ENVIRONMENTAL ASSESSMENT
(Final)

MANAGING DAMAGE AND THREATS OF DAMAGE CAUSED BY BIRDS IN THE STATE OF TEXAS

Prepared by

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

In Cooperation with:

Texas A&M AgriLife Extension Service
Texas A&M University

Texas Wildlife Damage Management Association

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EXECUTIVE SUMMARY

Wildlife are an important public resource that can provide economic, recreational, emotional, and esthetic benefits to many people. However, wildlife can cause damage to agricultural resources, natural resources, property, and threaten human safety. When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other entities. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife. Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from WS. Pursuant to the Texas Health and Safety Code, the Texas A&M University System, through the Texas A&M AgriLife Extension Service and the WS program have signed a Memorandum of Understanding (MOU) to conduct a cooperative program to alleviate wildlife damage. In addition, the Texas Wildlife Damage Management Association (TWDMA), which consists of local cooperative groups, including county governments, private associations, and/or individuals, also signed the MOU. This document will refer to the cooperative program created by the MOU as the Texas Wildlife Services Program (TWSP). In Texas, the TWSP has and continues to receive requests for assistance to reduce and prevent damage associated with several bird species.

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

Chapter 1 of this EA discusses the need for action and the scope of analysis associated with requests for assistance that the TWSP receives involving several bird species in Texas. Chapter 2 identifies and discusses the issues that the TWSP identified during the scoping process for this EA and through consultation with state and federal agencies. Issues are concerns regarding potential effects that might occur from proposed activities. Federal agencies must consider such issues during the decision-making process required by the NEPA. Chapter 2 also discusses the alternative approaches that the TWSP developed to meet the need for action and to address the issues identified during the scoping process.

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

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

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ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
CBC	Christmas Bird Count
CFR	Code of Federal Regulations
CPS	Central Plains States
DNC	4,4'-dinitrocarbanilide
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Federal Fiscal Year
HDP	2-hydroxy-4,6-dimethylpyrimidine
IUCN	International Union for Conservation of Nature and Natural Resources
LD	Median Lethal Dose
LC	Median Lethal Concentration
MBTA	Migratory Bird Treaty Act
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
T&E	Threatened and Endangered
TPWD	Texas Parks and Wildlife Department
TWSP	Texas Wildlife Services Program
UAV	Unmanned Aerial Vehicle
USC	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WS	Wildlife Services
WT	Work Tasks

CHAPTER 1: NEED FOR ACTION AND SCOPE OF ANALYSIS

1.1 INTRODUCTION

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

Wildlife damage management is the alleviation of damage or other problems caused by or related to the behavior of wildlife and can be an integral component of wildlife management (Berryman 1991, Reidinger and Miller 2013, The Wildlife Society 2015) and the North American Model of Wildlife Conservation (Organ et al. 2010, Organ et al. 2012). Resolving damage caused by wildlife requires consideration of both sociological and biological carrying capacities. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988).

The cultural carrying capacity is especially important because it defines the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity is lower or already met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety. Therefore, the wildlife acceptance capacity helps define the range of wildlife population levels and associated damages acceptable to individuals or groups (Decker and Purdy 1988, Decker and Brown 2001).

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

When people experience damage caused by wildlife or when wildlife threatens to cause damage, people may seek assistance from other entities. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program is the lead federal agency responsible for managing conflicts between people and wildlife (USDA 2019*a*; see WS Directive 1.201)[1]. The primary statutory authority for the WS program is the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353). WS' directives define program objectives and guide WS' activities when managing wildlife damage (see WS Directive 1.201, WS Directive 1.205, WS Directive 1.210).

WS is part of a cooperative program within Texas that operates under Memorandum of Understanding (MOU) with the Texas AgriLife Extension Service within the Texas A&M University System and the Texas Wildlife Damage Management Association. This document will refer to the cooperative program created by the MOU as the Texas Wildlife Services Program (TWSP). The TWSP receives state legislative support through legislative action, which mandates that the State of Texas cooperate through the Texas A&M University System with appropriate federal officers and agencies in controlling animals to protect livestock, food and feed supplies, crops and rangeland. The TWSP conducts activities to manage wildlife damage through the cooperative relationship with the Texas AgriLife Extension Service under the Texas A&M University System. The TWSP is the program in Texas that has the expertise to respond to the majority of wildlife damage complaints, including damage caused by birds.

The Texas AgriLife Extension Service and the federal WS program cooperate further, through a separate MOU, with the Texas Wildlife Damage Management Association, which identifies requested services on a more localized basis. The Texas Wildlife Damage Management Association consists of local cooperative groups, including county governments, private associations, and individuals. This MOU also allows for sharing the direct operating costs of activities to manage wildlife damage. Therefore, people experiencing damage or threats of damage associated with wildlife could seek assistance from the TWSP.

1.2 NEED FOR ACTION

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

While any species of bird can cause damage or concerns at some time or another, most species of birds in Texas represent little or no risk of problems to the endeavors of people. As of December 6, 2020, the official list of bird species accepted for Texas by the Texas Bird Records Committee included 655 bird species (Texas Bird Records Committee 2021), which does not include feral or free-ranging domestic bird species, such as feral domestic chickens. Of these 655 bird species, 457 species are regularly found in Texas all year or seasonally, and their range may be widespread or restricted. Of the 457 regularly occurring species in Texas, 124 bird species (27%) have been identified as having at least the potential of causing damage to resources, excluding those species that pose an aircraft strike risk at airports and for disease surveillance or oil spills where more species could be involved. The other 333 bird species are not likely to cause damage, except possibly very infrequently. Appendix C lists all bird species with their scientific names that have been documented to occur in Texas. Table C-1 in Appendix C lists the 266 bird species that have the highest probability of coming into conflict with people in Texas or being part of disease surveillance projects, excluding feral, non-established populations.

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

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

Table 1.1 summarizes the regularly occurring avian groups in Texas, the number of regularly occurring species within each avian group, the number of species that cause damage in Texas, and the resource types those species could damage based on previous requests for assistance that the TWSP has received. The TWSP received an average of 1 or fewer requests for assistance for 13 of the 32 groupings of species listed in Table 1.1. The species that this EA will primarily address are those species that are normally found in Texas that cause problems (see Table C-1 in Appendix C). The primary species that the TWSP receives requests for assistance include black vultures[3], turkey vultures, rock pigeons, great-tailed grackles and other blackbirds (blackbirds, grackles, and cowbirds), European starlings, herons and egrets, doves, gulls, corvids (ravens and crows), and raptors (hawks and owls). Several other species cause minor, but potentially locally serious, problems, especially at airports.

Table 1.1 - Avian species groups in Texas and those species that cause problems that are regularly occurring, non-accidental species and the protection activities conducted by TWSP that involve them.

ORDER - Family	SPECIES GROUP (feral poultry and escaped exotics not included in numbers)	# Regular Occurring Species	Problem Spp.- not airport/oil spill	Accidental Species	Federal T&E Species	TWSP PROTECTION ACTIVITY							
						Airport in Texas	Oil Spill Hazing	Agric. Aquaculture	Agric. Crops	Agric. Livestock/Disease	Human Safety	Natural Resources	Property
ANSERIFORMES	Ducks, geese, swans	32	17	13	-	X	X	X	X	x	X	X	X
GALLIFORMES	Chachalaca, pheasant, grouse, turkey, quail	9	3	0	1	x	-	-	X	-	x	-	-
GAVIIFORMES	Loons	1	1	3	-	x	X	x	-	-	-	-	-
PODICIPEDIFORMES	Grebes	6	5	1	-	x	X	x	-	-	-	-	-
PROCELLARIIFORMES	Albatross, shearwaters, petrels, storm-petrels	2	-	10	-	x	X	-	-	-	-	-	-
PELECANIFORMES	Boobies, pelicans, Anhinga, cormorants	8	5	4	-	X	X	X	-	-	x	-	x
CICONIIFORMES	Herons, egrets, bittern, ibises, stork	17	11	1	-	X	X	X	-	x	X	x	X
PHOENICOPTERIFORMES	Flamingos	-	-	1	-	x	x	-	-	-	-	-	-
FALCONIFORMES	Hawks, kites, eagles, falcons, vultures	25	10	11	1	X	x	x	-	X	X	-	x
GRUIFORMES	Rails, gallinules, coots, limpkin, cranes	11	2	2	1	X	X	x	X	-	-	-	x
CHARADRIIFORMES	Shorebirds, gulls, terns, jaegers	61	15	35	3	X	X	X	-	x	x	x	X
COLUMBIFORMES	Pigeons, doves	9	5	3	-	X	-	-	X	x	X	x	X
PSITTACIFORMES	Parakeets, parrots	3	1	0	-	x	-	-	X	-	x	-	x
CUCULIFORMES	Cuckoos, roadrunner, ani	4	1	2	-	x	-	-	-	-	-	x	-
STRIGIFORMES	Owls	12	3	5	1	X	-	-	-	x	-	x	x
CAPRIMULGIFORMES	Nighthawks, nightjars	6	0	-	-	X	-	-	-	-	-	-	-
APODIFORMES	Swifts, hummingbirds	7	1	15	-	x	-	-	-	-	-	-	x
TROGONIFORMES	Trogon	-	-	1	-	-	-	-	-	-	-	-	-
CORACIIFORMES	Kingfishers	3	3	-	-	x	x	x	-	-	-	x	-
PICIFORMES	Woodpeckers	11	11	5	2	x	-	-	x	-	-	-	X
PASSERIFORMES	Passerines: perching birds												
- Tyrannidae, Laniidae, Motacillidae, Ptilogonatidae, Emberizidae	- Flycatchers, shrikes, pipits, silky flycatchers, towhees, sparrows	70	2	21	1	x	-	-	x-	-	-	-	-
- Thamnophilidae, Vireonidae, Paridae, Remizidae, Aegithalidae, Sittidae, Certhiidae, Troglodytidae, Cinclidae, Regulidae, Sylviidae, Peucedramidae, Parulidae, Thraupidae	- Ant-shrikes, vireos, chickadees, titmice, verdin, bushtit, nuthatches, creeper, wrens, dipper, kinglets, gnatcatchers, warblers, tanagers	88	0	16	2	-	-	-	-	-	-	-	-
- Corvidae	- Crows, ravens, jays	10	5	4	-	X	-	x	X	X	X	X	x
- Alaudidae	- Larks	1	1	-	-	X	-	-	X	-	-	-	-

[3] Bird species found in Texas and their scientific names are given in Appendix A.

- Hirundinidae	- Swallows	8	4	1	-	x	-	-	-	x	x	-	x
- Turdidae	- Wheatear, bluebirds, thrushes	10	1	8	-	x	-	-	-	-	x	-	x
- Mimidae	- Catbirds, thrashers, mockingbird	7	1	2	-	x	-	-	-	-	x	-	-
- Sturnidae, Passeridae	- Starling, House Sparrow	2	2	-	-	X	-	-	X	X	X	X	X
- Bombycillidae	- Waxwings	1	1	1	-	x	-	-	x	-	-	-	-
- Cardinalidae	- Cardinal, grosbeaks, bunting, Dickcissel	10	1	2	-	x	-	-	-	-	-	-	x
- Icteridae	- Blackbirds, grackles, cowbirds, orioles	19	9	3	-	X	-	x	X	X	X	x	X
- Fringillidae	- Finches, crossbills, grosbeaks	7	3	5	-	x	-	-	x	-	x	x	x
TOTAL		460	124	175	12								

X - primary concern x - minor concern (-) - not associated with damage, but possible

Table 1.2 shows the number of work tasks and the value of damage reported to or verified by the TWSP in Texas from federal fiscal year (FY) 2017 through FY 2019. The TWSP receives requests for assistance to conduct activities to manage bird damage for only a small number of species in Texas. From FY 2017 through FY 2019, the TWSP received requests for assistance associated with an average of 142 bird species per year. Most of those requests involve bird at airports where they create an aircraft strike hazard. Excluding requests to conduct activities at airports, the TWSP receives requests for assistance for less than 15 species annually. From FY 2017 through FY 2019, birds were responsible for an annual average of 5,494 work tasks (individual species request actions) in Texas, which does not include disease monitoring activities. Of those 5,494 work tasks, 30% involved human health and safety, 41% involved property, 26% involved agriculture, and 3% involved for natural resources.

In addition to the requests for assistance involving damage, the TWSP was also involved in conducting disease surveillance (no damage associated with this) and collected an average of 1,748 samples annually from FY 2017 to FY 2019 from waterfowl, shorebirds, and their droppings (watched from a distance and collected following defecation). Most samples were collected from hunter harvested birds in support of highly pathogenic avian influenza sampling.

Table 1.2 - Work tasks (WTs) and the value of damage associated with birds in Texas. The value is that which is reported to or verified by TWSP from FY 2017 through FY 2019 and is only a fraction of the actual damage caused by birds in Texas. This table includes disease sampling requests where TWSP is requested to collect samples from particular groups of species (waterfowl and shorebirds) to determine the prevalence of different diseases and requests for information about a given species, but the requestor is not suffering damage.

SPECIES	FY 2017		FY 2018		FY 2019		Average	
	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $
Black-bellied Whistling-Duck	50	$0	34	$0	54	$0	46	$0
Fulvous Whistling-Duck	3	$12,500	3	$16,667	50	$16,667	19	$11,111
Greater White-fronted Goose	127	$0	110	$0	6	$0	81	$0
Snow Goose	127	$0	200	$216	6	$0	111	$72
Canada Goose	147	$16,000	183	$0	317	$350,000	215	$121,000
Greater White-Fronted Goose	127	$0	110	$0	6	$0	81	$0
Feral Goose	-	-	330	$0	376	$2,000	235	$665
Mute Swan	-	-	1	$0	-	-	.3	$0
Wood Duck	139	$0	125	-	6	$0	90	$0
Feral ducks (Muscovy)	17	$45,720	36	$9,900	12	$19,174	22	$24,931
Gadwall	164	$0	123	$0	424	$0	237	$0
American Black Duck	-	-	116	$0	4	$0	1	$0
American Wigeon	169	$0	168	$0	424	$0	254	$0
American Black Duck	127	$0	116	$0	4	$0	82	$0
Mallard	256	$0	314	$0	665	$1,500	412	$500

SPECIES	FY 2017		FY 2018		FY 2019		Average	
	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $
-Feral ducks (Dom. Mallard)	5	$0	8	$5,000	11	$0	8	$1,667
Mottled Duck	281	$0	34	$0	136	$0	150	$0
Blue-winged Teal	147	$0	126	$0	147	$0	140	$0
Cinnamon Teal	-	-	1	$0	419	$0	140	$0
Northern Shoveler	163	$0	170	$0	507	$0	280	$0
Northern Pintail	148	$0	133	$0	423	$0	235	$0
Green-winged Teal	150	$0	149	$0	653	$0	317	$0
Canvasback	6	$0	4	$0	420	$0	143	$0
Redhead	285	$0	258	$0	430	$0	324	$0
Ring-necked Duck	132	$0	113	$0	665	$0	303	$0
Greater Scaup	-	-	2	$0	-	-	1	$0
Lesser Scaup	147	$20,000	130	$0	82	$0	120	$6,667
Bufflehead	8	$0	9	$0	419	$0	145	$0
Common Goldeneye	-	-	-	-	419	$0	140	$0
Hooded Merganser	8	$0	-	-	-	-	3	$0
Common Merganser	2	$0	7	$0	-	-	3	$0
Red-breasted Merganser	1	$0	-	-	419	$0	140	$0
Ruddy Duck	129	$0	110	$0	4	$0	81	$0
Scaled Quail	-	-	2	$0	420	$0	141	$0
Wild Turkey	1	$0	170	$0	214	$0	128	$0
Feral chicken	-	-	3	$0	-	-	1	$0
Common Peafowl	1	$0	1	$0	-	-	1	$0
Pied-billed Grebe	4	$172,750	7	$40,409	422	$27,576	144	$80,145
Horned Grebe	-	-	-	-	1	$0	.3	$0
Eared Grebe	127	-	109	-	81	$0	106	$0
Common Gallinule	-	-	-	-	419	$0	140	$0
American White Pelican	171	$541,670	175	$333,250	919	$619,689	422	$498,203
Brown Pelican	1	$400,000	8	$249,700	432	$580,000	147	$409,900
Neotropic Cormorant	-	-	-	-	427	0	142	$0
Double-crested Cormorant	597	$732,154	467	$457,000	799	$638,783	621	$609,312
Anhinga	2	$5,909	3	$5,909	415	$5,910	140	$5,909
Great Blue Heron	680	$374,354	918	$392,775	1,755	$634,000	1118	$467,043
Great Egret	628	$302,520	628	$152,074	1,598	$243,150	951	$232,581
Snowy Egret	806	$332,546	691	$277,831	1,409	$597,021	969	$402,466
Cattle Egret	874	$13,700	899	$29,500	1,233	$18,500	1,002	$20,567
Little Blue Heron	268	$5,909	239	$28,133	550	$17,202	352	$17,081
Tricolored Heron	-	-	-	-	420	$0	140	$0
Green Heron	268	$42,858	314	$28,132	321	$17,021	301	$29,337
Black-crowned Night-Heron	269	$62,767	247	$59,009	87	$225,112	201	$115,629
Yellow-crowned Night-Heron	269	$14,855	239	$5,909	151	$6,210	220	$8,991
White Ibis	266	$0	287	$0	718	$0	424	$0
White-faced Ibis	-	-	123	$0	-	-	41	$0
Black Vulture	3,116	$940,530	2,809	$1,947,374	3,801	$1,458,241	3,242	$1,448,706
Turkey Vulture	1,784	$283,835	2,138	$371,894	2,852	$169,097	2,258	$274,942
Osprey	272	$2,000	341	$0	776	$0	463	$667
Mississippi Kite	308	$42	303	$42	441	$126	351	$70

