

Black Vulture Biology and Population Impacts

MO population estimate: 40,000
BBS MO, 1966-2015: 17.56%
BBS Central Hardwoods, 1966-2015: 7.81%
WS proposed take as % of state population: 0.5%

WS proposed removal: 200 + 20 nests (and eggs)
BBS MO, 2005-2015: 19.66%
BBS Central Hardwoods, 2005-2015: 6.58%

Black vultures are the most numerous vulture in the Western Hemisphere (Wilbur 1983). Historically in North America, black vultures occurred in the southeastern United States, Texas, Mexico, and parts of Arizona (Wilbur 1983). Black vultures have been expanding their range northward in the eastern United States (Wilbur 1983, Rabenhold and Decker 1989), and they are considered locally resident with little movement during the migration periods (Parmalee and Parmalee 1967, Rabenhold and Decker 1989); however, some populations will migrate (Eisenmann 1963 cited from Wilbur 1983). Black vultures can be found in virtually all habitats but are most abundant where forest is interrupted by open land (Buckley 1999). Black vultures typically feed by scavenging, but occasionally take live prey, especially newborn livestock (Brauning 1992). This species has been reported to live up to 25 years of age (Henny 1990).

Since 1966, black vultures have shown a generally increasing trend in the survey data collected for the CBC (NAS 2010). Vultures produce very few auditory cues that would allow for identification (Buckley 1999) and thus, surveying for vultures is reliant upon visual identification. For visual identification to occur during surveys, vultures must be either flying or visible while roosting. Coleman and Fraser (1989) estimated that black and turkey vultures spend 12 to 33% of the day in summer and 9 to 27% of the day in winter flying. Avery et al. (2011) found that both turkey vultures and black vultures were most active in the winter (January to March) and least active during the summer (July to September). Avery et al. (2011) found that across all months of the year, black vultures were in flight only 8.4% of the daylight hours while turkey vultures were in flight 18.9% of the daylight hours.

Direct, Indirect, and Cumulative Effects:
The majority of the direct operational assistance conducted by WS on black vultures would occur in the spring, summer and fall. Cooperators report reduced black vulture numbers from November to March. Although not all, some black vultures migrate south during the winter months.

Based on the best scientific data, WS proposed annual removal level will have no adverse direct effects on black vulture populations. The number of black vultures observed continues to increase annually within the state and well as the number of calls for assistance have increases. The removal of black vultures can only occur when authorized through the issuance of depredation permits by the USFWS. The permitting of any lethal removal would ensure the cumulative removal of black vultures annually would occur within allowable removal levels to achieve desired population objectives for black vultures.

Cooper's Hawk Biology and Population Impacts
MO population estimate: 19,000 WS proposed take: 75
BBS Eastern Tall Grass Prairie, 1966-2015: 7.09% BBS Missouri, 1966-2015: 3.37%
BBS Eastern Tall Grass Prairie, 2005-2015: 9.05% BBS Missouri, 2005-2015: 3.09%
BBS Central Hardwoods, 1966-2015: 3.29% BBS Central Hardwoods, 2005-2015: 3.71%
WS proposed take as % of state population: 0.39 %

The Cooper's hawk is a strictly North American species. It is essentially a woodland species and although a true forest hawk, it has adapted remarkably well to life in and around the older suburbs, especially in areas where small woodlots and trees have been allowed to stand. Nesting often occurs in man-made open clearings. Wintering habitats are similar to nesting habitats and birds are less prone to migrate than sharp-shinned hawks. Home range of these hawks is relatively large.
Because of large home range, densities are quite low and 80% of prey are other avian species. Stick nests are placed in trees with overhead cover with clutch size from three to six eggs. Table 8 addresses the number of Cooper's hawk removed under depredation permits in Missouri from FY 2015-FY 2016.