SPECIES	FY 2017		FY 2018		FY 2019		Average	
	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $
White-Tailed Kite	265	$0	234	$0	11	$0	170	$0
Bald Eagle	6	$2,814	1	$402	3	$620	3	$1,279
Northern Harrier	579	$0	1,304	$0	2,051	$0	1,311	$0
Sharp-shinned Hawk	558	$0	767	$350	1,075	$0	500	$117
Cooper's Hawk	707	$0	906	$100	1,356	$0	990	$33
Harris's Hawk	-	-	220	$0	194	$0	138	$0
Red-shouldered Hawk	302	$0	380	$2,862	623	$500	435	$1,121
Broad-winged Hawk	265	$0	234	$0	13	$0	171	$0
Swainson's Hawk	673	$0	1172	$6,224	1472	$0	1106	$2,075
Red-tailed Hawk	1077	$318	1593	$293	2209	$5,226	1626	$1,946
White-tailed Hawk	1	$0	-	-	6	$0	2	$0
Golden Eagle	5	0	1	$0	1	$0	2	$0
Crested Caracara	1353	$9,304	1301	$7,874	1701	$31,794	1452	$16,324
American Kestrel	925	$462	1399	$168	2,159	$84,180	4,483	$28,270
Prairie Falcon	1	$0	-	-	145	$0	6	$0
Merlin Falcon	185	$0	108	$0	-	-	98	$0
Peregrine Falcon	-	-	-	-	354	$0	118	$0
American Coot	132	$208,583	118	$61,868	427	$43,334	22	$32,666
Sandhill Crane	139	$0	231	$3,553	443	$0	271	$1,184
Semipalmated Plover	127	$0	109	$0	346	$0	194	$0
Black-Bellied Plover	-	-	-	-	342	$0	115	$0
Killdeer	1,092	$12,542	1,095	$16,667	2,223	$16,709	1,470	$15,306
Black-necked Stilt	-	-	3	$16,667	55	$16,667	16	$11,111
Long-billed Curlew	270	$0	442	$0	767	$0	493	$0
American Bittern	127	$0	109	$0	4	$0	80	$0
Greater Yellowlegs	-	$0	1	$0	343	$0	115	$0
Lesser Yellowlegs	-	-	99	$0	555	$0	218	$0
Upland Sandpiper	598	$42	556	$42	1,405	$0	853	$28
Solitary Sandpiper	-	-	-	-	1	$0	.3	$0
Buff-Breasted Sandpiper	-	-	-	-	342	$0	114	$0
Baird's Sandpiper	-	-	-	-	1	$42	.3	$14
Sanderling	-	-	-	-	333	$0	111	$0
Semipalmated Sandpiper	154	$0	172	$0	370	$0	232	$0
Least Sandpiper	-	-	-	-	428	$0	143	$0
Dickcissel	-	-	-	-	85	$333,305	28	$111,102
Belted Kingfisher	127	$0	109	$0	7	$0	81	$0
Wilson's Snipe	127	$0	-	-	-	-	42	$0
Common Snipe	-	-	112	$0	5	$0	39	$0
Bonaparte's Gull	-	-	-	-	419	$0	140	$0
Laughing Gull	298	$336,039	362	$206,233	677	$148,071	447	$230,114
Franklin's Gull	4	$0	60	$0	442	$16,000	169	$5,333
Ring-billed Gull	288	$0	385	$0	126	$12,000	266	$4,000
Herring Gull	330	$0	303	$0	961	$0	531	$0
Wood Stork	-	-	-	-	420	$0	140	$0
Roseate Spoonbill	266	$0	234	$0	118	$0	206	$0
Least Tern	7	$12,500	5	$16,667	345	16,667	119	$15,278

SPECIES	FY 2017		FY 2018		FY 2019		Average	
	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $
Caspian Tern	1	$189,583	4	$37,200	427	$190,000	144	$138,927
Common Tern	2	$40,832	4	55,418	109	$21,668	38	$39,306
Forster's Tern	130	$48,767	113	$28,133	426	$17,022	223	$31,307
Black Skimmer	-	-	-	-	342	$0	114	$0
Whimbrel	-	-	-	-	342	$0	114	$0
Willet	-	-	-	-	52	$0	17	$0
American Avocet	-	-	-	-	411	$0	137	$0
Long-Billed Dowitcher	-	-	-	-	343	$0	114	$0
Rock Pigeon (feral)	1,262	$662,194	1,580	$73,184	2,037	$33,450	1,626	$256,276
Loggerhead Shrike	127	$0	295	$0	318	$0	247	$0
Eurasian Collared-Dove	666	$0	820	$0	571	$42	686	$14
White-winged Dove	447	$12,000	855	$10,042	1,737	$0	1,013	$7,347
Mourning Dove	1,320	$3,472,584	1,636	$31,295	2,676	$16,919	1,877	$1,173,597
Inca Dove	-	-	-	-	1	$0	.3	$0
Common Ground-Dove	1	$0	-	-	-	-	.3	$0
Monk Parakeet	1	$500	-	-	-	-	.3	$167
Indigo Bunting	-	-	1	$0	-	-	.3	$0
Greater Roadrunner	179	$60,000	382	$0	1,060	$0	540	$20,000
Barn Owl	477	$0	521	$500	51	$0	350	$167
Short-Eared Owl	127	$0	109	$0	47	$0	94	$0
Burrowing Owl	1	$0	1	$25,000	1	$0	3	$20
Great Horned Owl	320	$318	481	$122	806	$100	536	$180
Barred Owl	-	-	1	$0	-	-	.3	$0
Nighthawks (all)	303	$13,042	223	$16,835	297	$16,709	268	$15,529
Chimney Swift	2	$42	-	-	-	-	1	$14
Ruby-throated Hummingbird	1	$0	1	$0	-	-	1	$0
Red-headed Woodpecker	146	$0	143	$3,500	10	$0	100	$1,167
Golden-fronted Woodpecker	13	$0	18	$0	424	$0	152	$0
Red-bellied Woodpecker	1	$300	-	-	5	$0	2	$100
Yellow-bellied sapsucker	127	$0	109	$0	10	$0	46	$465
Downy Woodpecker	1	$0	-	-	9	$0	3	$0
Pileated Woodpecker	127	$0	109	$0	5	$300	80	$100
Ladder-Backed Woodpecker	-	-	-	-	1	$5,000	.3	$1667
Western Kingbird	204	$42	123	$42	239	$0	189	$28
Scissor-tailed Flycatcher	951	$0	1,013	$294	947	$183	970	$159
Blue Jay	1	$0	1	$0	-	-	.3	$0
American Crow	765	$2,219	918	$10,780	724	$727	803	$4,575
Common Raven	199	$23,770	485	$2,711	357	$7,302	347	$11,261
Horned Lark	134	$336	311	$0	224	$126	223	$154
Purple Martin	-	-	-	-	69	$0	23	$0
Cliff Swallows	889	$21,193	914	$168	753	$1,300	852	$7,554
Barn Swallow	1068	$550	1,148	$1,042	1,743	$126	3,959	$573
Cave Swallow	4	$0	-	-	-	-	1	$0
Wren sp.	-	-	1	$0	-	-	.3	$0
American Robin	472	$42	480	$0	125	$0	360	$0
Northern Mockingbird	121	$17,500	122	$16,687	617	$16,689	287	$16,957

SPECIES	FY 2017		FY 2018		FY 2019		Average	
	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $	WTs	$ Value $
Starling/blackbirds[1]	345	$94,356	668	$41,613	682	$4,955	565	$46,975
European Starling	1,115	$30,250	957	$784	1,678	$36,600	1,250	$22,545
American Pipit	1	$42	-	-	-	-	.3	$14
Cedar Waxwing	1	$42	1	$42	1	$9,060	1	$3,048
Northern Cardinal	135	$0	110	$0	431	$0	225	$0
Red-winged Blackbird	481	$1,942	482	$84	868	$3,500	610	$1,842
Eastern Meadowlark	976	$546	1,557	$1,494	2,801	$0	1,778	$681
Western Meadowlark	887	$0	1,215	$84	1,100	$126	1,067	$70
Yellow-headed Blackbird	-	-	-	-	1	$0	.3	$0
Brewer's Blackbird	-	-	-	-	86	$0	29	$0
Common Grackle	698	$6,030	1,073	$0	1,152	$7,500	974	$4,510
Boat-tailed Grackle	363	$0	247	$0	11	$0	207	$0
Great-tailed Grackle	783	$0	1,124	$0	1,943	$2,000	1,283	$667
Brown-headed Cowbird	205	$1,942	624	$2,539	1,163	$0	664	$1,494
House Finch	127	$0	110	$0	18	$4,500	85	$1,500
Savannah Sparrow	184	$0	235	$84	98	$42	172	$42
Field Sparrow	1	$100	-	-	-	-	.3	33
Lark Sparrow	127	$0	109	$0	85	$0	107	$0
Chipping Sparrow	227	$0	234	$0	346	$0	269	$0
House Sparrow	609	$200	781	$6,000	586	$0	657	$2,067
Vesper Sparrow	-	-	3	$0	-	-	1	$0
Total (174 spp.)	42,472	$9,560,767	50,543	$5,106,471	84,886	$6,748,866	64,480	$7,078,562
No. Spp. per year	133		137		155		142	

WTs. = Work Tasks associated with requests for assistance
1 - Species that commonly roost or feed together are often combined in the MIS
3 – Mostly birds involved in aircraft strikes that cannot be identified to species
4 – Total species and average per year includes feral peafowl, guineas, and chickens, as appropriate, and other feral domestic species

1.2.1 Need to Resolve Bird Damage to Agricultural Resources

In 2017, Texas agriculture generated about $24.9 billion in annual sales from farm and ranch commodities (USDA 2019*b*). Of this, $18.0 billion included annual sales involving livestock (primarily cattle, dairy, poultry, eggs, and hogs) production, including aquaculture, in Texas. Crops accounted for another $6.8 billion in annual sales in Texas, but about 50% of those annual sales were for crops, such as cotton and greenhouse/nursery crops, which are not typically involved in bird damage. Birds can cause extensive damage to agricultural products and accounted for an average of $3.1 million dollars in damage reported to or verified by the TWSP from FY 2017 to FY 2019 from an average of 351 work tasks associated with agriculture (see Table 1.3).

Verified losses are defined as those losses examined by a TWSP specialist during a site visit and identified to have been caused by a specific bird species or group of birds. Often a TWSP specialist can determine the species by observing it (them) causing the damage. Sometimes, damage and other sign may have to be examined to determine the causative species. For example, predatory birds may not be at the kill site when a TWSP specialist responds to a predation complaint. Bird kills can be typically distinguished from mammals, but determination of the bird often depends on the species that are present in the area. Some species' kills, such as vultures, are similar to other bird kills, such as ravens therefore, the TWSP specialist must observe the birds in the area. A few species though, cause characteristic kills that are specific to them; for example, great horned owls often kill poultry with the back area typically exhibiting wide talon marks and the head only partially consumed. Confirmation of the species that caused the loss is often a vital step toward establishing the need for control and the damage management activities necessary to resolve the problem. A TWSP specialist not only tries to confirm the predator responsible, but also records the extent of the damage when possible. Losses that cannot be confirmed or those that are reported by a cooperator but not confirmed are defined as reported losses.

Table 1.3 - The number of requests for assistance and value of damage caused by birds in Texas as reported to or verified by the TWSP from FY 2017 to FY 2019 for agriculture. The damage reported in this table is only a fraction of the actual damage caused by birds in Texas.

Category	Resource	FY 2017		FY 2018		FY 2019		Average	
		WTs.	$ Value $	WTs.	$ Value $	WTs	$ Value $	WTs.	$ Value/Yr $
Aquaculture	Bait/Ornamental Fish	10	$178,137	14	$103,506	10	$53,309	11	$111,650
	Bass	15	$1,422,747	32	$374,176	14	$825,004	20	$873,976
	Catfish	30	$810,765	44	$465,504	20	$149,780	31	$475,350
	Other Food Fish	17	$833,040	44	$132,755	20	$2,712,300	27	$1,226,032
Subtotal		**72**	**3,244,689**	**134**	**$1,075,941**	**64**	**$3,740,393**	**89**	**$2,687,008**
Livestock	Cattle	98	$95,700	63	$54,015	75	$47,897	79	$65,871
	Goats	39	$11,961	31	$9,363	47	$22,348	39	$14,557
	Sheep	45	$14,104	45	$9,797	44	$12,422	45	$12,107
	Other Hoof-stock	-	-	-	-	2	-	<1	-
	Poultry/Eggs	22	$1,388	53	$2,449	9	$4,252	28	$2,696
	Livestock Feed	10	$355,099	10	$82,500	5	$92,571	8	$176,723
Subtotal		**214**	**$478,252**	**202**	**$158,124**	**182**	**$179,490**	**199**	**$271,951**
Crops	Pecan/Nuts	5	$1,619	5	$9,980	4	$332	5	$3,977
	Rice	17	$88,240	20	$44,110	11	$354,955	16	$162,435
	Grain	7	$10,000	8	$3,727	10	-	8	$4,575
	Commercial Trees	1	300	-	-	1	-	<1	$100
	Other Crops	2	$600	2	$820	2	$2,033	2	$1,151
	Subtotal	**32**	**$100,759**	**35**	**$58,637**	**28**	**$357,320**	**32**	**$172,238**
Total		**318**	**$3,823,700**	**371**	**$1,292,702**	**274**	**$4,277,203**	**320**	**$3,131,197**

WTs = Work tasks associated with requests for bird damage management assistance to protect that resource. One work task for livestock damage could involve multiple predations and one for aquaculture could be losses for the entire year and include brood fish that would not be sold.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic organisms. Damage can also result from the death of fish and other aquatic wildlife from injuries suffered when birds attempt to prey upon aquatic organisms. Threats of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites can also be a concern for aquaculture producers. In 2016, aquaculture producers in Texas raised 30 million pounds of aquaculture products worth $60 million with the top products being catfish, shrimp, striped bass, and red drum (Treece 2017). The National Agricultural Statistical Service estimated the market value of aquaculture products at nearly $69.3 million in Texas during 2017 (USDA 2019*b*).

In Texas, aquaculture producers have reported to the TWSP or the TWSP personnel have verified an average of about $2.68 million in damage to fish and shellfish annually from FY 2017 through FY 2019 (see Table 1.3) representing about 4.3% of the Texas aquaculture sales during 2018. The TWSP primarily responded to requests for assistance involving cormorants, herons, egrets, pelicans, terns, and gulls depredating a variety of fish, but primarily catfish and hybrid striped bass at aquaculture sites (see Table 1.3). About one-third of the work tasks (31) were associated with protecting catfish.

Double-crested cormorants can feed on fish that people raise for human consumption, and on fish commercially raised for bait and restocking in Texas. Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. The magnitude of economic impacts that double-crested cormorants have on the aquaculture industry can vary dependent upon many different variables including, the value of the fish stock, number of depredating birds present, and the time of year the predation is taking place. The frequency at which double-crested cormorants occur at a given aquaculture facility can be a function of many interacting factors, such as the size of the regional and local cormorant population, the number, size, and distribution of aquaculture facilities, and the size distribution, density, health, and species composition of fish populations at facilities. Other factors may include the number, size, and distribution of wetlands in the immediate area, the size distribution, density, health, and species composition of free-ranging fish populations in the surrounding landscape, the number, size, and distribution of suitable roosting habitat, and the variety, intensity and distribution of local damage abatement activities.

Double-crested cormorants are adept at seeking out the most favorable foraging and roosting sites. As a result, cormorants rarely distribute evenly over a given region, but rather tend to be highly clumped or localized. Damage abatement activities can shift bird activities from one area to another; thereby, not eliminating predation but only reducing damage at one site while increasing damage at another location (Aderman and Hill 1995, Mott et al. 1998, Reinhold and Sloan 1999, Tobin et al. 2002). Thus, some aquaculture producers in a region may suffer little or no economic damage from cormorants while others experience exceptionally high predation.

Great blue herons, great egrets, and other wading birds may forage at aquaculture facilities. These problems have been associated with depredations on trout (Parkhurst et al. 1992, Pitt and Conover 1996, Glahn et al. 1999*a*, Glahn et al. 1999*b*), baitfish (Hoy et al. 1989), and ornamental fish (Avery et al. 1999). The two primary wading bird species implicated in depredations on catfish are the great blue heron and the great egret (Glahn et al. 1999*c*). Herons and egrets occur at most catfish farms throughout the year (Glahn and King 2004). However, research has clarified that great blue herons and great egrets mostly eat catfish that are unhealthy, or they eat live, healthy catfish that are close to the surface and margins of the pond, such as during feeding operations. Studies showed that almost half of great blue heron diets consisted of live catfish, but the other half was already dead catfish and wild fish, including sunfish and *Gambusia* spp. (Stickley et al. 1995, Glahn et al. 1999*c*). Of the live catfish consumed by herons in the fall and winter, most were likely diseased (Glahn et al. 2002). By contrast, most of the live fish consumed during the summer were healthy (Glahn et al. 2002).

Although generally not considered a fish-eating bird species, lesser scaup do consume farm raised fish (Clements et al. 2020, Engle et al. 2020). Engle et al. (2020) estimated that fish losses to lesser scaup in Arkansas averaged nearly $1.1 million per year and that lesser scaup cause an average of $5.5 million in total direct negative economic effects to the baitfish industry in Arkansas per year.

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

Birds may be a possible source of transmission of Spring Viraemia of Carp, Viral Hemorrhagic Septicaemia, and Infectious Pancreatic Necrosis in Europe, which are fish viruses capable of causing severe damage (European Inland Fisheries Advisory Commission 1989). Viral Hemorrhagic Septicaemia and Infectious Pancreatic Necrosis now occur in North America (Price and Nickum 1995, Goodwin 2002). Spring Viraemia of Carp also occurs in North America (USDA 2003). Peters and Neukirch (1986) found the Infectious Pancreatic Necrosis virus in the fecal droppings of herons when herons fed on trout infected with Infectious Pancreatic Necrosis. Olesen and Vestergard-Jorgensen (1982) found herons could transmit the Viral Hemorrhagic Septicaemia (Egtved virus) from beak to fish when the virus occurs on the beaks of herons. However, Eskildsen and Vestergard-Jorgensen (1973) found the Egtved virus did not pass through the digestive tracks into the fecal droppings of black-headed gulls (*Chroicocephalus ridibundus*) when artificially inserted into the esophagus of the gulls.

Birds may also be capable of passing bacterial pathogens through fecal droppings and on their feet (Price and Nickum 1995). The bacterial pathogen for the fish disease Enteric Septicemia of Catfish can occur within the intestines and rectal areas of great blue herons, great egrets, snowy egrets, and double-crested cormorants (Taylor 1992). However, because Enteric Septicemia of Catfish is endemic to parts of the United States, Taylor (1992) did not consider birds as a primary vector of the disease. Birds also pose as primary hosts to several cestodes, nematodes, trematodes, and other parasites that can infect fish. Birds can also act as intermediate hosts of parasites that can infect fish after completing a portion of their life cycle in crustaceans or mollusks (Price and Nickum 1995).

Although actual transmission of diseases through transport by birds is difficult to document, birds have the capability of spreading diseases through fecal droppings and possibly through other means such as on feathers, feet, and regurgitation. However, the rate of transmission is likely very low. Birds are very mobile and have the ability to move from one impoundment or facility to another. Therefore, the threat of disease transmission can be a concern given the potential economic loss that could occur from extensive mortality of fish or other cultivated aquatic wildlife if a disease outbreak occurs.

Damage and Threats to Livestock Operations

On January 1, 2020, there were approximately 13 million cows and calves in Texas (USDA 2021). In 2017, cattle and calves represented 49% of all agricultural sales in Texas, which amounted to about $12.3 billion is sales (USDA 2019*b*). Other livestock and products that contributed to agricultural sales in Texas included poultry and eggs ($3 billion), milk from cows ($2.2 billion), swine ($163 million), sheep/goats and associated products ($105 million), and horses/mules/burros/donkeys ($125 million) (USDA 2019*b*). Several other livestock such as goats are important in Texas. Livestock, their products, and feed losses cause economic hardships to their owners, and without bird damage management to protect them, depredation losses and, hence, economic impacts, would be greater (Nass 1977, Nass 1980, Howard and Shaw 1978, Howard and Booth 1981, O'Gara et al. 1983). Damage to livestock and associated resources by birds reported to or verified by TWSP averaged about $272,000 from FY 2017 through FY 2019 and resulted in an average of 199 work tasks associated with requests from producers per year (see Table 1.3).

Damage to livestock operations can occur from several bird species in Texas. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, and from the increased risks of disease transmission associated with large concentrations of birds. Although individual or small groups of birds can cause economic damage to livestock producers, such as a vulture or a group of vultures killing a newborn calf, most damage occurs from bird species that congregate in large flocks at livestock operations. Birds also defecate while feeding, which can increase the possibility of disease transmission through livestock directly contacting or consuming fecal droppings. Birds can also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be esthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions. Although birds can be carriers (vectors) of diseases that are transmissible to livestock, the rate of transmission is unknown but is likely to be low. Because many sources of disease transmission exist, identifying a specific source can be difficult. Birds can be vectors of disease, especially when large numbers of birds congregate and defecate in livestock feed or water.

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

Economic damages associated with starlings and blackbirds feeding on livestock rations has been documented in France and Great Britain (Feare 1984), and in the United States (Besser et al. 1968, Dolbeer et al. 1978, Glahn and Otis 1981, Glahn 1983, Glahn and Otis 1986). Starlings damage an estimated $800 million worth of agricultural resources per year (Pimentel et al. 2005). Diet rations for cattle contain all of the nutrients and fiber that cattle need; however, cattle are unable to select any single component over others. Livestock feed and rations ensure proper health of the animal. Livestock producers and feedlots often supplement higher fiber roughage in livestock feed with corn, barley, and other grains to ensure weight gain and, in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs is most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered, which can negatively affect the health and production of livestock. The removal of this high-energy source by European starlings and red-winged blackbirds may reduce milk yields and weight gains, which can be economically critical (Feare 1984, Carlson et al. 2018*a*, Carlson et al. 2018*b*). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, freezing temperatures, and the number of livestock on feed.

Besser et al. (1968) found the value of losses in feedlots to starlings near Denver, Colorado was $84 per 1,000 starlings during the winter in 1967. Forbes (1990) reported European starlings consumed up to 50% of their body weight in feed each day. Glahn and Otis (1981) reported losses of 4.8 kg of pelletized feed consumed per 1,000 bird minutes. Glahn (1983) reported that 25.8% of farms in Tennessee experienced starling depredation problems of which 6.3% experienced considerable economic loss. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily brown-headed cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000. Depenbusch et al. (2011) estimated that feed consumption by European starlings increased the daily production cost by $0.92 per animal at a Kansas feedlot. In Washington, dairy operators reported annual feed losses of $55 per cow due to birds, which resulted in annual losses totaling $14.7 million in the state (Elser et al. 2019*a*).

The TWSP responded to an average of eight requests for assistance involving livestock feed annually from FY 2017 to FY 2019 with an average of about $176,723 in losses (see Table 1.3). European starlings and rock pigeons are the primary cause of the damage, especially in the panhandle region of Texas. The TWSP has responded to a request for assistance from a large cattle feeding operations in the panhandle of Texas that had upwards of one million starlings and blackbirds using a facility per day. The requester had a similar facility that did not have a bird damage problem. The requester reported that, based on a comparison of feed losses, livestock health problems (primarily coccidiosis), and water trough maintenance costs (continuous labor costs for cleaning bird droppings out of water troughs), bird damage was costing them about $5,000 per day.

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

Several pathogens that affect livestock have been associated with rock pigeons, European starlings, and house sparrows (Weber 1979, Carlson et al. 2010, Carlson et al. 2011*a*). Pigeons, starlings, and house sparrows can be carriers of erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981). Weber (1979) also reported pigeons, starlings, and house sparrows as carriers of several viral, fungal, protozoal, and rickettsial diseases, which can infect livestock and pets. Numerous studies have focused on starlings and the transmission of *Escherichia coli* (LeJeune et al. 2008, Gaukler et al. 2009, Cernicchiaro et al. 2012). LeJeune et al. (2008) found that starlings could play a role in the transmission of *E. coli* between dairy farms. Carlson et al. (2010) found *Salmonella enterica* in the gastrointestinal tract of starlings at cattle feedlots in Texas and suggested starlings could contribute to the contamination of cattle feed and water. Salmonella contamination levels can relate directly to the number of European starlings present (Carlson et al. 2010, Carlson et al. 2011*b*, Carlson et al. 2012). Poultry operations can be highly susceptible to pathogens, such as *Salmonella* spp., campylobacter, and clostridium, which are sometimes isolated in wild birds, such as European starlings and house sparrows (Craven et al. 2000).

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

Transmission of *Salmonella* spp. from gulls to livestock can also be a concern (Williams et al. 1977, Johnston et al. 1979, Coulson et al. 1983). Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. Pedersen and Clark (2007) did an extensive review of the literature and found Canada geese, gulls, pigeons, house sparrows, cowbirds, grackles, blackbirds and starlings have the potential to play a role in the direct transmission of *E. coli* and *S. enterica* among cattle at feedlots and dairies and from livestock operation to livestock operation. Migratory birds are capable of spreading diseases over a larger area, and domestic livestock might serve as reservoirs within farm operations. The birds also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be esthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions.

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

Starlings, gulls, and other species can transfer pathogens that are specific to some livestock, such as transmittable gastroenteritis (Faulkner 1966, Gough et al. 1979). Many bird species that use barn areas, pastures, manure pits, or carcass disposal areas can directly or indirectly contact a disease pathogen and transfer it to another farm or to healthy animals at the same farm. Due to the ability of those bird species to move large distances and from one facility to another, farm-to-farm transmission can be an important concern.

Waterfowl, including ducks, geese, and swans, can also be a concern to livestock producers because the fecal droppings of waterfowl can carry pathogens that can cause diseases in livestock. Fraser and Fraser (2010) provided a literature review of disease pathogens of concern to livestock from Canada geese and other waterfowl. The review highlighted several bacterial, viral, and fungal diseases, and parasites that can infect livestock, including swine, cattle, and poultry. However, Fraser and Fraser (2010) pointed out that due to a lack of data, they could not perform an evidence-based risk assessment on the health risks to humans or livestock from free ranging waterfowl. Livestock producers may have concerns that waterfowl droppings in and around ponds that provide drinking water for livestock could affect water quality and could be a source of several different types of pathogens. For example, *Salmonella* spp. can cause shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, salmonellosis can kill cattle and calves. In addition, the contamination of feed by waterfowl through droppings in pastures, crops, or harvested grasses is also a possible method of pathogen transmission to livestock (*e.g.*, see Fraser and Fraser 2010).

Another disease often associated with waterfowl is avian influenza. Avian influenza is a viral disease caused by various strains of avian influenza viruses. Avian influenza viruses occur naturally among many bird species throughout the world. Wild and domestic waterfowl, as well as a variety of other bird species, can be reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Brown et al. 2006, Keawcharoen et al. 2008, Pedersen et al. 2010, United States Geological Survey 2020). Scientists often categorize the different types of avian influenza viruses as either a low pathogenic avian influenza virus or a highly pathogenic avian influenza virus, which refers to the viruses ability to produce disease (Centers for Disease Control and Prevention 2017, United States Geological Survey 2020).

Most of the avian influenza viruses that circulate naturally in wild birds are low pathogenic avian influenza viruses. Typically, the low pathogenic avian influenza viruses circulate among wild birds without clinical signs, and is not an important mortality factor in wild birds (Davidson and Nettles 1997, Clark and Hall 2006, Centers for Disease Control and Prevention 2017, United States Geological Survey 2020). However, highly pathogenic avian influenza viruses can cause severe disease and high mortality in birds, especially in domestic poultry and domestic waterfowl (Nettles et al. 1985, Clark 2003, Gauthier-Clerc et al. 2007, Pedersen et al. 2010, Centers for Disease Control and Prevention 2017, United States Geological Survey 2020). The potential for avian influenza virus to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Hahn and Clark 2002, Clark and Hall 2006, Gauthier-Clerc et al. 2007). The potential impacts of a severe outbreak of highly pathogenic avian influenza in domestic poultry could cripple the industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

Another viral disease that is often associated with wild birds and can be a concern to the poultry industry is Newcastle disease. More than 230 species of birds may be susceptible to natural or experimental infections with the viruses that cause Newcastle disease, but in most cases were asymptomatic. In wild birds, the effects appear to vary depending on the species of bird and the virulence of the particular strain of viruses that causes Newcastle disease. Newcastle disease can cause high rates of mortality in some bird populations, such as double-crested cormorants, but often show little effect on other species (Glaser et al. 1999), although poultry have been found to be highly susceptible (Docherty and Friend 1999, Alexander and Senne 2008). Other species, such as pigeons, may carry avian paramyxoviruses, which may pose a risk of transmission because of their close association with livestock (Kommers et al. 2001).

Certain bird species may also prey upon livestock, resulting in economic losses to livestock producers. Predatory birds are responsible for the depredation of a wide variety of livestock including cattle, goats, sheep, swine, exotic pen-raised game, other hoofed-stock, and poultry. Depredation to livestock is defined as the killing, harassment, or injury of livestock resulting in monetary losses to the owner. Direct damage to livestock in Texas occurs primarily from black vultures, crested caracaras, great horned owls, common ravens, American crows, turkey vultures, red-tailed hawks, and red-shouldered hawks. To a lesser extent, other raptors, including eagles, other owls, falcons, and accipiters, have also impacted livestock resources. The diet of black vultures consists primarily of carrion; however, black vultures can also be predatory, killing and consuming domestic young livestock (pigs, lambs, calves), young birds, mammals, reptiles, and fish (Buckley 2020). From FY 2017 through FY 2019, an average of 473 livestock were killed by avian predators (all raptors) valued at $95,231, about 35% of the losses of livestock and feed attributed to birds (see Table 1.3).

Of all predatory birds, the black vulture alone is responsible for over 82% of the value of damage to livestock in Texas as they predated all categories of hoofed livestock. Vultures can prey upon newly born calves and harass adult cattle, especially during the birthing process. The National Agricultural Statistics Service (2011) reported that in 2010, 11,900 cows and calves valued at $4.6 million were lost to vultures in the United States. While both turkey vultures and black vultures have been documented harassing expectant cattle, livestock predation is generally restricted to black vultures. Vulture predation on livestock is distinctive. Lovell (1947, 1952) and Lowney (1999) reported black vultures killed pigs by pulling eyes out followed by attacks to the rectal area or directly attacking the rectal area. During a difficult birth, vultures can harass the mother and peck at the half-expunged calf. This predation behavior often results in serious injury to livestock, which can cause livestock to die from those injuries or require the producers to euthanize livestock due to the extent of the injuries.

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

Ravens can be attracted to and concentrate around livestock birthing grounds. Ravens will attack young lambs, calves, and goats, and even adult ewes, nannies, and cattle in certain situations, by pecking the eyes and other vulnerable spots, such as the anus, nose, or umbilical cord, which results in the animal going into shock and dying (Larsen and Dietrich 1970, Peebles and Spencer 2020). Direct damage can also result from raptors, particularly red-tailed hawks, preying on domestic fowl, such as chickens and waterfowl (Washburn 2016). Free-ranging fowl or fowl allowed to range outside of confinement for a period are particularly vulnerable to predation by raptors.

Damage to Agricultural Crops

Texas produces a wide variety of crops and birds can cause damage to many of them, primarily by feeding on the crop. From FY 2017 through FY 2019, most requests for assistance involving bird damage to crops involved grain crops (*e.g*., wheat and corn), rice, and pecans. Damage was associated with a variety of birds, including blackbirds, crows, ravens, sandhill cranes, starlings, house sparrows, doves, and gulls. Birds that cause the most damage to crops are often those that congregate into large flocks. Damage is often not widespread but localized and is usually within a short flying distance of a where the birds congregate at night to roost. From FY 2017 through FY 2019, the TWSP has conducted an average of 32 work tasks per year involving bird damage to crops in Texas. People requesting assistance have reported to the TWSP or the TWSP has verified an average of $172,238 in damage to crops caused by birds from FY 2017 through FY 2019 (see Table 1.3).

Besser (1985) estimated damage to agricultural crops associated with birds exceeded $100 million annually in the United States. Bird damage to agricultural crops occurs primarily from the consumption of crops (*i.e*., loss of the crop and revenue), but also consists of trampling of emerging crops and compaction of soil by waterfowl, consumption of cover crops used to prevent erosion and condition soil, damage to fruits associated with feeding, and fecal contamination. Several studies have shown that European starlings can pose a great economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, Feare 1984). Starlings and sparrows can also have a detrimental effect on agricultural food production by feeding at vineyards, orchards, gardens, crops, and feedlots (Weber 1979). For example, starlings feed on numerous types of fruits such as cherries, figs, blueberries, apples, apricots, grapes, nectarines, peaches, plums, persimmons, strawberries, and olives (Weber 1979). Starlings were also found to damage ripening corn (Homan et al. 2017) and are known to feed on the green, milk, and dough stage kernels of sorghum (Weber 1979). Additionally, starlings may pull sprouting grains, especially winter wheat, and feed on planted seed (Homan et al. 2017). Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits, and localized damage can be considerable because sparrows often feed in large flocks on a small area (Fitzwater 1994).

Rice. Rice production is a major industry in Texas producing about 817,000 tons in 2020 valued at $195.6 million (USDA 2021). During a crop survey conducted in 2001, rice producers in Louisiana, Arkansas, California, Texas, and Missouri reported the minimum economic loss to rice production in those states from blackbird damage was $21.5 million (Cummings et al. 2005)[4]. Red-winged blackbirds, brown-headed cowbirds, common grackles, and boat-tailed grackles are the primary blackbird species responsible for causing damage to sprouting rice (Meanley 1971, Cummings et al. 2005).

Rice fields in the gulf coast prairies and marshes of Texas provide a readily available food supply for resident and migrant blackbirds. In the fall, northern blackbirds and cowbirds migrate to Texas joining the residential flocks. The tendency of blackbirds to form large communal roosts in rice-growing areas and to travel and feed in large social flocks often results in locally serious damage to rice crops, and

[4]Estimate includes damage to the ripening crop in the fall and damage to the newly seed/sprouting crop in the spring. Most of the damage reported by respondents occurred to ripening rice.

monetary losses to individual farmers can be substantial. Blackbirds damage rice at many different times during the season. They consume rice seed before it sprouts, pull sprouts as the plants emerge from the soil, and consume the mature rice once it has headed. From FY 2017 through FY 2019, the TWSP recorded an average of 16 work tasks associated with rice production and received reports of or verified an average of $162,000 damage at these sites. However, damage to rice, and rice production acres, can be quite variable depending on weather and water availability. Damage with crops also depends on the availability of insects, wild mast, and other, more preferable, feed.

Pecans. Pecans are another important cash crop in Texas with the value of production estimated at nearly $65 million in 2020 (USDA 2021). Pecans can be severely damaged by crows, and to lesser extent ravens, blue jays, grackles, and woodpeckers, which mostly migrate into Texas during the fall. Damage primarily occurs following ripening (shuck split) from late September until December. While loss estimates due to birds are not available industry-wide, individual producers have reported as much as $100,000 loss to one 2,600 acre orchard, which would have been even higher without the producer employing both lethal and non-lethal control measures for crows. From FY 2017 through FY 2019, the TWSP has conducted an average of 5 work tasks associated with damage to pecans and other nuts. In addition, people requesting assistance have reported or the TWSP has verified an average of $3,977 in bird damage to pecans from FY 2017 to FY 2019 (see Table 1.3). However, in FY 2003 and FY 2004, the TWSP received 149 and 109 requests for assistance involving bird damage to pecans and recorded about $116,000 and $77,000 in damage to pecans, respectively. Thus, as with other crops, bird damage to pecans can vary sporadically.

Wheat and other grain. Wheat is another valuable commercial crop in Texas with the value of production estimated at nearly $314 million in 2020 (USDA 2021). Other grain crops, including corn and milo, are also susceptible to bird damage, especially when newly planted or as the grain ripens. Wintering populations of Canada, white-fronted, and snow geese, and sandhill cranes occur across much of Texas with larger concentrations associated to the high plains and coastal agricultural areas. The TWSP has received requests from wheat and other grain producers who experience losses to winter grain crops due to concentrations of migratory birds feeding on crops. From FY 2017 through FY 2019, the TWSP conducted an average of eight work tasks associated with wheat averaging $4,575 in damage (see Table 1.3). Crop damage can be excessive during dry conditions when young plants (*e.g.*, winter wheat) have a poorly developed root system.

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985, Bodenchuk and Bergman 2020). Damage to sprouting corn occurs primarily from grackles and crows, but red-winged blackbirds and Sandhill cranes can also cause damage to sprouting corn (Stone and Mott 1973, Barzen and Ballinger 2017). Additionally, starlings may pull sprouting grains and feed on planted seed (Homan et al. 2017). Damage to sprouting corn is likely localized and highest in areas where breeding colonies of grackles exist in close proximity to agricultural fields planted with corn (Stone and Mott 1973, Rogers and Linehan 1977). Rogers and Linehan (1977) found grackles damaged two corn sprouts per minute on average when present at a field planted near a breeding colony of grackles.

As resident Canada goose populations have increased across the United States, including the resident population in Texas, the number of requests for assistance to manage damage associated with geese has also increased. Agricultural impacts include losses to corn, soybeans, and winter wheat, as well as overgrazing of pastures and a degradation of water quality (Gabig 2000, United States Fish and Wildlife Service (USFWS) 2005, Atlantic Flyway Council 2011, Mississippi Flyway Council Technical Section 2017).

Commercial Trees. In 2017, there were 93 farms cultivating Christmas trees and other short rotation woody crops in Texas with a market value of products sold estimated at $1.5 million (USDA 2019*b*). Bird damage to commercially grown trees comes directly from species such as woodpeckers and indirectly from communally roosting or nesting birds such as vultures, cormorants, egrets, and blackbirds because their fecal droppings can eventually kill the trees. From FY 2017 through FY 2019, the TWSP received only one request for assistance to protect commercial trees annually and recorded $300 damage (see Table 1.3).

Other Crops. The TWSP responds to damage and losses to many other crops. Examples include peaches, watermelon, grapes, soybeans, truck garden plants, greenhouse/nursery plants, sunflowers, and barley. The TWSP recorded an average of two work tasks annually resulting in $1,151 in damage to these other crops from FY 2017 through FY 2019 (see Table 1.3).

Besser (1985) estimated bird damage to grapes, cherries, and blueberries exceeded $1 million annually in the United States. In 1972, Mott and Stone (1973) estimated that birds caused $1.6 to $2.1 million in damage to the blueberry industry in the United States, with starlings, robins, and grackles causing the most damage. Red-winged blackbirds, cowbirds, and crows may also cause damage to blueberries (Besser 1985). Damage to blueberries typically occurs from birds plucking and consuming the berry or from knocking the berries from the bushes (Besser 1985). During a survey conducted in 15 states and British Columbia, Avery et al. (1991) found that 84% of respondents to the survey considered bird damage to blueberries to be "*serious*" or "*moderately serious*". Respondents of the survey identified starlings, robins, and grackles as the primary cause of damage (Avery et al. 1991); however, respondents identified several additional bird species as causing damage to blueberries (Avery et al. 1991). Avery et al. (1991) estimated bird damage to blueberry production in the United States cost growers $8.5 million in 1989.