Table 8 – Number of Cooper's hawks addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	WS Relocated
2015	1	3	26
2016	6	5	40

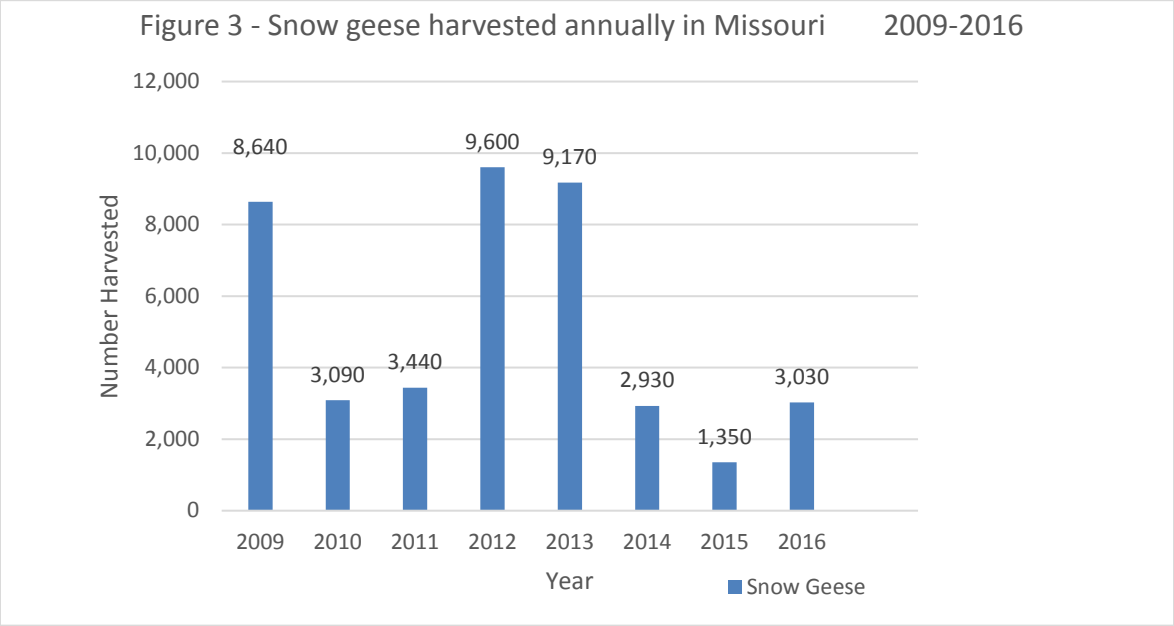
[1] Data reported by federal fiscal year
[2] Data reported by calendar year
[3] As per USFWS permit

Direct, Indirect, and Cumulative Effects:
Based on surveys at Missouri airports, WS anticipates banding and relocating up to 100 and lethally removing up to 75 Cooper's hawks. WS' proposed removal level will have no adverse direct or indirect effects on Cooper's hawk populations based on the best available data. The permitting of the removal by the USFWS pursuant to the MBTA ensures removal by WS and by other entities occurs within allowable removal levels to achieve the desired population objectives for Cooper's hawks in Missouri.

Snow geese Biology and Population Impacts
Mid-continent population estimate: 3,814,700[1] WS proposed take: 400
WS proposed take as % of state population: 0.01 %
1 USFWS 2014

Snow geese breed across the extreme northern portions of Canada and along the Arctic coast (Mowbray et al. 2000). No breeding populations of snow geese occur in Missouri. However, snow geese are common

migrants through Missouri with large concentrations overwintering in the state. The fall migration period occurs from September through November with the spring migration occurring from late February through the first part of June (Mowbray et al. 2000).
Snow geese are considered migratory game birds and many states, including Missouri, have regulated hunting seasons for snow geese. Snow geese can be harvested in Missouri between October and January. They can also be harvested in the spring under the spring light goose conservation order, which was authorized by congress under the Arctic Tundra Habitat Emergency Conservation act in 1999. The annual harvest numbers in Missouri for snow geese from 2009 through 2016 are shown in Figure 3 (www.flyways.us). Snow goose populations have increased dramatically since the mid-1970s and have reached historic highs across their breeding and wintering range.



The number of snow geese addressed in Missouri by WS to alleviate damage is shown in Table 9. The annual harvest of snow geese in Missouri averaged from 1,350 to 9,600 individuals per year from 2009-2016 (Figure 2).

Table 9 – Number of snow geese addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits	
		WS Removal[1,3]	WS Relocated
2015	25,491	5	0
2016	377,403	17	0

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

Direct, Indirect, and Cumulative Effects:
All removal of snow geese by WS would occur only after a depredation permit had been issued by the USFWS either to WS or to the entities experiencing damage or threats of damage. If a permit was issued to an entity other than WS, WS participation in damage management activities requiring lethal removal would occur as an agent of the cooperating entity under the depredation permit. Due to the rapidly increasing population, WS proposed removal is expected to have no adverse direct or indirect effects on

snow geese populations. Additionally, WS proposed removal combined with the potential removal of non-WS entities, including annual harvest, is not expected to create adverse cumulative impacts on snow geese populations. WS' limited proposed removal would not hinder the ability of those interested persons to harvest snow geese during the hunting seasons.

Herring gull Biology and Population Impacts

WS proposed take: 300
BBS Eastern Tall Grass Prairie, 1966-2015: -0.73%
BBS Eastern Tall Grass Prairie, 2005-2015: -0.74%

Herring gulls are the largest of the five species of gulls that occur in Missouri and their population size in the Great Lakes region had increased dramatically up through the 1990's (Belant et al. 1993). They can be found near garbage dumps, along lakes and rivers, and on rooftops within metropolitan areas. Biologists often only find out about their nesting sites on rooftops when the presence of the birds results in complaints and requests for assistance with damage management. Herring gulls are sometimes observed wintering in Missouri as large numbers migrate south through the Mississippi Flyway. The North American Waterbird Conservation Plan ranked the herring gull as a species of "low concern" in North America (Kushlan et al. 2002).

The number of herring gulls addressed in Missouri by WS to alleviate damage is shown in Table 12. The number of herring gulls removed by WS in Missouri averaged 4 in FY 2015 to FY 2016 (Table 10).

Table 10 – Number of herring gull addressed in Missouri from FY 2015 through FY 2016

Year	Dispersed by WS[1]	Take under Depredation Permits
		WS Removal[1,3]
2015	0	0
2016	2	8

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

Direct, Indirect, and Cumulative Effects:

Given the low magnitude of this take level and the fact that the USFWS provides oversight for cumulative and regional take, this ensures that WS take will not have an adverse direct or indirect impact to herring gull populations. Previous take levels did not appear to have a negative impact on the gull population and given that WS take impacts only a small amount of the area in the state, WS has concluded that the proposed level of herring gull take will not have an adverse cumulative impact to the state, regional, or national gull population.

Summary

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

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

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

Additional Target Species

WS occasionally receives requests for assistance with the below listed species. While these requests are infrequent, it is possible that WS may need to harass or lethally remove limited numbers of these species. Additionally, WS may be requested to remove limited numbers of nests for the species indicated in the next section.:

Species List: barn owls (*Tyto alba*), ross geese (*Anser rossii*), western meadowlarks (*Sturnella neglecta*), prairie falcons (*Falco mexicanus*), peregrine falcons (*Falco peregrinus*), buff-breasted sandpipers *(Calidris subruficollis*), western kingbirds (*Tyrannus verticalis*), white-fronted geese (*Anser albifrons*), Caspian terns (*Hydroprogne caspia*), semipalmated sandpipers (*Calidris pusilla*), tree swallows *(Tachycineta bicolor*), black terns (*Chlidonias niger*), sanderlings (*Calidris alba*), cedar waxwings (*Bombycilla cedrorum*), laughing gulls (*Leucophaeus atricilla*).