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

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

1.2.2 Need to Resolve Threats that Birds Pose to Human Safety

Several bird species can be closely associated with human habitation and often exhibit gregarious roosting or flocking behavior, such as vultures, gulls, pigeons, sparrows, starlings, waterfowl, crows, swallows, grackles, cowbirds, and red-winged blackbirds. The close association of those bird species with human activity can pose threats to human safety from disease transmission and threaten the safety of air passengers if aircraft struck birds. In addition, excessive droppings can be esthetically displeasing, accumulations of nesting material can pose a fire risk in buildings and on electrical transmission structures, and aggressive behavior, primarily from waterfowl and raptors, can pose risks to human safety. Other concerns can involve birds making excessive noise (*e.g.*, communal bird roosts, nesting crows, feral peacocks, woodpeckers hammering on a house), injured birds (*e.g.*, wrapped with fishing line or struck by a car and need to be trapped/hand captured to be taken to a rehabilitator), birds stuck in a building (*e.g.*, Cooper's hawk in a warehouse, starling in a flume), birds leaving excrement on sidewalks (*e.g.*, geese, ducks, starlings, swallows), or birds creating an unpleasant smell (*e.g.*, droppings at communal bird roosts near residences, vulture roosts from vomitus and droppings, pigeon nests near air-intake to buildings).

The TWSP responded to an annual average of 14,121 human health and safety conflicts involving birds from FY 2017 to FY 2019, not including work tasks associated with disease surveillance. The vast majority (95.6%) of human safety complaints are associated with protection of people at airports. At airports, the species involved with most requests for assistance in Texas are raptors (22.4%), wading birds/cormorants (11.9%), and blackbirds and starlings (11.8%). Requests for assistance not involving airports accounted for only 4.4% of all human health and safety requests. The species most associated with non-airport health and safety conflicts included wild and feral waterfowl (29.8%), vultures (16.5%), and blackbirds and starlings (16.0%).

Threat of Disease Transmission

Birds can play a role in the transmission of zoonotic diseases (*i.e.*, diseases that animals can transmit to people) (Conover 2002). However, few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to people or domestic animals from transmission of those diseases (Clark and McLean 2003). Complicating the study of disease threats is the fact that people can contract some disease-causing agents associated with birds from other sources. Although many people are concerned about disease transmission from birds, the probability of contracting a disease indirectly (when no physical contact occurs) is likely to be low. However, direct contact with birds, nesting material, fecal droppings, or the inhalation of fecal particles from accumulations of droppings increases the likelihood of disease transmission. The TWSP could receive requests to assist with identifying the cause or source of a disease by collecting samples from birds for testing.

The gregarious behavior of bird species leads to accumulations of fecal droppings, which can pose a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are esthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings. Fecal droppings in and around water resources can affect water quality and can be a source of a number of different types of pathogens and contaminants. Waterbird excrement can contain coliform bacteria, streptococcus bacteria, *Salmonella*, toxic chemicals, and nutrients, which could compromise water quality, depending on the number of birds, the amount of excrement, and the size of the water body. Elevated contaminant levels associated with breeding and/or roosting concentrations of birds and their potential effects on water supplies can be concerns. The primary species that congregate to form communal roosts or nesting colonies in Texas where people could be exposed to disease pathogens include black and turkey vultures, starlings and blackbirds, crows, egrets and herons, waterfowl, and swallows.

Birds can play a role in the transmission of diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Birds may also play a direct and indirect role in transmission of *Escherichia coli* and *S. enterica* to humans through contact with infected cattle feces, watering troughs, and agriculture fields fertilized with manure slurries (Pedersen and Clark 2007). For example, as many as 65 different diseases transmittable to humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). Public health officials and residents at such sites express concerns for human health related to the potential for disease transmission where fecal droppings accumulate. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms, which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum*, which causes the disease histoplasmosis in humans (Weeks and Stickley 1984).

Crows, blackbirds, and starlings can form large communal roosts of the kind associated with disease organisms, such as *H. capsulatum* (Weeks and Stickley 1984). The disturbance of soil or fecal droppings under bird roosts where fecal droppings have accumulated can cause *H. capsulatum* to become airborne. Once airborne, people in the area can inhale the fungus. For example, two siblings contracted pneumonia in Arkansas during 2011, and additional family members suffered from respiratory disease, after burning bamboo from a grove that red-winged blackbirds roosted in (Haselow et al. 2014). *H. capsulatum* can remain in the soil and can become airborne several years after blackbirds abandon a roost (Clark and McLean 2003).

Salmonella (*Salmonella* spp.) may be contracted by people from handling materials soiled with bird feces (Stroud and Friend 1987). Several types of the Salmonella bacteria are carried by wild birds with varying degrees of impact on people and livestock. Salmonella has been isolated from the gastrointestinal tract of starlings (Carlson et al. 2010). Friend and Franson (1999) reported relative rates of detection of *Salmonella* spp. in free ranging birds. *Salmonella* spp. isolates were frequent in songbirds, common in doves and pigeons, occasional in starlings, blackbirds and cowbirds, and infrequent in crows. Salmonella causes gastrointestinal illness, including diarrhea. Public health concerns often arise when gulls feed and loaf near fast food restaurants, and picnic facilities; deposit waste from landfills in urban areas and drinking water reservoirs; and contaminate industrial facility ventilation systems with feathers, nesting debris, and droppings. Gulls feeding on vegetable crops and livestock feed can potentially aid in the transmission of *Salmonella.*

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

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

Escherichia coli are fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *Escherichia coli* with the majority of serological types being harmless (Sterritt and Lester 1988). The serological type of *Escherichia coli* that is best known is *Escherichia coli* O157:H7, which is usually associated with cattle (Gallien and Hartung 1994). Many communities monitor water quality at swimming beaches and lakes but lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, the beaches are often temporarily closed, which can adversely affect the enjoyment of those areas by the public, even though the serological type of the *Escherichia coli* is unknown. Unfortunately, linking the elevated bacterial counts to the frequency of waterfowl use and attributing the elevated levels to human health threats has been problematic until recently. Advances in genetic engineering have allowed microbiologists to match genetic code of coliform bacteria to specific animal species and link those animal sources of coliform bacteria to fecal contamination (Simmons et al. 1995, Jamieson 1998). Research found that 28% of the *Escherichia coli* at sites in Belton Lake and Leon River were were from birds.

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

Research has shown that gulls can carry various species of bacteria, such as *Bacillus* spp., *Clostridium* spp., *Campylobacter* spp., *E. coli*, *Listeria* spp., and *Salmonella* spp. (MacDonald and Brown 1974, Fenlon 1981, Butterfield et al. 1983, Monaghan et al. 1985, Norton 1986, Quessey and Messier 1992, Franklin et al. 2020). Transmission of bacteria from gulls to humans is difficult to document; however, Reilly et al. (1981) and Monaghan et al. (1985) both suggested that gulls were the source of contamination for cases of human salmonellosis. Gulls can threaten the safety of municipal drinking water sources by potentially causing dangerously high levels of coliform bacteria from their fecal matter. Contamination of public water supplies by gull feces has been stated as the most plausible source for disease transmission (*e.g*., see Jones et al. 1978, Hatch 1996). Gull feces has also been implicated in accelerated nutrient loading of aquatic systems (Portnoy 1990), which could have serious implications for municipal drinking water sources.

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

The TWSP has been part of an interagency team conducting, assisting, or supervising in disease surveillance by collecting biological samples to monitor for the presence of various diseases such as highly pathogenic avian influenza. Similar sampling may occur in the future and is considered as part of this analysis. Typically, samples are obtained from live and dead birds or droppings. Depending on the disease certain species of birds are targeted for surveillance. The EA discusses the need to monitor, and possibly manage, wild and feral birds to reduce the risk of disease transmission to humans and livestock. As an emergency response agency, WS continues to prepare for requests for assistance with disease surveillance in wild and feral birds. Numerous potential routes for introduction of viruses into the United States exist including illegal movement of domestic or wild birds, contaminated products, and the migration of infected wild birds.

While transmission of diseases or parasites from birds to people has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blankespoor and Reimink 1991, Hatch 1996, Graczyk et al. 1997, Saltoun et al. 2000, Kassa et al. 2001). In some cases, infections may even be life threatening for people with suppressed or compromised immune systems (Roffe 1987, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting a disease from feces is believed to be small. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Several of the bird species addressed in this EA are closely associated with the activities of people and they often exhibit gregarious roosting and nesting behavior. This gregarious behavior can lead to accumulations of fecal droppings that could be considered a threat to human health and safety due to the close association of those species of birds with people. Accumulations of bird droppings in public areas are esthetically displeasing and are often in areas where people may come in direct contact with fecal droppings. In most cases in which human health concerns are a major reason for requesting assistance, no actual cases of bird transmission of disease to humans have been proven to occur. Thus, the risk of disease transmission would be the primary reason people request assistance. The TWSP recognizes and defers to the authority and expertise of local and state health officials in determining what does or does not constitute a threat to public health.

Threat to Human safety associated with Aircraft Striking Birds at Airports and Military Bases

In addition to potentially transmitting zoonotic pathogens, birds also pose a threat to human safety related to aircraft. Bird strikes can cause catastrophic failure of aircraft systems (*e.g*., ingesting birds into engines), which can cause the plane to become uncontrollable leading to crashes. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2004). Appendix E provides a list of bird species struck by aircraft in the United States and Texas.

While bird strikes that result in human fatalities are rare, the consequences can be catastrophic. The worst strike on record for loss of human lives in the United States occurred in Boston during 1960 when 62 people died in the crash of an airliner that collided with a flock of European starlings (Terres 1980, Dolbeer and Wright 2008). In 1995, 24 individuals died when a military aircraft struck a flock of Canada geese at Elmendorf, Alaska and crashed (Smith et al. 1999). In Oklahoma, an aircraft struck American white pelicans (*Pelecanus erythrorhynchos*) causing the plane to crash, which killed all five people aboard (Dove et al. 2009). Fatalities have occurred in Texas following aircraft striking birds. In 1992, an experimental plane crashed in Texas killing the pilot after a strike with an unknown bird. During 2003, two people were killed following a collision with an unknown bird species (suspected vulture) in Texas (Wright 2014). From 1990 through 2019, 35 human fatalities have occurred after civil aircraft struck birds in the United States (Dolbeer et al. 2021). Among those 35 fatalities, eight occurred after striking birds that were not identified, eight occurred after strikes involving red-tailed hawks, five from American white pelicans, four from bald eagles, three from snow geese, two each from Canada geese and rock pigeons, and one fatality each occurred from striking turkey vultures, black vultures, and brown pelicans

(Dolbeer et al. 2021). From 1988 through 2019, wildlife strikes have killed more than 292 people and destroyed over 271 aircraft globally (Dolbeer et al. 2021).

Injuries can also occur to aircraft crewmembers and passengers from bird strikes. From 1990 through 2019, injuries to crewmembers and passengers have occurred from aircraft strikes involving several bird species, including vultures, waterfowl, hawks, eagles, gulls, cormorants, anhingas, kestrels, pigeons, doves, and unknown bird species. For example, from 1990 through 2019, 49 aircraft strikes involving unknown bird species caused 65 human injuries and 18 strikes involving turkey vultures resulted in 22 injuries (Dolbeer et al. 2021). From FY 2017 to FY 2019, the TWSP recorded an annual average of 1,534 work tasks associated with protecting human health and safety from bird-aircraft strikes at airfields.

Additional Human Safety Concerns Associated with Birds

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife, especially around urban areas, has led to a decline in the fear wildlife have toward people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension can occur, which can lead those species to exhibit threatening or abnormal behavior toward people. This behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening behavior can occur in the form of aggressive posturing, a general lack of apprehension toward people, or abnormal behavior. Although birds attacking people occurs rarely, aggressive behavior by birds does occur, especially during nest building and the rearing of eggs and chicks. The TWSP has received requests for assistance to address birds that are attacking or threatening injury to people, including Canada geese, mute swans, Mississippi kites, red-tailed hawks, northern mockingbirds, Brewer's blackbirds, great-tailed grackles and northern cardinals. Bird attacking or posing a threat of injury to people are infrequent. From FY 2017 through FY 2019, the TWSP responded to an average of two incidents per year.

Raptors can aggressively defend their nests, nesting areas, and young, and may swoop and strike at pets, children, and adults. As an example of a typical attack complaint, in one instance Mississippi kites have attacked children at a daycare facility. One child was struck and injured (scalp laceration) by an adult kite when the children played near a tree with a nest. After several repeated attacks and threats to individuals nearby, TWSP personnel resolved the problem by coordinating the hand capture of the nestlings which were transferred to a wildlife rehabilitator to be raised in captivity. Once the nest and nestlings were removed, the aggressive, defensive behavior of the parent birds ceased, and the problem was resolved.

In addition to raptors, waterfowl can also aggressively defend their nests and nestlings during the nesting season. Feral waterfowl often nest in high densities in areas used by people for recreational purposes, such as industrial areas, parks, beaches, and sports fields (VerCauteren and Marks 2004). If people or their pets unknowingly approach waterfowl or their nests at those locations, injuries could occur if waterfowl react aggressively to the presence of those people or pets (Conover 2002). During the nesting season, geese aggressively defend the area around their nests and goslings from other animals and people (Mississippi Flyway Council Technical Section 1996, Gabig 2000, USFWS 2005, Atlantic Flyway Council 2011).

Additionally, slipping hazards can be created by the buildup of feces from birds on docks, walkways, and other foot traffic areas. To avoid those conditions, regular cleanup is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

1.2.3 Need to Resolve Bird Damage Occurring to Property

All of the bird species addressed in this EA can cause damage to property in Texas. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property occurs through direct damage to structures, through roosting behavior, and through their nesting activities. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows (Avery and Lowney 2016). Accumulations of fecal droppings can cause damage to buildings and statues. Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime. Gulls can pick up refuse at landfills and carry it off the property to feed, resulting in garbage being deposited on buildings, equipment, and vehicles in neighboring areas. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, which can scratch paint and siding (Miller 2018).

About 41% of the work tasks conducted by the TWSP from FY 2017 through FY 2019 involved projects to protect property. Property encompasses a wide range of people-owned resources that are damaged by birds. Table 1.4 shows the number of requests for assistance that the TWSP received from FY 2017 through FY 2019 involving bird damage to property in Texas. Table 1.4 also shows the value of damage to property caused by birds in Texas from FY 2017 through FY 2019 as reported to or verified by the TWSP. Table 1.4 only reflects damages associated with the requests for assistance received by the TWSP and is only a fraction of the actual damage caused by birds in Texas.

Table 1.4 - The number of requests for assistance and value of damage caused by birds in Texas as reported to or verified by the TWSP from FY 2017 to FY 2019 for property

	FY 2017		FY 2018		FY 2019		Average	
CATEGORY	**WTs**	**$ Value $**	**WTs**	**$ Value $**	**WTs**	**$ Value $**	**WTs**	**$ Value $**
Pets/Zoo Animals	25	$73,931	6	$2,200	17	$65,010	16	$47,047
Aircraft	1,156	$181,761	1,003	$1,187,376	9,123	$554,288	3,761	$641,142
Equipment/vehicles	59	$3,802,600	73	$800,003	75	$889,653	69	$1,830,752
Landscaping	9	$29,250	16	$11,585	5	$1,000	10	$13,945
General Property	40	$561,200	51	$89,450	68	$136,280	53	$262,310
Buildings/Structures	93	$334,715	118	$501,050	109	$159,974	107	$331,913
Utilities	39	$678,500	28	$413,250	23	$436,000	30	$509,250
TOTAL	**1,421**	**$5,661,957**	**1,295**	**$3,004,914**	**9,420**	**$2,224,205**	**4,045**	**$3,630,359**

WTs = Work tasks conducted by TWSP personnel in response to requests for assistance

From FY 2017 through FY 2019, the TWSP verified or the TWSP received reports of birds causing an average of $3.6 million in damage to property per year in Texas. The majority of work tasks conducted by the TWSP from FY 2017 through FY 2019 involved reducing the risk of aircraft striking birds at airports in Texas (see Table 1.4). On average, birds caused over $1.8 million in damage to equipment and vehicles per year in Texas from FY 2017 through FY 2017.

Property Damage to Aircraft from Bird Strikes

Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transportation industry as a whole (Conover et al. 1995). Wildlife strikes pose increasing risks and economic losses to the aviation industry worldwide. Wildlife strikes in the United States result in millions of dollars in direct and indirect damages annually. Annual economic losses from wildlife strikes with civil aircraft are likely to exceed $1.2 billion worldwide (Allan and Orosz 2001, Allan 2002). Direct costs include damage to aircraft, aircraft downtime, and medical expenses of injured personnel and passengers. Indirect costs can include lost revenue from the flight, cost of housing delayed passengers, rescheduling aircraft, and flight cancellations. The TWSP reported an average of 3,761 work tasks associated with aircraft protection with an average of $641,142 in damage from FY 2017 to FY 2019 (see Table 1.4).

The increase in aircraft striking birds may be a result of increases in populations of many large bird species that are hazardous to aviation (Dolbeer and Eschenfelder 2003). For example, 13 of the 14 largest (>8 lbs) bird species in North America have shown population increases in the past 20 to 40 years. These species include Canada geese, brown pelicans, sandhill cranes and bald eagles. Populations of many other hazardous species, such as turkey vultures, snow geese, red-tailed hawks, and double-crested cormorants, have also increased. Furthermore, many of these species have adapted to living in urban environments, such as at airports (Dolbeer and Eschenfelder 2003). In addition, birds may be less able to detect and avoid the quieter turbofan-powered aircraft in use today compared to older, noisier aircraft. Finally, air traffic has increased, and all of these factors equate to higher numbers of strikes.

From 1990 through 2019, Federal Aviation Administration records indicate total reported losses from bird strikes cost the civil aviation industry over $774 million in monetary losses and nearly 795,000 hours of aircraft downtime (Dolbeer et al. 2021). Because reporting rates of aircraft strikes have been historically low, these figures likely underestimate total damage caused by bird strikes. Historically, wildlife strike reporting rates may have been as low as 20% (Linnell et al. 1999, Wright and Dolbeer 2005). However, reporting rates for civil aviation in the United States appear to be increasing (Dolbeer et al. 2021). Not all reports provide notation as to whether or not there was damage and some strike reports to the Federal Aviation Administration that indicate there was an adverse impact on the aircraft from the strike do not include a monetary estimate of the damage caused. Additionally, most reports indicating damage to aircraft report direct damages and do not include indirect damage, such as lost revenue, cost of putting passengers in hotels, rescheduling aircraft, and flight cancellations. Thus, actual monetary losses from bird strikes are likely much higher than estimated losses.

Target bird species can present a safety threat to aviation when those species occur in areas on and around airports. Species of birds that occur in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on airport property can result in aircraft strikes involving several individuals of a bird species, which can increase damage and increase the risks of catastrophic failure of the aircraft. A high percentage of bird strikes occur during peak migration periods, but dangerous situations can develop during any season. Aircraft are most vulnerable to bird strikes while at low altitudes, generally related to landing and take-off. From 1990 through 2019, approximately 71% of reported bird strikes to general aviation aircraft in the United States and 72% of bird strikes involving commercial aircraft occurred when the aircraft was at an altitude of 500 feet above ground level or less. Additionally, approximately 92% occurred at less than 3,500 feet above ground level (Dolbeer et al. 2021).

Gulls, raptors, waterfowl, shorebirds, and doves/pigeons are the bird groups most frequently struck by aircraft in the United States with aircraft strikes involving waterfowl, gulls, and raptors causing the most damage. From 1990 through 2019, aircraft strikes involving waterfowl caused more than $268 million in damages to civil aircraft in the United States and strikes involving hawks, eagles, and vultures caused nearly $150 million in damages (Dolbeer et al. 2021). In total, aircraft strikes involving birds has resulted in over $774 million in reported damages to civil aircraft from 1990 through 2019 in the United States (Dolbeer et al. 2021).

From January 1990 through early June 2021, the Federal Aviation Administration (2021) has 20,067 reports of aircraft striking birds in Texas. In Texas, over 94% of the reported aircraft strikes from January

1990 through early June 2021 involved birds (Federal Aviation Administration 2021). Aircraft in Texas have struck over 100 species of birds (Federal Aviation Administration 2021). From January 1990 through early June 2021, 9,470 aircraft strike reports in Texas indicated the aircraft struck an "*unknown bird*" species. In addition, some reports provide limited identification information, such as aircraft striking "*gulls*" or "*hawks*" (Federal Aviation Administration 2021). Therefore, aircraft could have struck additional species in Texas during this period.

Vultures and raptors can present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Geese and vultures are two of the most hazardous birds for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000, DeVault et al. 2011, Dolbeer et al. 2021). When in large flocks or flight lines entering or exiting a winter roost at or near airports, starlings and blackbirds present a safety threat to aviation. Starlings and blackbirds are particularly dangerous birds to aircraft during take-offs and landings because of their high body density and tendency to travel in large flocks of hundreds to thousands of birds (Seamans et al. 1995). Mourning doves also present similar risks when their late summer behaviors include creating large roosting and loafing flocks. Their feeding, watering, and picking up grit on airport turf and runways further increase the risks of bird-aircraft collisions.

From 2017 through 2019, northern harriers caused 34 airstrikes, white-tailed kites 33 (showing their preference for hunting grasslands), Mississippi kites 6, and swallow-tailed kites 1 (see Appendix E). Of these, the only species that typically causes problems away from airports are the Mississippi kites, which are very aggressive nest protectors and will often strike people causing lacerations; those injured sometimes must seek medical attention because the lacerations are so deep. This is a concern when they nest in urban or other areas frequented by people that unknowingly get close to the nest. This has occurred in Texas is easily resolved by removing the nest.

Several species of passerines frequent grasslands and could cause damage or pose a threat of damage, primarily at airports. A few of these species, though, cam cause damage to crops. True grassland species include the meadowlarks, horned larks, pipits, emberizids (lark bunting, certain sparrows, and longspurs), dickcissels, and bobolinks. We include the flycatchers/kingbirds, orioles, and goldfinches with this group because often they are found in open grassland areas with some perches (trees, wires, poles, shrubs), but favor a wider variety of habitats. Damage associated with grassland species is typically much less than other groups of birds, but they can be substantial locally. With a single exception during the period from FY 2017 to FY 2019, all damage and threats reported were to human safety at airports or damage to aircraft (the exception was one instance of damage to blueberries). As a result mostly from work at airports and aircraft strikes, these species were responsible for an annual average of 4,491 work tasks; 69% of which were related to aircraft and 31% associated with safety of the flying public. In all, these species were responsible for 5,259 strikes at airports in the United States from 2017 through 2019 with 249 occurring in Texas with just over 1% causing damage (see Appendix E). Of these species, the only species causing other types of damage, primarily to small grain crops, are horned larks, lark buntings, dickcissels, and goldfinches.

The open, grassland habitats of airports and military facilities can provide ideal habitat for many grassland bird species, such as barn swallows and meadowlarks. Barn swallows will often forage in large groups. The open habitats associated with airports can provide ideal locations for swallows to forage and the presence of those swallows can increase the risks of an aircraft strike. From 1990 through 2019, 12,430 reported civil aircraft strikes have occurred in the United States involving swallows resulting in 3,982 hours of aircraft downtime and nearly $718,000 in damages to aircraft (Dolbeer et al. 2021). Since 1990, 992 reported aircraft strikes involving swallows occurred in Texas, including bank swallows, barn swallows, cave swallows, northern rough-winged swallows, tree swallows, and cliff swallows. Of the bird species identified most frequently as being struck by civil aircraft in the United States, barn swallows ranked third from 1990 through 2019 and second in 2019 (Dolbeer et al. 2021).

The open areas found at airports also make ideal habitat for meadowlarks to forage and nest while providing ample perching areas. Most requests for assistance to reduce threats associated with meadowlarks occur at airports in Texas. Meadowlarks found on and adjacent to airport property can pose a strike hazard, causing damage to the aircraft and threatening passenger safety. From 1990 through 2019, there have been 5,474 reported civil aircraft strikes involving meadowlarks in the United States causing over $1 million in damages (Dolbeer et al. 2021). Since 1990, 766 reported civil aircraft strikes involving meadowlarks have occurred in Texas (Federal Aviation Administration 2021).

Similar to meadowlarks, airports often have ideal habitat for killdeer. From 1990 through 2019, there have been 7,056 reported civil aircraft strikes involving killdeer in the United States causing over $4.3 million in damages (Dolbeer et al. 2021). From January 1990 through early June 2021, 697 reported civil aircraft strikes involving killdeer have occurred in Texas (Federal Aviation Administration 2021). The loggerhead shrike is a grassland species that can occur on airport properties. Loggerhead shrikes were known to be struck 5 times at Texas airports from 2017 to 2019 (see Appendix E).

Finally, a question often arises whether or not airports are legally liable for such losses. Several airports have been sued due to damage to aircraft at an airport. One, of many, examples was for a bird strike in 1995 at John F. Kennedy Airport in New York. An Air France Concorde, at about 10 feet above ground while landing ingested 1 or 2 Canada geese into the #3 engine. The engine suffered an uncontained failure. Shrapnel from the #3 engine destroyed the #4 engine and severed several hydraulic lines and control cables. The pilot was able to land the plane safely, but the runway was closed for several hours. Damage to the Concorde was estimated at over $7 million. The French Aviation Authority sued the Port Authority of New York and New Jersey and eventually settled out of court for $5.3 million (MacKinnon et al. 2001). Based on a summary of cases by MacKinnon et al. (2001) and Dolbeer (2006) and legal reviews by Michael (1986), Robinson (2000), and Matijaca (2001), it is apparent that airport operators must exercise "*due diligence*" in managing wildlife hazards to avoid potentially serious liability issues. The exercise of "*due diligence*" to manage wildlife hazards initially involves (in the United States) an assessment of wildlife hazards at the airport. Based on the assessment, a wildlife hazard management plan may need to be developed (requirements for the development of a wildlife hazard management plan are outlined in 14 U.S. Code of Federal Regulations (CFR) Part 139.337) and implemented, particularly for certificated airports (airports that serve scheduled and unscheduled air carrier aircraft with more than 30 seats). Based on 14 CFR Part 139, certificated airports experiencing hazardous wildlife conditions must conduct formal Wildlife Hazard Assessments and develop Wildlife Hazard Management Plans as part of the certification standards.

Damage to Buildings and Houses

Damage to buildings and houses can occur from accumulations of droppings and feather debris associated with large concentrations of birds. Although damage and threats can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks, such as migration periods and during winter months when food sources are limited. Birds that routinely nest, roost, and/or loaf in the same areas often leave large accumulations of droppings and feather debris, which can be esthetically displeasing and can cause damage to property (Dolbeer and Linz 2016, Homan et al. 2017).

The TWSP annually averaged 107 work tasks associated with damage to houses and buildings from FY 2017 to FY 2019, or about 2.6% of all bird requests for property damage and protection. Buildings and residences suffer damage from several bird species. Most requests arise from bird droppings that have accumulated to the point that they are aesthetically displeasing or smell. Corrosion damage to metal structures and painted finishes can occur because of uric acid from bird droppings (Homan et al. 2017). Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Damage to buildings and houses is primarily from rock pigeons but starlings, house sparrows, gulls, blackbirds, and vultures also cause damage to buildings and houses.

In addition to damage caused by the accumulation of droppings, damage can also occur in other ways. When gulls, European starlings, house sparrows, raptors, rock pigeons, swallows, and other bird species nest on or in buildings or other structures they transport large amounts of nest material and food debris to the area. These materials can obstruct roof drainage systems and lead to structural damage or roof failure if clogged drains result in rooftop flooding (Vermeer et al. 1988, Blokpoel and Scharf 1991, Belant 1993, Lowney et al. 2018). Nesting material and feathers can also clog ventilation systems or fall onto or into equipment or goods (Gorenzel and Salmon 1994*a*, Homan et al. 2017).

Woodpeckers sometimes cause structural damage to wood siding and stucco on homes by drilling holes. Several species of woodpeckers are responsible for this type of damage, but the flicker and golden-fronted woodpecker that are commonly found in urban settings create the biggest problems in Texas. Damage, if unabated, can result in thousands of dollars of damage to homes or buildings. As an example, the TWSP received a call from a resident who had experienced repeated and accumulative damage to unoccupied residential property by woodpeckers. Wood and stucco construction of the home was damaged and required complete replacement at a cost of $50,000 to repair.

Birds, including wild turkeys and cardinals, can also cause damage to windows, siding, vehicles, and other property when they mistake their reflection as another bird and attack the image. Damage from vultures can include tearing and consuming latex window caulking or rubber gaskets that seal windowpanes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and other equipment. Similarly, nesting colonies of gulls frequently cause damage to structures when they nest on rooftops and peck at spray-on-foam roofing and rubber roofing material, including caulking.

Nests of starlings, house sparrows, and house finches can also be of concern to owners and managers of buildings and houses. Those species can have bulky nests built of straw and other similar items that, in an attic, become an extreme fire hazard and a source of bird ectoparasites, such as mites that can cause problems. Some swallows build nests under eaves and their droppings and mud can be a concern and create continual clean-up costs.

Damage to Utilities

Electrical utility companies frequently have problems with bird nests causing power outages when they short out transformers and substations (United States Geological Survey 2005, Pruett-Jones et al. 2007, Avery and Lindsay 2016). For example, osprey nests are often constructed of large sticks, twigs, and other building materials that can cause damage and prevent access to critical areas when those nests are built on man-made structures (*e.g.*, power lines, cell towers, boats). Disruptions in the electrical power supply can occur when nests are located on utility structures and can inhibit access to utility structures for maintenance by creating obstacles to workers. The average osprey nest size in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (United States Geological Survey 2005). In 2001, 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites (United States Geological Survey 2005).

Monk parakeets build large colonial nests from sticks in trees and on utility poles. Monk parakeet nests can cause equipment damage, result in lost revenue from nest and bird caused power outages, increase operation and maintenance costs associated with nest removal and repair of damaged structures, and result in public safety concerns. Monk parakeet nests can attract predators (including people) that also can cause outages. Problems with nesting on utility structures have been reported in Rhode Island, New York, New Jersey, Colorado, Florida, and Texas (Newman et al. 2004). If their nests are built on light or electrical utility poles, the bulbs or transformers can overheat, causing fires and blackouts. The weight of a nest can cause its support, such as a tree or man-made structure, to collapse (Stafford 2003).

For example, for a five-month period in 2001, 198 electrical outages related to monk parakeets were logged, which affected over 10,000 customers in two counties in South Florida (Newman et al. 2004). The frequency of outages increases during wet weather. These outages result from nesting material completing an electric circuit between two energized parts or an energized part and a grounded part of electrical equipment. In some cases, the nests get too large and complete an electric circuit. In other cases, individual parakeets can bring nesting materials that can result in completing a circuit. Fires can start in the nesting material causing damage to transformers and other utility equipment (Newman et al. 2004). Monk parakeet nests, in their native range, can grow up to over 200 chambers, with some weighing up to 1,180 kg (2,600 lbs) (Burgio 2020). These nests can result in damage to ornamental trees when they become too heavy to support or because of increased susceptibility to wind damage resulting in broken branches. Falling nests can damage buildings, automobiles, and other property. Nests of ravens, red-tailed hawks, and golden eagles can also be of concern when they occur on utility poles or structures.

Accumulations of fecal droppings can also be of concern to utility companies. For example, the TWSP responded to a request to alleviate property damage and power outage losses for a central Texas electrical power company in 2000 that involved vultures roosting on transmission line towers. A power outage caused by the fecal droppings on transmission line insulators caused an estimated $2 million loss to a production facility in Austin, Texas. An additional $3,000 clean up expense followed the outage loss. On average, the TWSP conducted 30 work tasks annually associated with protecting utilities resulting in $509,250 damage from FY 2017 through FY 2019 (see Table 1.4).

Damage to Heavy Equipment, Automobiles, Boats, and Other Equipment

Corrosion damage to metal structures and painted finishes of vehicles and boats can occur from accumulations of fecal accumulations when birds roost or loaf over such property. Blackbirds, starlings, gulls, vultures, house sparrows, and egrets are bird species that often use areas where damage to equipment and other property occurs. Parking lot owners, such as at airports, that have bird roosts in them have had to pay for damage to cars where a car sits for an extended period of time and gets covered in fecal droppings because the droppings can etch the paint. Nesting birds, such as feral pigeons, starlings, and house sparrows and their droppings, can cause damage to farm and road maintenance equipment that sits in yards during the off-season. The TWSP conducted an annual average of 69 work tasks associated with protecting vehicles and equipment from birds that caused an average $1,830,752 in damages from FY 2017 through FY 2019 (see Table 1.4).

Damage to Landscaping

Property damage most often involves fecal matter that contaminates landscaping and walkways, often at golf courses and waterfront property. Fecal droppings and the overgrazing of vegetation can be esthetically displeasing (*e.g.* see Fitzwater 1994, Gorenzel and Salmon 1994*a*, Gorenzel and Salmon 1994*b*, Johnson 1994, Williams and Corrigan 1994, Cummings 2016, Homan et al. 2017). The accumulation of fecal matter from birds can also negatively affect landscaping and walkways, often at golf courses and waterfront property (Conover and Chasko 1985). Businesses may be concerned about the negative esthetic appearance of their property caused by excessive droppings and excessive grazing and are sensitive to comments by clients and guests. Costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, implementation of wildlife management methods, loss of property use, loss of esthetic value of flowers, gardens, and lawns consumed by birds, loss of customers or visitors irritated by walking in fecal droppings, repair of golf greens, and replacing grazed turf. The reoccurring presence of fecal droppings can lead to constant cleaning costs for property owners.

Waterfowl can cause damage to landscaping, when they consume or trample flowers, gardens, and lawns (Conover 1991). Damage and the threat of damage associated with increasing populations of resident Canada geese are well documented (*e.g.*, see Mississippi Flyway Council Technical Section 1996, Gabig 2000, Atlantic Flyway Council 2011, Mississippi Flyway Council Technical Section 2017). Those potential impacts include damage to property. Damage to property can occur when geese congregate on lawns or mowed areas, including athletic fields, golf courses, lawns, and parks, as well as beaches and marinas, depositing their droppings and feathers (Mississippi Flyway Council Technical Section 1996, Gabig 2000, Atlantic Flyway Council 2011).

In the fall and winter, American crows often form large roosting flocks in urban areas. American crows typically roost in trees and they tend to concentrate in areas where abundant food and roosting sites are available. Adaptation to human industrialization and agricultural expansion has allowed the American crow to expand its home range since the 1800s (Emlen 1940, Marzluff et al. 1994). The socialization of corvids, such as American crows, has further increased the prevalence of crows across urban sprawls by attracting populations to metropolitan epicenters and residential neighborhoods (Hogrefe et al. 1998). In the United States, some crow roosts may reach a half-million birds (Verbeek and Caffrey 2020). These large flocks disperse to different feeding areas during the day. Crows can fly six to 12 miles from a roost to a feeding site each day (Johnson 1994). Large fall and winter crow roosts may cause serious problems in some areas particularly when located in towns or other sites near people. Such roosts are objectionable because of the odor of the bird droppings, health concerns, noise, and damage to trees in the roost.

Turf, flowers, other ornamental plants, and trees are often damaged from excessive feeding or fecal accumulations by bird species, such as Canada geese, mallard ducks, feral waterfowl, American coots, starlings, crows, cattle egrets, and vultures. Costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, loss of property use, loss of aesthetic value of flowers, gardens, and lawns consumed by waterfowl, loss of customers or visitors irritated by walking in or breathing the fumes of fecal droppings, repair of golf greens, replacing grazed turf, and costs of implementing non-lethal wildlife management methods. The TWSP has conducted an annual average of 10 work tasks with damage valued at $13,945 from FY 2017 through FY 2019 involving damage to landscape (see Table 1.4).

Damage to Pets and Zoo Animals

Although uncommon, Pets and zoo animals can be harassed, injured, and predated by certain predatory bird species. Species, such as corvids and raptors, including black vultures and great horned owls, will attack and kill small pets, such as cats and little dogs. Some species of birds, such as crows, mockingbirds, and kites endlessly harass pets, especially where they are defending a nesting territory. They typically swoop upon pets, such as small dogs, causing them to bark incessantly. Zoo animals, especially birds in outdoor aviaries, are susceptible to many diseases transmitted by birds, such as avian tuberculosis and streptococcus. From FY 2017 through FY 2019, the TWSP conducted an annual average of 16 work tasks associated with protecting pets and zoo animals. People reported or the TWSP verified an average of $47,047 in damage to pets and zoo animals per year from FY 2017 through FY 2019 (see Table 1.4).

Damage to Other Property and Structures

Similar damages as discussed above from many of the same bird species can occur to a variety of other structures and property. Swimming pools, bridges, refineries, beaches, food items, clothes, and more can all be damaged by birds. Businesses are often concerned about the negative aesthetic appearance of their property caused by excessive droppings and are sensitive to comments by clients and guests. As discussed, costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, implementation of methods to alleviate bird damage, and loss of property use, but these costs are generally not included in damage estimates. The TWSP conducted an annual average of 53 work tasks involving bird damage to other property and structures. People reported or the TWSP verified an average of $262,310 in damage to other property and structures per year from FY 2017 through FY 2019 (see Table 1.4).