Nests removal only list: killdeer (*Charadrius vociferous*), American kestrels (*Falco sparverius*), great-horned owls (*Bubo virginianus*), Cooper's hawks (*Accipiter cooperii*), wood ducks (*Aix sponsa*), mourning doves (*Zenaida macroura*), American robins (*Turdus migratorius*), house finches *(Haemorhous mexicanus*), herring gulls (*Larus argentatus*), sharp-shinned hawks (*Accipiter striatus*), bank swallows (*Riparia riparia*), rough-legged hawks (*Buteo lagopus*), ring-billed gulls (*Larus delawarensis*), merlins (*Falco columbarius*), common nighthawks (*Chordeiles minor*), scissor-tailed flycatchers (*Tyrannus forficatus*).

Based on previous requests for assistance and the removal levels necessary to alleviate those requests for assistance, no more than 20 individuals and 20 nests (and eggs) of any of those species could be taken annually by WS. None of those bird species are expected to be taken by WS at any level that would adversely affect populations throughout the state. All of those birds listed are afforded protection under the MBTA and take is only allowed through the issuance of a depredation permit and only at those levels stipulated in the permit. The USFWS, as the agency with management responsibility for migratory birds, could impose restrictions on depredation take as needed to assure cumulative take does not adversely affect the continued viability of populations. This would assure that cumulative impacts on these bird populations would have no significant adverse impact on the quality of the human environment.

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

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

The issue of non-target species effects, including effects on threatened and endangered (T&E) species, arises from the use of non-lethal and lethal methods identified in the alternatives. The use of non-lethal and lethal methods has the potential to inadvertently disperse, capture, or kill non-target wildlife. WS' SOPs are designed to reduce the effects of damage management activities on non-target species' populations which were discussed in the EA. To reduce the risks of adverse effects to non-target wildlife, WS selects damage management methods that are as target-selective as possible or applies such methods in ways that reduces the likelihood of capturing non-target species. Before initiating management activities, WS also selects locations which are extensively used by the target species and employs baits or lures which are preferred by those species. Despite WS' best efforts to minimize non-target take during program activities, the potential for adverse effects to non-targets exists when applying both non-lethal and lethal methods to manage damage or reduce threats to safety.

Non-lethal methods have the potential to cause adverse effects on non-targets primarily through exclusion, harassment, and dispersal. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected. Therefore, non-target species excluded from areas may potentially be adversely impacted if the area excluded is large enough. The use of auditory and visual dispersal methods used to reduce damage or threats caused by target species are also likely to disperse non-targets in the immediate area where the methods are employed. However, the potential impacts on non-target species are expected to be temporary with target and non-target species often returning after the cessation of dispersal methods.

While every precaution is taken to safeguard against taking non-targets during operational use of methods and techniques for resolving damage and reducing threats caused by wildlife, the use of such methods can result in the incidental take of unintended species. Those occurrences are minimal and should not affect the overall populations of any species. WS has only live captured and released 12 non-target mourning doves in FY 2014 during bird damage management activities since the Decision and FONSI were signed for the EA.

The EA concluded that effects of control methods on non-target species is biologically insignificant to nonexistent and that WS has not adversely affected the viability of any wildlife species populations through bird damage management activities. Bird damage management activities implemented by WS utilize the most selective and appropriate methods for taking targeted bird species and excluding non-target species. The lethal removal of non-targets from using those methods described in the EA is likely to remain low with removal never reaching a magnitude that a negative impact on populations would occur.