Large numbers of gulls can be attracted to landfills as they often use landfills as feeding and loafing areas throughout the year, while attracting larger populations of gulls during migration periods (Mudge and Ferns 1982, Patton 1988, Belant et al. 1995, Belant et al. 1998, Gabrey 1997, Bruleigh et al. 1998, Lowney et al. 2018). Landfills may be contributing to the increase in gull populations (Verbeek 1977, Patton 1988, Belant and Dolbeer 1993). Gulls that visit landfills may loaf and nest on nearby rooftops, causing health concerns and structural damage to buildings and equipment. Bird conflicts associated with landfills include accumulation of feces on equipment and buildings, distraction of heavy machinery operators, and the potential for birds to transmit disease to workers on the site. The tendency for gulls to carry waste off site results in accumulation of feces and deposition of garbage in surrounding industrial and residential areas which creates a nuisance, as well as generates the potential for birds to transmit disease to neighboring residences.

Severe grazing can result in the loss of turf that stabilizes soil on manmade levees. Heavy rains on the bare soil of levees can result in erosion, which would not have occurred if the levee had been vegetated. Large concentrations of waterfowl have affected water quality around beaches and in wetlands by acting as nonpoint source pollution. There are four forms of nonpoint source pollution: sedimentation, nutrients, toxic substances, and pathogens. Large concentrations of waterfowl can remove shoreline vegetation resulting in erosion of the shoreline and soil sediments being carried by rainwater into lakes, ponds, and reservoirs.

In many areas of the West, the common raven is seen as an indicator of human disturbance, being closely associated with garbage dumps, sewage ponds, highways, agricultural fields, urbanization, and other human-altered landscapes (Boarman 1993, Restani and Marzluff 2001). Adaptability, predacious habits, and ability to use resources provided by human activities have benefitted the raven population. Supplemental feeding sources such as garbage, crops, and road-killed animals have afforded ravens an advantage over other not-so-opportunistic feeders and has allowed the raven population to increase precipitously in some areas (Liebezeit and George 2002). Non-agricultural property damage complaints received by the TWSP involving common ravens have included damage to electrical lines, power outages, buildings, landscaping, and other structures. Health related complaints involving common ravens have included turning garbage containers over and strewing its trash, and carrying trash from landfills into nearby residential areas.

1.2.4 Need to Resolve Bird Damage Occurring to Natural Resources

Birds can also negatively affect natural resources through habitat degradation, competition with other wildlife, and through direct depredation of natural resources. Habitat degradation can occur when large concentrations of birds in a localized area negatively affect characteristics of the surrounding habitat, which can adversely affect other wildlife species and can be esthetically displeasing. Direct depredation occurs when predatory bird species feed on other wildlife species, which can negatively influence those species' populations, especially when depredation occurs on threatened and endangered (T&E) species. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites. From FY 2017 through FY 2019, the TWSP conducted an average of 11 work tasks per year involving bird damage and threats of damage to natural resources. People report or the TWSP verified an average of $18,833 in damages per year to natural resources in Texas from FY 2017 through FY 2019, primarily damage to trees (see Table 1.5).

Table 1.5 - The number of requests for assistance and value of damage caused by birds in Texas as reported to or verified by TWSP from FY 2017 to FY 2019 for natural resources.

CATEGORY	FY 2017		FY 2018		FY 2019		Ave.	
	WTs	$ Value	WTs	$ Value	WTs	$ Value	WTs	$ Value $
T&E Wildlife	6	-	14	-	27	-	7	-
Other Wildlife	3	-	-	-	-	-	1	-
Fisheries	2	$5,000	-	-	2	$500	1	$1,833
Trees	6	$51,000	-	-	-	-	2	$17,000
TOTAL	**17**	**$56,000**	**14**	**-**	**29**	**$500**	**11**	**$18,833**

WTs = Work Tasks – activities associated with a request
1 - Species that commonly roost or feed together are often combined in the MIS
2 - Several species do not have MIS codes and are lumped in another category

Damage and Threats of Damage to T&E, Sensitive, and Other Wildlife Species

The TWSP could receive requests for assistance to reduce damage or threats of damage to T&E species and/or other species of concern. For example, brood parasitism by brown-headed cowbirds may be a concern for wildlife professionals where those birds are plentiful. Somewhat unique in their breeding habits, brown-headed cowbirds are known as brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 2020). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, 144 species of which have actually raised cowbird young (Lowther 2020). The raising of cowbird young occurs by the host species because brown-headed cowbirds provide no parental care. Young cowbirds often out-compete the young of the host species (Lowther 2020). Due to this, brown-headed cowbirds can have adverse effects on the reproductive success of other species (Lowther 2020) and can threaten the viability of a population or even the survival of a host species (Trail and Baptista 1993).

Historically, the TWSP has provided assistance with reducing the risk of brown-headed cowbirds laying eggs in the nests of black-capped vireos and golden-cheeked warblers. Nests of the vireo and warbler, as well as the southwestern willow flycatcher, are frequently parasitized by brown-headed cowbirds. The cowbirds lay their eggs in active nests of other bird species. The cowbird eggs hatch first, much quicker than the native songbirds, and the young are cared for by the host bird as if they were its own. By the time the host birds' own eggs hatch, the cowbird young are larger and out-compete the host birds' young for food and frequently push them out of the nest. With endangered bird species, such parasitism can cause enough nest failures to jeopardize the host species. The removal of brown-headed cowbirds from nesting habitat of the vireos and warblers has been successful in increasing local populations of these T&E species. For example, managing brown-headed cowbirds in areas where black-capped vireos nest can reduce nest parasitism rates and increase fledgling success (USFWS 2018).

As their range expansion in North America demonstrates, European starlings are highly adaptable and occur in a wide range of habitats; however, they are most often associated with disturbed areas created by people (Homan et al. 2017, Cabe 2020). European starlings are aggressive cavity nesters that can evict native cavity nesting species (Homan et al. 2017, Cabe 2020). In the absence of natural cavities, European starlings will nest in structures, such as streetlights, mailboxes, and attics. Although few conclusive studies exist, evidence suggests European starlings can have a detrimental effect on native species (Homan et al. 2017, Cabe 2020). Miller (1975) and Barnes (1991) reported starlings were responsible for a severe depletion of the eastern bluebird population due to nest competition.

Nest competition by starlings has also been known to adversely impact American kestrels (Nickell 1967, Von Jarchow 1943, Wilmer 1987, Bechard and Bechard 1996), red-bellied woodpeckers, Gila woodpeckers (Ingold 1994, Kerpez and Smith 1990), and wood ducks (Shake 1967, Heusmann et al. 1977, Grabill 1977, McGilvery and Uhler 1971). Weitzel (1988) reported 9 native species of birds in Nevada had been displaced by starling nest competition, and Mason et al. (1972) reported starlings evicting bats from nest holes.

Prairie-chickens were once common birds in parts of Texas. The lesser prairie-chicken is found in the panhandle and the Attwater's greater prairie-chicken is found along the Gulf Coast. A lack of quality habitats, along with other factors have contributed to over a 90% decline in prairie-chicken numbers over time. The lesser prairie-chicken is currently at a critical period for long-term survival (Hagen 2003). In 2014, the species was listed as a threatened species under the Endangered Species Act (ESA), but in 2016 the USFWS removed the bird from the list to comply with a court order. Some research has shown that management of predator species, including predatory birds, in fragmented habitat can enhance prairie-chicken recruitment (Schroeder and Baydack 2001). Primary predators of lesser prairie-chickens are red-tailed hawks, rough-legged hawks, Ferruginous hawks, prairie falcons, great horned owls, golden eagles, and northern harriers.

Crows and gulls consume a variety of food items, including the eggs and chicks of other birds (Pollet et al. 2020, Verbeek and Caffrey 2020, Weseloh et al. 2020). They are among the most frequently reported avian predators of colonial nesting waterbirds in the United States (Frederick and Collopy 1989). Gulls can displace other colonial nesting birds (Hunter et al. 2006). For example, gulls nesting on islands can displace piping plovers and removing gulls may effectively increase the number of piping plovers nesting on an island (USFWS 2016*a*, USFWS 2020*a*). Some of the species listed as threatened or endangered under the ESA are preyed upon or otherwise could be adversely affected by certain bird species. Impacts on the productivity and survivorship of rare or threatened colonial waterbirds can be severe when nesting colonies become targets of avian predators. Fish eating birds such as egrets, herons, and osprey also have the potential to impact local fish and amphibian populations, especially those of threatened or endangered species. Additionally, high raven numbers potentially represent a threat to nesting waterfowl, upland gamebirds, Neotropical songbirds, and T&E species or other sensitive wildlife. The raven has been implicated as a causative factor in the declines of several T&E species, including desert tortoise (*Gopherus agassizi*), California condor, marbled murrelet, and least tern (Liebezeit and George 2002, Boarman and Heinrich 2020).

The TWSP may enter in agreements to protect T&E species that have birds identified as being a limiting factor for reasons identified above. For example, Texas wild rice (*Zizania texana*) has been severely depleted and overgrazing by waterfowl has been identified as a problem. Sea turtles nest along coastal beaches and hatchlings are easily predated by gulls and other coastal predatory birds. If the USFWS, the Texas Parks and Wildlife Department (TPWD), or other management agency requests the TWSP to assist with resolving a bird associated problem, the TWSP could enter into an MOU and assist with such a program.

Damage and Threats of Damage to Fisheries

Recreational fisheries are important to the economy of Texas with $3.2 billion in annual fishing expenditures (USFWS and United States Department of Commerce 2006). Several species of birds can cause damage to fisheries, including the double-crested cormorant. The TWSP has historically received requests for assistance to manage bird damage to fisheries. From FY 2017 through FY 2019, the TWSP has conducted an average of only 1 work task per year involving bird damage to fisheries in Texas. People reported or the TWSP verified an average of $1,833 in damage to fisheries from FY 2017 through FY 2019 (see Table 1.5), mostly from double-crested cormorants.

Damage and Threats of Damage to Other Natural Resources

Birds can cause damage or pose threats of damage to several other natural resources, including trees, water quality, beaches, and recreational areas. A common concern among members of the public is the loss of trees to heron/egret/cormorant rookeries, and vulture, starling, crow, and blackbird roosts. These species nest or roost in trees and the excessive fecal output at the local site eventually kills the trees. Where these sites are located near urban areas and recreational, sites such as swimming areas, the concern is often increased. The dead trees can equate to a loss of aesthetic value. The TWSP conducted an average of two work tasks per year to protect trees from bird damage from FY 2017 through FY 2019. People reported or the TWSP verified an average of $17,000 in damage per year to trees associated with birds from FY 2017 through FY 2019 (see Table 1.5).

Cattle egrets form gregarious nesting colonies, or heronries, generally in medium to tall upland trees found in woodlands, swamps, and wooded islands adjacent to water. However, proximity to water is not a requirement of egret nesting sites with many heronries located in or near residential areas (Telfair II 2020). The accumulation of guano under heronries can defoliate and kill vegetation (Telfair II 2020). Telfair II and Bister (2004) noted that the composition of vegetation under heronries rapidly changed within two- to three-years after the establishment of a cattle egret heronry in Texas due to large concentrations of feces. Similarly, a study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979). Nesting colonies of double-crested cormorants can also have an impact on vegetation and change soil characteristics (Rush et al. 2011, Lafferty et al. 2016, Veum et al. 2019).

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

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

1.3 NATIONAL ENVIRONMENTAL POLICY ACT AND WS' DECISION-MAKING

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

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

1.3.1 Complying with the National Environmental Policy Act

To comply with the NEPA and Council on Environmental Quality regulations, WS, as part of the TWSP, is preparing this Environmental Assessment (EA) to evaluate alternative approaches of achieving the objectives of WS and to determine whether the potential environmental effects caused by the alternative approaches might be significant, requiring the preparation of an Environmental Impact Statement (EIS). As described by the Council on Environmental Quality (2007), the intent of an EA is to provide brief but sufficient evidence and analysis to determine whether to prepare an EIS, aid in complying with the NEPA when an EIS is not necessary, and to facilitate preparation of an EIS when one is necessary. The Council on Environmental Quality (2007) further states, "*The EA process concludes with either a Finding of No Significant Impact…or a determination to proceed to preparation of an EIS*". WS developed this EA under the 1978 NEPA regulations and existing APHIS NEPA implementing procedures because WS initiated this EA prior to the NEPA revisions that went into effect on September 14, 2020.

1.3.2 Rationale for Preparing an EA Rather Than an EIS

One comment that WS often receives during the public involvement process associated with the development of an EA is that WS should have prepared an EIS instead of an EA or that proposed activities require the development of an EIS. As discussed in Section 1.3.1, the primary purpose for developing an EA is to determine if the alternative approaches developed to meet the need for action could potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS (see 40 CFR 1501.4, 40 CFR 1508.9(a)(3)). WS, as part of the TWSP, prepared this EA so that WS can make an informed decision on whether or not an EIS would be necessary if WS implemented the alternative approaches to meeting the need for action.

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

If WS decides that implementation of a selected alternative approach would have a significant impact on the quality of the human environment based on this EA, WS would publish a Notice of Intent to prepare an EIS. This EA would be the foundation for developing that EIS in accordance with the 1978 NEPA implementing regulations of the Council on Environmental Quality (40 CFR 1508.9(a)(3)).

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

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

Another major purpose of the NEPA is to include other agencies and the public during the planning process to support informed decision-making. Prior to making and publishing the decision[5] to conclude this EA process, WS will make this EA available to the public, agencies, tribes, and other interested or affected entities for review and comment. Making the EA available to the public, agencies, tribes, and other interested or affected entities during the planning process will assist with understanding applicable issues and reasonable alternative means to meeting the need for action (see Section 1.2) and to ensure that the analyses are complete for informed decision-making. WS will proceed under the 1978 regulations and existing APHIS procedures as this EA was initiated prior to the September 14, 2020 NEPA revisions.

Based on agency relationships, Memorandum of Understandings, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Section 1.5 discusses the roles and responsibilities of agencies related to activities discussed in this EA. As discussed in Section 1.2, WS receives requests for assistance associated with many bird species in Texas. The USFWS and the TPWD have regulatory authority over many of those bird species and the activities of the TWSP involving the take of certain bird species would require authorization from the USFWS and/or the TPWD prior to the TWSP conducting activities. In addition, WS would be subject to any conditions associated with the authorizations given by the USFWS and/or the TPWD. Therefore, the take of many bird species to alleviate damage or reduce threats of damage would only occur at the discretion of the USFWS and/or the TPWD.

Based on the scope of this EA, a decision to be made is should activities to manage bird damage in Texas, as currently implemented, be continued? If not, how can the TWSP best fulfill its legislative responsibilities for managing bird damage in the state? When providing assistance with managing bird damage, what operating procedures should the TWSP implement to minimize potential impacts? In addition, would activities conducted when providing assistance have significant effects on the human environment requiring the preparation of an EIS?

1.3.4 Public Involvement

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

The TWSP will coordinate the preparation of this EA with consulting partner agencies and tribes to facilitate planning, to promote interagency and tribal coordination, and to incorporate agency and tribal expertise, which includes the TPWD. The TWSP has asked each consulting agency to review the draft

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

EA and provide input and direction to the TWSP to ensure proposed activities would comply with applicable federal and state regulations and policies, federal land management plans, Memorandum of Understandings, and cooperative agreements.

1.3.5 Period for which this EA is Valid

If the TWSP determines that the analyses in this EA indicate that an EIS is not warranted, this EA remains valid until the TWSP determines that new or additional needs for action, changed conditions, new issues, and/or new alternatives having different environmental impacts need to be analyzed to keep the information and analyses current. At that time, this analysis and document would be reviewed and, if appropriate, supplemented if the changes would have "*environmental relevance*" (40 CFR 1502.9(c)), or a new EA prepared pursuant to the NEPA.

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

1.4 SCOPE OF ANALYSIS

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

Many of the bird species that cause damage or pose a threat of damage occur statewide and may occur throughout the year in Texas. Birds are dynamic and mobile; therefore, damage and threats of damage caused by birds can occur wherever those bird species occur in the state. Birds could occur in and around commercial, industrial, public, and private buildings, facilities, and properties where birds may roost, loaf, feed, nest, or otherwise occur. Examples of areas where birds occur include, but are not necessarily limited to, residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, and schools. Activities could also occur in and around agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, military bases, or at any other sites where birds may roost, loaf, or nest. Target bird species could occur in and around agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, grain mills, and grain handling areas (*e.g.*, railroad yards) where birds destroy crops, feed on spilled grains, or contaminate food products for human or livestock consumption. Additionally, target bird species could occur at airports and surrounding properties where birds represent a threat to aviation safety.

Responding to requests for assistance falls within the category of actions in which the exact timing or location of individual requests for assistance can be difficult to predict with sufficient notice to describe accurately the locations or times in which the TWSP could reasonably expect to be acting. Although the TWSP could predict some of the possible locations or types of situations and sites where some requests for assistance could occur, the TWSP cannot predict the specific locations or times at which affected resource owners would determine that damage had become intolerable to the point that they request assistance from the TWSP. The TWSP must be ready to provide assistance on short notice anywhere in

Texas when receiving a request for assistance. Therefore, the geographic scope of the actions and analyses in this EA is statewide and this EA analyzes actions that could occur on federal, tribal, state, county, city, and private lands, when requested. However, the TWSP would only provide assistance when the appropriate property owner or manager requested such assistance and only on properties where the TWSP and the appropriate property owner or manager has signed a work initiation document.

The analyses in this EA would apply to any actions that the TWSP may conduct to alleviate damage caused by bird species in any locale and at any time within Texas when the TWSP receives a request for such assistance from the appropriate property owner or property manager. The standard WS Decision Model (see WS Directive 2.201; Slate et al. 1992) would be the site-specific procedure for individual actions conducted by the TWSP in the state (see Chapter 2 for a description of the WS Decision Model and its application). The WS Decision Model is an analytical thought process used by personnel with the TWSP for evaluating and responding to requests for assistance. If the TWSP determines that the analyses in this EA do not warrant the preparation of an EIS, the decisions made by personnel with the TWSP using the model would be consistent with the alternative approach that the TWSP selects to meet the need for action. In addition, decisions made using the model would be in accordance with WS' directives as well as relevant laws and regulations.

The TWSP recognizes that wildlife is a key component of Native American culture and beliefs. The exact nature of this relationship and role varies among tribes and individuals within tribes. The TWSP would only conduct activities on tribal lands at the request of the Tribe and only after the TWSP and the Tribe sign an appropriate written agreement that allows the TWSP to conduct activities on their tribal lands. The TWSP has not been requested to provide assistance to manage bird damage on tribal lands in Texas. Those methods discussed and described in this EA would be available to manage bird damage on tribal lands; however, the TWSP would only use those methods allowed by the Tribe. Because tribal officials would determine when assistance from the TWSP was required and what methods the TWSP could use, no conflict with traditional cultural properties or beliefs is anticipated.