Threatened and Endangered Species
A review of T&E species listed by the USFWS showed that the listing of the red-cockaded woodpecker (*Picoides borealis*) and the small whorled pogonia (*Isotria medeoloides)* has occurred since the completion of the EA in 2015. Based on a review of the best scientific data available, WS has determined that activities conducted pursuant to the proposed action would have "No Effect" on these two newly listed species or their critical habitats. WS has not historically conducted operations in red-cockaded woodpecker or small whorled pogonia habitat. WS does not anticipate performing operations in these habitats in the future. While WS may make recommendations for habitat modifications, the program does not typically perform these functions.

WS' program activities in Missouri to manage damage and threats caused by birds have not changed from those described in the EA. A review of those species listed in Missouri and discussed in the EA indicates that WS' bird damage management activities would continue to have no adverse effects on those species.

Program activities and their potential impacts on other wildlife species, including T&E species have not changed from those analyzed in the EA. Impacts of the program on this issue are expected to remain insignificant.

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

Since the completion of the EA and the Decision and FONSI in 2015, no injuries to employees or the public occurred from the implementation of methods under the proposed action. Based on the analyses in the EA, when WS' activities are conducted according to WS' directives, SOPs, and in accordance with federal, state, and local laws those activities pose minimal risks to human safety. Program activities and their potential impacts on human health and safety have not changed from those analyzed in the EA. No additional methods or techniques are being proposed for use under the proposed action. Impacts of the program on this issue are expected to remain insignificant.

Issue 4 – Effects on the Aesthetic Values of Birds

As described in the EA, WS employs methods when requested that would result in the dispersal, exclusion, or removal of individuals or small groups of birds to resolve damage to agriculture, property, natural resources, or threats to human health and safety. In some instances where birds are excluded, dispersed, or removed, the ability of interested persons to observe and enjoy those birds will likely temporarily decline. Even the use of non-lethal methods can lead to dispersal of birds if the resource being protected was acting as an attractant. Thus, once the attractant has been removed or made unattractive, birds will likely disperse to other areas where resources are more available.

The use of lethal methods would result in a temporary reduction in local populations resulting from the removal of target birds to resolve requests for assistance. WS' goal is to respond to requests for assistance and to manage those birds responsible for the resulting damage. Therefore, the ability to view and enjoy those birds will still remain if a reasonable effort is made to view those species outside the area in which damage management activities occurred.

The EA concluded the effects on aesthetics would be variable depending on the stakeholders' values towards wildlife. Program activities and potential impacts on human affectionate bonds with birds and aesthetics have not changed from those analyzed in the EA.

Summary

No significant cumulative environmental impacts are expected from activities considered under the Supplement. Likewise, no significant cumulative impacts have been identified from the implementation of the proposed action in the EA since 2015. Under the proposed action, the reduction of wildlife damage or threats using an integrated approach employing both non-lethal and lethal methods would not have significant impacts on wildlife populations in Missouri or nationwide. WS continues to coordinate activities with federal, state, and local entities to ensure activities do not adversely impact wildlife populations. No risk to public safety is expected when WS' activities are conducted pursuant to the proposed action or the proposed supplement to the EA. The EA further describes and addresses cumulative impacts from the alternatives, including the proposed action.

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LITERATURE CITED

Audubon. 2014. American coot (*Fulica americana*). Accessed online November 11, 2014: http://birds.audubon.org/birds/american-coot

Avery, M. L., and J. L. Cummings. 2004. Livestock depredations by black vultures and golden eagles. Sheep and Goat Research Journal. 19:58-63.

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

Ayers, C.R., Hanson-Dorr, K.C., O'Dell, S., Lovell, C.D., Jones, M.L., Suckow, J.R., Dorr, B. S., 2015. Impacts of colonial waterbirds on vegetation and potential restoration of island habitats. Restor. Ecol. 23, 252–260

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

Beveroth, T. 2014. Spring bird coiunt, unpublished data. Illinois Natrual History Survey, University of Illinois, Champaign, IL.

Boutin, C., Dobbie, T., Carpenter, D., Hebert, C.E., 2011. Effects of Double-crested cormorants (Phalacrocorax auritus Less.) on island vegetation, seedbank, and soil chemistry: evaluating island restoration potential. Restor. Ecol. 19, 720–727.