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

1.5 AGENCIES INVOLVED IN THIS EA AND THEIR ROLES AND AUTHORITIES

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

1.5.1 Texas A&M AgriLife Extension-Wildlife Services Legislative Authority

The Federal Smith-Lever Act of 1914 (7 USC 341 et seq.) authorizes and provides for the conduct of cooperative extension work in agriculture and related subjects by the land-grant colleges and universities in several states where the USDA is cooperating with that state. The Texas Legislature accepted the provisions of this Act in 1915 with the passing of House Concurrent Resolution No. 2 and designated Texas A&M University as the institution to receive and administer funds made available under the Smith-Lever Act. The TWSP is a unit within the Texas A&M University System, Texas AgriLife Extension

Service. The Legislature authorized the State of Texas to cooperate through the Texas A&M University System with the appropriate federal officers and agencies in the control of predatory animals and rodent pests and placed responsibility for administering the Act with the Director of the TWSP (Texas Health and Safety Code, Ch. 825, Subch. A). Through cooperative agreements, state and federal employees jointly conduct activities to manage wildlife damage in Texas, including damage caused by birds, under the cooperative TWSP.

1.5.2 United States Fish and Wildlife Service

The USFWS is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife resources and their habitats. The USFWS shares responsibility with other federal, tribal, state, and local entities. However, the USFWS has specific responsibilities for the protection of threatened and endangered species under the ESA, migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources, such as the National Wildlife Refuge System.

1.5.3 United States Environmental Protection Agency

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

1.5.4 Texas Parks and Wildlife Department

The TPWD has the primary responsibility to protect the State's fish and wildlife resources as directed in the Texas Statutes (Titles 1-7) and as authorized by the USFWS under the Migratory Bird Treaty Act, including resident and migratory bird species.

1.5.5 Texas Department of Agriculture

In Texas, pesticide use and regulation occur within the Texas Department of Agriculture. Before a person can use or sell a pesticide in Texas, the Texas Department of Agriculture must approve the use of the product. The registration and approval of pesticides by the Texas Department of Agriculture ensures products meet all state and federal requirements to provide for both human and environmental protection.

1.6 DOCUMENTS RELATED TO THIS EA

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

1.6.1 Resident Canada Goose Management Final Environmental Impact Statement

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

1.6.2 Light Goose Management Final Environmental Impact Statement

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

1.6.3 Double-crested Cormorant Management Final Environmental Impact Statement

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

1.6.4 Bird Damage Management Environmental Assessment Developed by the TWSP

In 2013, the TWSP previously developed an EA that analyzed the need for action to manage damage associated with bird species. That EA identified the issues associated with managing damage associated with bird species in the state and analyzed alternative approaches to meet the specific need identified in the EA while addressing the identified issues. Changes in the need for action and the affected environment have prompted the TWSP to initiate this new analysis to address damage management activities in the state. This new EA will address more recently identified changes and will assess the potential environmental effects of program alternatives based on the current need for action. Because this EA will re-evaluate activities conducted under the 2013 EA, the outcome of the Decision issued based on the analyses in this EA will supersede the 2013 EA that addressed birds.

1.7 STATE AND FEDERAL REGULATIONS THAT COULD APPLY TO TWSP ACTIVITIES

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

1.7.1 Federal regulations that could apply to activities conducted by the TWSP

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

Endangered Species Act

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

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

The Migratory Bird Treaty Act (MBTA) makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). A list of bird species protected under the MBTA occurs in the CFR at 50 CFR 10.13. The MBTA also provides the USFWS regulatory authority to protect families of migratory birds. The law prohibits any "*take*" of migratory bird species by any entities, except as authorized by the USFWS. Under permitting guidelines in the MBTA, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the MBTA. In addition, the USFWS may establish depredation/control orders for migratory birds that allow people to take bird species without the need for a depredation permit when those species cause damage. Information regarding migratory bird permits and depredation/control orders occurs in 50 CFR 13 and 50 CFR 21, respectively. The USFWS has the overall regulatory authority to manage populations of migratory bird species, while the TPWD has the authority to manage wildlife populations in the State of Texas.

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

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to take certain species of blackbirds, cowbirds, grackles, crows, and magpies when those species cause serious injuries to agricultural crops, horticultural crops, or livestock feed. In addition, a depredation permit is not required when those species cause a health hazard or cause structural property damage. A depredation permit is also not required to protect species designated as endangered, threatened, or a candidate species by a federal, state, and/or tribal government.

Control Order for Muscovy Ducks

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

Depredation/Control Orders for Canada Geese

As discussed previously, the USFWS developed an EIS to evaluate alternatives to address increasing resident goose populations across the United States and to reduce associated damage (USFWS 2005).

Canada geese are "*resident*" when they nest within the lower 48 states and the District of Columbia or that reside within the lower 48 states and the District of Columbia in the months of April, May, June, July, or August (see 50 CFR 20.11, 50 CFR 21.3) (Rusch et al. 1995, Ankney 1996). The USFWS selected an approach that established several depredation/control orders to manage damage associated with resident Canada Geese. When certain criteria are occurring, the depredation/control orders allow people to take resident Canada geese without the need for a depredation permit from the USFWS.

Under 50 CFR 21.49, airport authorities or their agents can lethally take resident Canada Geese at airports and military airfields without the need for a depredation permit when resident Canada geese are causing damage or posing a threat of damage to aircraft. The USFWS also established a Canada goose nest and egg depredation order that allows people to destroy the nests and eggs of those resident Canada geese causing or posing a threat to people, property, agricultural crops, and other interests without the need for a depredation permit once the participant has registered with the USFWS (see 50 CFR 21.50). The USFWS established a similar depredation order to manage damage to agricultural resources associated with Canada geese. Under 50 CFR 21.51, designated people can lethally remove resident Canada geese without a permit from the USFWS in those states designated, including Texas, when geese are causing damage to agricultural resources. Pursuant to 50 CFR 21.52, state agencies, tribes, and the District of Columbia can address resident Canada geese using lethal and non-lethal methods when those geese pose a direct threat to human health.

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

The Bald and Golden Eagle Protection Act and the MBTA protect the bald eagle and the golden eagle from a variety of harmful actions and impacts. Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of bald eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "*take*" includes actions that can "*molest*" or "*disturb*" eagles. For the purposes of the Act, under 40 CFR 22.3, the term "*disturb*" as it relates to take has been defined as "*to agitate or bother a Bald and Golden Eagles to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior*."

Federal Insecticide, Fungicide, and Rodenticide Act

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

National Historic Preservation Act

The National Historic Preservation Act and its implementing regulations (see 36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Section 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106.

The Native American Graves Protection and Repatriation Act of 1990

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

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

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

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

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

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

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

Invasive Species - Executive Order 13112 and Executive Order 13751

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. Executive Order 13751 amended Executive Order 13112 by clarifying the operations of the National Invasive Species Council and by expanding its membership. In addition, Executive Order 13751 incorporated additional considerations into federal efforts to address invasive species and to strengthen coordinated, cost efficient federal actions.

1.7.2 State regulations that could apply to TWSP activities

If the TWSP provides assistance to manage bird damage or the threat of damage, state regulations could also apply to the activities that the TWSP conducts. The following are the primary state regulations that could apply to activities conducted by the TWSP.

Title 10 Health and Safety Code

Subchapters 825.001 - 825.007. These statues of the Health and Safety Code establish the cooperative arrangement between WS and the Texas A&M University System and allows TWSP to operate as a cooperative program controlling predatory animals and rodents to protect livestock, food and feed supplies, crops, and ranges. The statutes also allows local governing bodies such as counties to enter into an agreement with TWSP. Section 825.007 specifically exempts personnel performing their duties under this subchapter from licensing requirements under Title 5 of the Parks and Wildlife Code.

Title 5 Parks and Wildlife Code

Subchapter 43.151-57. These statutes provide the permitting process to control protected wildlife, including T&E species that are causing damage or public health concerns.

Subchapter 43.154 (d). This statute requires landowners or their agents who wish to take birds on that person's land to relieve damage-related situations obtain a USFWS permit for migratory birds or a TPWD permit for protected resident birds for such activities.

Subchapter 64.002. This statute prohibits a person from catching, killing, injuring, pursuing, or possessing, dead or alive, or purchasing, selling, exposing for sale, transporting, shipping, or receiving or delivering for transportation, a bird that is not a game bird. In addition, people may take European starlings, house sparrows, and rock pigeons at any time in any manner, including their nests and eggs. A permit is also not required to take yellow-headed, red-winged, rusty, or Brewer's blackbirds or all grackles, cowbirds, crows, or magpies when found committing or about to commit depredations on ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in numbers and in a manner that constitutes a health hazard or other nuisance.

Subchapter 68.001 - 68.021. Chapter 68 of the Parks and Wildlife Code established Texas' endangered species law equivalent to the ESA. The statute requires that Federally listed T&E species be placed on the list. In addition, on the basis of investigations on wildlife, other available scientific and commercial data and after consultation with wildlife agencies in other states, appropriate federal agencies, local and tribal governments and other interested persons and organizations, the commission director shall by regulation develop a list of those species of wildlife indigenous to the state that are determined to be threatened or endangered within Texas.

CHAPTER 2: ISSUES AND ALTERNATIVES

The TWSP has identified a need for action based on requests for assistance that the TWSP receives to manage damage caused by birds in the state (see Section 1.2). The TWSP has identified several issues associated with the activities that the TWSP could implement to meet that need for action. Issues are concerns regarding potential effects that might occur from proposed activities. Federal agencies must consider such issues during the decision-making process required by the NEPA. Section 2.1 of this EA discusses the issues that the TWSP identified, which could occur from the implementation of alternative approaches to meet the need for action. Section 3.2 discusses additional issues that the TWSP identified; however, the EA does not analyze those issues in detail for the reasons provided in Section 3.2.

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

2.1 ISSUES USED TO DEVELOP THE ALTERNATIVE APPROACHES

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

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

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

The basis for the analysis to determine the magnitude of impacts on the populations of those target bird species addressed in this EA from the use of lethal methods would be a measure of the number of individuals lethally removed in relation to that species abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations may rely on population estimates, allowable removal levels, and actual removal data. Qualitative determinations may rely on population trend data, when available. The TWSP would monitor the annual take of target bird species by comparing the number of birds lethally removed with overall populations or trends. Personnel with the TWSP would only use lethal methods at the request of a cooperator seeking assistance. In addition, the take of those migratory bird species protected pursuant to the MBTA would only occur after the USFWS and the TPWD authorized the take. For those bird species not protected by the MBTA that are managed by the TPWD (*e.g.*, wild turkeys), lethal take by the TWSP would only occur when authorized by the TPWD.

In addition, people can harvest some of the bird species addressed in this EA during annual hunting seasons in the state, such as waterfowl species. A concern is that damage management activities conducted by the TWSP would affect the ability of people to harvest those bird species during the regulated hunting seasons either by reducing local populations through the lethal removal of birds or by reducing the number of birds present in an area through dispersal techniques. Therefore, any activities conducted by the TWSP under the alternatives addressed would be occurring along with other natural processes and human-induced events, such as natural mortality, human-induced mortality from private damage management activities, mortality from regulated harvest, and human-induced alterations of wildlife habitat.

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

Breeding Bird Survey

The BBS is a large-scale inventory of North American birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2020). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. During the BBS, observers count birds at established survey points along roadways for a set duration along a pre-determined route. Survey routes are 24.5 miles long with the observer stopping every 0.5 miles along the route to conduct the survey. The observer records the number of birds seen and heard within 0.25 miles of each survey point during a 3-minute sampling period. A survey along the route occurs once per year. Surveys first occurred in 1966 and occur in June, which is generally the period of time when those birds present at a location are likely breeding in the immediate area. The BBS occurs annually in the United States and Canada, across a large geographical area, under standardized survey guidelines. Scientists monitor bird populations by using trend data derived from bird observations collected during the BBS. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. Hierarchical model analysis is the basis for the current population trends derived from BBS data (Link and Sauer 2002, Sauer and Link 2011) and are dependent upon a variety of assumptions (Link and Sauer 1998).

Christmas Bird Count

Numerous volunteers conduct the CBC annually in December and early January under the guidance of the National Audubon Society. The CBC reflects the number of birds frequenting a location during the winter months. Survey data consists of the number of birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but the data can be an indicator of trends in a population over time. Researchers have found that population trends reflected in CBC data tend to correlate well with those from censuses taken by more stringent means (National Audubon Society 2020).

Partners in Flight Landbird Population Estimate

The BBS monitors the status of trends within North American bird populations, but it is also possible to use BBS data to develop a general estimate of the size of bird populations (Will et al. 2020). Using relative abundances derived from the BBS conducted from 2006 through 2015, the Partners in Flight (2020) extrapolated population estimates for many bird species in North America as part of the Partners in Flight Landbird Population Estimate database (see Will et al. 2020). The Partners in Flight system involves extrapolating the number of birds in the 50 quarter-mile circles (total area/route = 10 mi^2) surveyed during the BBS to an area of interest. The model used by the Partners in Flight (2020) makes assumptions on the detectability of birds, which can vary for each species (Stanton et al. 2019, Will et al. 2020). Some species of birds that are more conspicuous (visual and auditory) are more likely to be detected during bird surveys when compared to bird species that are more secretive and do not vocalize often. Therefore, the Partners in Flight Landbird Population Estimate database uses information on the detectability of a species to create a detectability factor, which may be combined with relative abundance data from the BBS to yield a population estimate (Rich et al. 2004, Blancher et al. 2013, Will et al. 2020).

Annual Harvest Data

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. The USFWS establishes frameworks for the migratory bird hunting seasons that the TPWD implements in the state.

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

The potential for effects on non-target species and threatened or endangered species arises from the use of non-lethal and lethal methods identified in the alternative approaches. The use of non-lethal and lethal methods has the potential to inadvertently exclude, disperse, capture, or kill non-target wildlife. A non-target animal would be an animal that personnel with the TWSP excludes, disperses, captures, or kills unintentionally while targeting a specific bird or group of birds. Appendix B describes the methods available for use under the alternative approaches. During the development of this EA, the TWSP considered potential impacts on T&E species in Texas, which Section 3.1.2 discusses in further detail.

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

An additional issue often raised is the potential risks to human health and safety associated with employing methods to manage damage caused by target species. Employees of the TWSP would use and recommend only those methods that were legally available, selective for target species, and were effective at resolving the damage associated with the target species. Still, some concerns exist regarding the safety of methods despite their legality, selectivity, and effectiveness. As a result, this EA will analyze the potential for proposed methods to pose a risk to members of the public and employees of the TWSP. Section 3.1.3 further evaluates the risks to human safety as this issue relates to the alternative approaches.

2.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

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

2.2 COMMON ACTIONS ASSOCIATED WITH DAMAGE MANAGEMENT ACTIVITIES

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

2.2.1 The Co-managerial Approach to Making Decisions Used by the TWSP

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

If a person and/or entity requested assistance from the TWSP and the TWSP was able to provide assistance, the TWSP would follow the "*co-managerial approach*" to alleviate damage or threats of damage as described by Decker and Chase (1997). Within this management model, the TWSP could provide technical assistance regarding the biology and ecology of target bird species and effective, practical, and reasonable methods available to a local decision-maker(s) to reduce damage or threats. Generally, a decision-maker seeking assistance would be part of a community, municipality, business, governmental agency, and/or a private property owner.

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

The decision-maker for the local community would be officials or representatives of the communities that residents of a community have elected to represent them. The elected officials or representatives would be people who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. In the case of private property owners, the decision-maker would be the individual that owns or manages the affected property. The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. If the TWSP implemented Alternative 4, the TWSP would not provide any assistance with managing the damage that birds can cause in the state; therefore, the co-managerial approach would not be applicable.

2.2.2 Availability of Methods to Manage Damage Caused by Birds

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

2.2.3 Effectiveness of Methods to Address Damage and Threats of Damage

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

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

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

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

If the TWSP implements Alternative 1, personnel with the TWSP could consider the use of an avicide known as DRC-1339, which could be applied as part of an integrated methods approach to managing damage or threats of damage. Like other methods, including non-lethal methods, the intent in using DRC-1339 is to reduce the number of birds present at a location where damage or threats of damage are occurring. Reducing the number of birds at a location where damage or threats of damage are occurring either using non-lethal methods or lethal methods can lead to a reduction in damage. The dispersal of birds using non-lethal methods can reduce the number of birds using a location, which can correlate to a reduction in damage at a location (Avery et al. 2008*a*, Chipman et al. 2008). Similarly, the use of lethal methods reduces the number of birds at a location by removing those birds identified as causing damage or posing a threat of damage. Similarly, the use of DRC-1339 can reduce the number of birds using a location. Boyd and Hall (1987) found the use of DRC-1339 to reduce local crow roosts by up to 25% could lead to a reduction in damage associated with those crows.

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

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

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

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

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

2.2.4 Research Methods and Information on the Life History of Birds

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

2.2.5 Authorization of Migratory Bird Take by the USFWS

As noted in Section 1.7.1, the MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). Most target bird species addressed in this EA are a migratory bird species protected by the MBTA (see 50 CFR 10.13), except native resident bird species (*e.g.*, wild turkey) and non-native species (*e.g.*, domestic waterfowl, house sparrows, European starlings). Pursuant to 50 CFR 21.41, "…*a depredation permit is required before any person may take, possess, or transport migratory birds for depredation control purposes. No permit is required merely to scare or herd depredating migratory birds other than endangered or threatened species or bald or golden eagles*". Therefore, prior to the use of lethal methods to alleviate damage or threats of damage associated with a migratory bird species, any entity, including the TWSP, must apply for and receive a depredation permit from the USFWS. In general, the dispersal (*i.e.*, scaring) of birds from an area using non-lethal methods would not require an entity to apply for and receive a depredation permit. A depredation permit is also not required to destroy inactive nests (*i.e.*, nests without eggs or nestlings). Under the permitting application process for a depredation permit, the USFWS requires applicants to describe prior non-lethal damage management techniques that they have used.

The USFWS can also authorize the take of migratory birds by establishing depredation orders, control orders, and other permitting processes. The USFWS has created depredation and control orders that allow the take of specific species of migratory birds for specific purposes without the need for a depredation permit. For example, the USFWS has established a depredation order that allows people to take specific species of blackbirds, cowbirds, grackles, and crows for specific purposes without the need for a depredation permit from the USFWS (see 50 CFR 21.43). Section 1.7.1 discusses the depredation and control orders that could apply to activities conducted by the TWSP.

2.2.6 Authorization of Take by the TPWD

The TWSP may also need authorization from the TPWD to address damage and threats of damage caused by certain bird species because most birds in Texas are also managed and protected by laws regulated by the TPWD. For example, the TWSP may need authorization from the TPWD to live-capture and translocate wild turkeys to alleviate damage or threats of damage.

2.2.7 Influence of Global Climate Change on Bird Populations

The State of the Climate in 2012 report indicates that every year has been warmer than the long-term average since 1976 (Blunden and Arndt 2013). Impacts of this change will vary throughout the United States, but some areas could experience air and water temperature increases, alterations in precipitation, and increased severe weather events. Temperature and precipitation often influence the distribution and abundance of a plant or animal species. According to the EPA (2016), as temperatures continue to increase, the ranges of many species will likely expand into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g.*, less snowfall, range expansions of other species). Sheikh et al. (2007) stated, "*Wildlife species can be affected by several climatic variables such as increasing temperatures, changes in precipitation, and extreme weather events*". Sheikh et al. (2007) further stated that changes in climate could benefit some species of wildlife.