Brown, S., C. Hickey, B. Harrington, and R. Gill, editors. 2001. The US Shorebird Conservation Plan, 2nd edition. Manomet Center for Conservation Science, Manomet, MA, USA.

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

Burger, Joanna and Michael Gochfeld. 2002. Bonaparte's Gull (*Chroicocephalus philadelphia*), 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.634 accessed online February 9, 2018

Buckley, Neil J. 1999. Black Vulture (Coragyps atratus), 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/411.

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

Dolbeer R.A., Wright S.E., and Cleary E.C. 2000. Ranking the hazard level of wildlife species to aviation. Wildlife Society Bulletin 28:372-378.

Dolbeer, Richard A. PhD. (2015). *Trends in Reporting of Wildlife Strikes With Civil Aircraft and Identification of Species Struck Under a Primarily Voluntary Reporting System, 1990-2013.* Federal Aviation Administration. Washington, DC: US Department of Agriculture-Animal and Plant Health Inspection Service-Wildlife Services.

Dolbeer, R.A., J.R. Weller, A.L. Anderson and M.J. Begier. 2016 Wildlife strikes to civil aircraft in the United States. Federal Aviation Administration National Wildlife Strike Database Serial Report No. 22. 121 pp.

Dorr, Brian S., Jeremy J. Hatch and D. V. Weseloh. 2014. Double-crested Cormorant (*Phalacrocorax auritus*), 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.441

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

Ehrlich, Paul R., Dobkin D.S., and Wheye D. 1988. American coots. https://web.stanford.edu/group/stanfordbirds/text/essays/American_Coots.html

Hatch, J. J., and D.V. Weseloh. 1999. Double-crested Cormorant (Phalacrocorax auritus) in A. Poole and F. Gill, editors. The Birds of North America, the Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologist' Union, Washington, D.C., USA.

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

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

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

Jackson, B. J., and J. A. Jackson. 2000. Killdeer (*Charadrius vociferus*) in A. Poole and F. Gill, editors. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, New York, USA. http://bna.birds.cornell.edu/bna/species/517/articles/introduction. Accessed April 11, 2012.

Koh, S., Tanentzap A.J., Mouland, G., Dobbie T., Carr, L., Keitel J, Hogsden K, Harvey G, Hudson J, Thorndyke R (2012) Double-crested cormorants alter forest structure and increase damage indices of individual trees on island habitats in Lake Erie. Waterbirds 35 (SP 1):13-22.

Kushlan, J. A., M. Steinkamp, K. Parsons, J. Capp, M. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC, U.S.A.

Lafferty, D., K. C. Hanson-Dorr, A. M. Prisock and B.S. Dorr. 2016. Biotic and abiotic impacts of Double-crested Cormorant breeding colonies on forested islands in the southeastern United States. Forest Ecology and Management, 69:Early View.224269

McGrath, D.M. and S.D. Murphy. 2012. Double-crested cormorant (Phalacrocorax auritus) nesting effects on understory composition and diversity on island ecosystems in Lake Erie. Environ Manage. 2012 Aug:50 (2):304-14.

Missouri Department of Conservation, 2017. Eurasian Collared-Dove. https://nature.mdc.mo.gov/discover-nature/field-guide/eurasian-collared-dove

Mowbray, T. B., F. Cooke and B. Ganter. 2000. Snow Goose (Chen caerulescens), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Accessed online January 7, 2014: http://bna.birds.cornell.edu/bna/species/514doi:10.2173/bna.514.

NAS. 2010. The Christmas Bird Count Historical Results. Accessed online April 8, 2016: www.christmasbirdcount.org.

National Audubon Society (2016). The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org [Feb. 23, 2018]

Parmalee, P. W., and B. G. Parmalee. 1967. Results of banding studies of the black vulture in eastern North America. Condor. 69:146–155.

Partners in Flight Science Committee (PFSC). 2013. Population Estimates Database, version 2013. Accessed online April 8, 2016: http://rmbo.org/pifpopestimates.

Preston, C. R., and R. D. Beane. 2009. Red-tailed hawk (Buteo jamaicensis) in A. Poole and Fill, editors. The Birds of North America Online. Cornell Lab of Ornithology, Ithaca New York, USA. Accessed online April 23, 2018 https://birdsna.org/Species-Account/bna/species/052/articles/introduction

Price, I.M., and J.G. Nickum. 1995. Aquaculture and birds: the context for controversy. Colonial Waterbirds 18 (Special Publication 1):33-35.

Rabenhold, P. P., and M. D. Decker. 1989. Black and turkey vultures expand their ranges northward. The Eyas. 12:11-15.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015. USGS Patuxent Wildlife Research Center, Laurel, Maryland.

Slate, D. A., R. Owens, G. Connolly, and G. Simmons. 1992. Decision making for wildlife damage management. Trans. N. A. Wildl. Nat. Res. Conf 57:5162.

Stickley, A.R., Jr., and K.J. Andrews. 1989. Survey f Mississippi catfish farmers on means, efforts, and costs to repel fish-eating birds from ponds. Proceedings of the Eastern Wildlife Damage Control Conference 4:105-108.

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

USDA. 2015. Environmental Assessment: Reducing Bird in the State of Missouri. United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Columbia, Missouri.

USFWS (United States Fish and Wildlife Service). 2000. Final Environmental Assessment. Depredation permits for the control and management of gulls in the Great Lakes region. U.S. Fish and Wildlife Service, Div. of Migratory Birds. Region 3. Minnesota.

USFWS. 2016. Waterfowl harvest and Population Survey Date, USFWS, compiled by David Fronczak, Preliminary September 23, 2016

USFWS. 2017. U.S. Fish and Wildlife Service. 2017 Waterfowl population status, 2017. U.S. Department of the Interior, Washington, D.C. USA.

USFWS. 2017. Migratory Bird Treaty Act: Final List of Bird Species to Which the Migratory Bird Treaty Act Does Not Apply. 12714 pp.

Weber, W. J. 1979. Health hazards from pigeons, starlings and English sparrows: diseases and parasites associated with pigeons, starlings, and English sparrows which affect domestic animals. Thomson Publications, Fresno, California, USA.

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

Wires, L. R., F. J. Cuthbert, D. R. Trexel, and A. R. Joshi. 2001. Status of the double-crested cormorant (*Phalacrocorax auritus*) in North America. Report to the U.S. Fish and Wildlife Service, Arlington, Virginia, USA.

Wires, L.R., 2014. The Double-crested Cormorant: plight of a feathered pariah. Yale University Press. 366 pp

Wywialowski, A.P. 1999. Wildlife-caused losses for producers of channel catfish (Ictalurus punctatus) in 1996. Journal of the World Aquaculture Society 30:461-472.

APPENDIX A

USFWS Listing of Threatened and Endangered Species in Missouri

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

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

Summary of Plant listings

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

- This report shows the listed species associated in some way with this state.
- This list does not include experimental populations and similarity of appearance listings.
- Click on the highlighted scientific names below to view a Species Profile for each listing.
- Critical habitat exists for Indiana bat, Niangua darter, Hine's emerald dragonfly and Tumbling Creek cavesnail and it has been proposed for Neosho mucket and rabbits foot mussels.

Obtained from the USFWS website at:
https://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=MO&status=listed
on 3-8-2018

APPENDIX E
MDC THREATENED AND ENDANGERED SPECIES IN MISSOURI

Missouri Species and Communities of Conservation Concern January 2018

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

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

AMPHIBIANS

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

REPTILES

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

BIRDS

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

MAMMALS

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

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