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

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

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

Monitoring conducted by the TWSP would also include reviewing the list of species the USFWS considers as threatened or endangered within the state pursuant to the ESA. As appropriate, the TWSP would consult with the USFWS pursuant to Section 7 of the ESA to ensure the activities conducted by the TWSP would not jeopardize the continued existence of threatened or endangered species or result in adverse modification to areas designated as critical habitat for a species within the state. Through the review of species listed as threatened or endangered and the consultation process with the USFWS, the TWSP can evaluate and adjust activities conducted to meet the need for action. Accordingly, the TWSP could supplement this analysis or conduct a separate evaluation pursuant to the NEPA based on the review and consultation process. If deemed necessary through the monitoring process, the TWSP could adjust activities to assure that actions conducted by the TWSP do not significantly contribute to changes in the environmental status quo that occur because of climate change.

2.2.8 Impacts of Avian Influenza on Bird Populations

A virus in the Orthomyxovirus group causes avian influenza. Viruses in this group vary in the intensity of illness (*i.e.*, virulence) they may cause. Wild birds, in particular waterfowl and shorebirds, can be natural reservoirs for the avian influenza virus (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2012). Most strains of the avian influenza virus rarely cause severe illness or death in birds, although some strains tend to be highly virulent and very contagious. However, even the strains that do not cause severe illness in birds are a concern for human and animal health officials because the viruses have the potential to become virulent and transmissible to other species through mutation and reassortment (Clark and Hall 2006).

There are two types of avian influenza viruses, low pathogenic and high pathogenic avian influenza. The low and high refer to the potential of the viruses to kill domestic poultry (Centers for Disease Control and Prevention 2017). In wild birds, low pathogenic avian influenza rarely causes signs of illness and it is not an important mortality factor (Davidson and Nettles 1997, Clark and Hall 2006). In contrast, high pathogenic avian influenza can cause clinical signs and lead to death in wild birds. Prior to 2014, high pathogenic strains were not known to occur in wild waterfowl species in North America (Brown et al. 2006, Keawcharoen et al. 2008, Centers for Disease Control and Prevention 2015).

In December 2014, a highly pathogenic avian influenza virus was isolated from a northern pintail (*Anas acuta*) in Washington State making it the first detection of highly pathogenic avian influenza virus in wild birds in North America (United States Geological Survey 2015). The detection in North America coincided with the detection of the virus in poultry across the western and central United States (USDA 2015*a*). The TWSP has been one of several agencies and organizations conducting surveillance and monitoring of avian influenza in migratory birds. Between December 20, 2014 and February 1, 2015, Bevins et al. (2016) reported 63 cases of highly pathogenic avian influenza virus in wild birds across the United States. All 63 cases involved detection of the virus in waterfowl that people harvested during the annual hunting season (Bevins et al. 2016). Although mortality events involving the highly pathogenic avian influenza virus have occurred in waterfowl, there have been no reports of major waterfowl die-offs from the virus. In addition, no reports of major die-offs of other bird species have occurred. Therefore, there is no evidence to suggest that the avian influenza virus is or will have an effect on bird populations. As stated previously, most strains of avian influenza do not cause severe illnesses or death in wild bird populations.

2.3 TWSP DIRECTIVES AND STANDARD PROCEDURES WHEN PROVIDING ASSISTANCE

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

Specific to Texas, the following operating procedures were developed to address concerns and minimize potential impacts to threatened or endangered bird species:

--No lethal bird damage management methods would be used within 2.5 miles of known aplomado falcon nests during the nesting season (March-September). The TWSP will consult with the USFWS annually to determine nesting sites.

--No use of mist nets in shorebird habitat during winter (November-March) season. If disease surveillance is necessary, the TWSP will consult with the USFWS regarding possible impacts to piping plovers or interior least terns and develop additional measures to prevent take of these species.

--No use of avicides in areas occupied by whooping cranes.

2.4 ALTERNATIVES THAT THE TWSP CONSIDERED

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

2.4.1 Alternatives Considered in Detail within this EA

As discussed in Section 1.2, people experiencing damage or threats of damage associated with wildlife often seek assistance from other entities to alleviate that damage or to prevent damage from occurring. WS is the lead federal agency responsible for managing conflicts between people and wildlife (see Section 1.2). Through cooperative agreements, state and federal employees jointly conduct activities to manage wildlife damage in Texas under the cooperative TWSP, including WS (see Section 1.5.1). Therefore, people could request assistance from the TWSP. This EA considers in detail the following four alternative approaches to meeting the need for action identified in Section 1.2 and those issues identified in Section 2.1.

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

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

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

1. **Receive Request for Assistance:** The TWSP would only provide assistance after receiving a request for such assistance. The TWSP would not respond to public bid notices.
2. **Assess Problem:** First, the TWSP would make a determination as to whether the assistance request was within the authority of the TWSP. If an assistance request were within the authority of the TWSP, TWSP employees would gather and analyze damage information to determine applicable factors, such as what species was responsible for the damage, the type of damage, the extent of damage, and the magnitude of damage. Other factors that TWSP employees could

gather and analyze would include the current economic loss or current threat (*e.g.*, threat to human safety), the potential for future losses or damage, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.

3. **Evaluate Management Methods:** Once a problem assessment was completed, a TWSP employee would conduct an evaluation of available management methods (see Appendix B). The employee would evaluate available methods in the context of their legal and administrative availability and their acceptability based on biological, environmental, humaneness, social, and cultural factors.
4. **Formulate Management Strategy:** A TWSP employee would formulate a management strategy using those methods that the employee determines to be practical for use. The TWSP employee would also consider factors essential to formulating each management strategy, such as available expertise, legal constraints on available methods, human safety, humaneness, non-target animal risks, costs, and effectiveness.
5. **Provide Assistance:** After formulating a management strategy, a TWSP employee could provide technical assistance and/or direct operational assistance to the requester (see WS Directive 2.101). All management actions conducted and/or recommended by the TWSP would comply with appropriate federal, state, and local laws in accordance with WS Directive 2.210.
6. **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, it is necessary to monitor the results of the management strategy. Monitoring would be important for determining whether further assistance was required or whether the management strategy resolved the request for assistance. Through monitoring, a TWSP employee would continually evaluate the management strategy to determine whether additional techniques or modification of the strategy was necessary.
7. **End of Project:** When providing technical assistance, a project would normally end after a TWSP employee provided recommendations or advice to the requester. A direct operational assistance project would normally end when TWSP personnel stop or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from TWSP personnel and may have no well-defined termination point.

Therefore, if the TWSP implements Alternative 1, the TWSP could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damage caused by birds, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The TWSP would provide technical assistance to those entities requesting assistance as described for Alternative 3. Direct operational damage management assistance would include damage management activities that TWSP personnel would conduct directly or supervise. TWSP employees may initiate operational damage management assistance when technical assistance alone would not effectively alleviate the damage or the threat of damage and when the TWSP and the entity requesting assistance have signed a work initiation document. Funding for TWSP activities could occur from state appropriations, federal appropriations, and/or from cooperative service agreements with an entity requesting TWSP assistance.

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

The initial investigation would define the nature, history, and extent of the problem; species responsible for the damage; and methods available to alleviate the problem. When evaluating management methods and formulating a management strategy, TWSP personnel would give preference to non-lethal methods when they determine those methods to be practical and effective (see WS Directive 2.101). For those migratory bird species protected by the MBTA, the TWSP would only use lethal methods, including egg destruction, after the USFWS and the TPWD authorized the lethal removal of the target migratory bird species and would only use those methods allowed in an authorization. The use of methods that live-capture migratory birds protected by the MBTA also require authorization from the USFWS and the TPWD; therefore, the TWSP would only use live-capture methods after the USFWS and the TPWD had issued the appropriate permit or authorization allowing capture of the target bird species (see Section 1.7.1, Section 1.7.2). Many non-native species, such as rock pigeons, European starlings, and house sparrows, do not require authorization from the USFWS or the TPWD to use lethal methods or live-capture methods. TWSP activities to manage damage associated with birds in Texas would comply with WS Directive 2.301.

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

Alternative 2 – WS would implement an integrated methods approach to managing damage caused by birds in Texas using only non-lethal methods

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

WS would refer requests for information regarding lethal methods to the USFWS, the Texas A&M AgriLife Extension Service, the Texas Wildlife Damage Management Association, the TPWD, and/or private entities. Although WS would not recommend or use lethal methods under this alternative, other entities, including the Texas A&M AgriLife Extension Service, the Texas Wildlife Damage Management Association, the TPWD, and/or private entities, could continue to use many of the lethal methods discussed in Section II of Appendix B to resolve damage or threats of damage. The USFWS could continue to authorize the lethal take of migratory birds protected by the MBTA. Similarly, the TPWD could continue to authorize the lethal take of bird species.

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

Under this alternative, the federal WS program would continue to participate as part of the TWSP; however, when people contacted personnel with the WS program, WS personnel would provide those people seeking assistance with technical assistance only. WS could also provide technical assistance to the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association and refer people requesting direct operational assistance to the Texas A&M AgriLife Extension Service and/or the Texas Wildlife Damage Management Association. The Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association could continue to provide technical assistance and direct operational assistance as described for Alternative 1.

If WS implements Alternative 3, WS would continue to use the WS Decision Model to respond to requests for assistance; however, WS would only provide those cooperators requesting assistance with technical assistance. Technical assistance would provide those cooperators experiencing damage or threats of damage associated with birds with information, demonstrations, and recommendations on available and appropriate methods available. The implementation of methods and techniques to alleviate or prevent damage would be the responsibility of the requester with no direct involvement by WS. In some cases, WS may provide supplies or materials that were of limited availability for use by private entities (*e.g.*, loaning of propane cannons). Similar to Alternative 1 and Alternative 2, a key component of assistance provided by WS would be providing information to the requester about birds and how to manage damage associated with target bird species.

Education would be an important component of technical assistance because wildlife damage management is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. When responding to a request for assistance, WS would provide those entities with information regarding the use of appropriate methods. WS would provide property owners or managers requesting assistance with information regarding the use of effective and practical techniques and methods. In addition to the routine dissemination of recommendations and information to individuals or organizations experiencing damage, WS could provide lectures, courses, and demonstrations to agricultural producers, homeowners, governmental entities, colleges and universities, and other interested groups. WS frequently cooperates with other entities in education and public information efforts. Additionally, WS personnel may present technical papers at professional meetings and conferences so that other wildlife professionals and the public receive updates on recent developments in damage management technology, programs, laws and regulations, and agency policies.

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

Generally, WS personnel would describe several management strategies to the requester for short and long-term solutions to managing damage based on the level of risk, need, and the practicality of their application. WS personnel would recommend and loan only those methods legally available for use by the appropriate individual. Those methods described in Appendix B would be available for other entities to manage damage or threats associated with birds in the state, except for DRC-1339, which is currently only available for use by WS personnel and by those persons under the direct supervision of WS personnel.

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

When conducting technical assistance, WS personnel could assist people experiencing damage caused by birds with the process for applying for their own depredation permit from the USFWS and/or seeking authorization from the TPWD. In accordance with WS Directive 2.301, WS personnel will assist people seeking assistance with applying for a depredation permit from the USFWS by completing a USFWS Migratory Bird Permit Application or Review form (WS Form 37). The USFWS Migratory Bird Permit Application or Review form provides the USFWS with the basic information required as part of the application process for a depredation permit, which includes information on the extent of the damages or risks, the number of birds involved, and recommended methods to alleviate damage (see 50 CFR 21.41 for required information). Following review by the USFWS of a complete application for a depredation permit from a property owner or manager and the USFWS Migratory Bird Permit Application or Review form, the USFWS could issue a depredation permit authorizing the lethal take of a specified number of birds and bird species.

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

This alternative would preclude any activities by the federal WS program to alleviate damage or threats of damage associated with those bird species addressed in the EA (*i.e.*, no federal involvement). WS would continue to cooperate with the TWSP; however, WS would not provide assistance with managing bird damage. The Texas AgriLife Extension Service and the Texas Wildlife Damage Management Association, as part of the TWSP, could continue to provide assistance with managing bird damage in the state. WS would refer all requests for assistance associated with target bird species to the TWSP (Texas AgriLife Extension Service and the Texas Wildlife Damage Management Association), to the USFWS, to the TPWD, and/or to private entities. This alternative would not prevent other governmental agencies and/or private entities from conducting damage management activities directed at alleviating damage and threats associated with birds in the state. Therefore, under this alternative, entities seeking assistance with addressing damage caused by those bird species addressed in this EA could contact WS but WS would immediately refer the requester to other entities. The requester could then contact other entities for information and assistance, could take actions to alleviate damage without contacting any entity, or could take no further action.

Many of the methods listed in Appendix B would be available for use by other governmental agencies and private entities to manage damage and threats associated with birds. The only method discussed in Appendix B that would not be available for other entities to use would be the avicide DRC-1339, which is only available for use by WS personnel and persons under their direct supervision. The avicide DRC-1339 is only available to alleviate damage associated with red-winged blackbirds, common grackles, brown-headed cowbirds, European starling, American crows, fish crows, rock pigeons, Eurasian collared-doves, and gulls.

2.4.2 Alternatives and Strategies that the TWSP Did Not Consider in Detail

In addition to those alternatives discussed in Section 2.4.1, the TWSP identified several additional alternative approaches to meeting the need for action. However, those alternatives will not receive detailed analysis in this EA for the reasons provided for each alternative. Those alternatives considered but not analyzed in detail include the following.

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

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

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

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

If WS implemented this alternative, WS would be required to implement non-lethal methods the entity requesting assistance had already used or would have to establish criteria to measure the efforts of the requesting entity to determine if the requesting entity applied non-lethal methods appropriately. For example, Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. Therefore, continuing to use methods already proven ineffective at alleviating the damage could prolong the amount of time damage occurs, which could increase the economic losses. Because many people that request assistance use non-lethal methods but continue to experience damage or threats of damage and because there is no standard that exists for the use of non-lethal methods, WS did not carry this alternative forward for further analysis in Chapter 3. In addition, implementation of Alternative 1 would be similar to a non-lethal before lethal alternative because TWSP personnel, including WS personnel, would consider the use of non-lethal methods before considering the use of lethal methods (see WS Directive 2.101). Adding a non-lethal before lethal alternative and the associated analysis would not add additional information to the analyses in this EA.

WS would implement Alternative 1 but would only use lethal methods

This alternative would be similar to Alternative 1 but WS would use only those methods that lethally remove birds. Under WS Directive 2.101, WS must consider the use of non-lethal methods before lethal methods. The USFWS also requires the use of non-lethal methods prior to issuing a depredation permit to take migratory birds. Non-lethal methods have been effective in alleviating some bird damage. For example, the use of non-lethal methods has been effective in dispersing urban crow roosts and vulture roosts (Avery et al. 2002, Seamans 2004, Avery et al. 2008*a*, Chipman et al. 2008). In those situations where damage could be alleviated using non-lethal methods, WS personnel could use those methods and/or recommend those methods as determined by the WS Decision Model. Therefore, WS did not consider this alternative in detail.

WS would develop a program that compensates people for damage

This alternative would require WS to establish a system to reimburse persons impacted by bird damage. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Compensation would require large expenditures of money and labor to investigate and validate damage claims and to determine and administer appropriate compensation. Compensation would most likely be below full market value. Compensation for damages would give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies and would not be practical for reducing threats to human health and safety. For the above listed reasons, WS did not carry this alternative forward for further analysis in Chapter 3.

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

There is also a concern that damage caused by animals should be a cost of doing business and/or that there should be a threshold of damage before allowing the use of lethal methods to manage damage. In some cases, cooperators likely tolerate some damage and economic loss until the damage reaches a threshold where the damage becomes an economic burden. The appropriate level of allowed tolerance or threshold before employing lethal methods would differ among cooperators and damage situations. In some cases, any loss in value of a resource caused by birds could be financially burdensome to some people. In addition, establishing a threshold would be difficult or inappropriate to apply to human health and safety situations. For example, aircraft striking birds could lead to property damage and could threaten passenger safety if a catastrophic failure of the aircraft occurred because of the strike. Therefore, addressing the threats of aircraft strikes prior to an actual strike occurring would be appropriate. For those reasons, WS did not carry this alternative forward for further analysis in Chapter 3.

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

This alternative would be similar to Alternative 1 or Alternative 2 except WS would require the entity requesting assistance to pay for any activities conducted by WS. Therefore, no activities conducted by WS would occur through federal appropriations (*i.e.*, no taxpayer money). Funding for WS' activities could occur from federal appropriations and/or through money received from the entity requesting assistance. In those cases where WS receives funding through money received from federal appropriations or from the entity requesting assistance, those entities have made the decision to provide funding for damage management activities and have allocated funds for such activities. Additionally, damage management activities are an appropriate sphere of activity for government programs because managing wildlife is a government responsibility. Treves and Naughton-Treves (2005) and the International Association of Fish and Wildlife Agencies (2005) discuss the need for wildlife damage management and that an accountable government agency is best suited to take the lead in such activities because it increases the tolerance for wildlife by those people being impacted by their damage and has the least impacts on wildlife overall. Therefore, WS did not carry this alternative forward for further analysis in Chapter 3.

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

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

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

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

Trap and translocate birds only by WS

Under this alternative, WS would address all requests for assistance using live-capture methods or the recommendation of live-capture methods. Birds could be live-captured using live-traps, cannon nets, rocket nets, bow nets, net guns, mist nets, or hand-capture. All birds live-captured through direct operational assistance by WS would be translocated. Prior to live-capture, WS personnel would identify a release site or sites and obtain approval from the appropriate property owner and/or manager to release birds on their property or properties. In addition, the translocation of most bird species requires prior authorization from the USFWS and/or the TPWD. For example, WS would need prior approval from the TPWD to live-capture and translocate wild turkeys within the state. WS could translocate birds if WS implemented Alternative 1 or Alternative 2. Other entities could translocate birds to alleviate damage if WS implemented Alternative 3 or Alternative 4.

Translocation may not be appropriate for all bird species. For example, it may be inappropriate to translocate and release non-native bird species in the state. In addition, the translocation of birds causing damage or posing a threat of damage to other areas following live-capture generally would not be effective or cost-effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, the same species of birds generally already occupy habitats in other areas, and translocation would most likely result in bird damage problems at the new location. In addition, WS would need to capture and translocate hundreds or thousands of birds to solve some damage problems (*e.g.*, urban crow roosts); therefore, translocation would be unrealistic in those circumstances. Translocation of wildlife is also discouraged by WS policy (see WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, the potential for disease transmission, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988, Craven et al. 1998, Massei et al. 2010). Therefore, WS did not consider this alternative in detail.

Reducing damage by managing bird populations through the use of reproductive inhibitors

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

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

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

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

CHAPTER 3: ENVIRONMENTAL EFFECTS

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

3.1 ISSUES CONSIDERED IN DETAIL AND THEIR IMPACTS BY ALTERNATIVE

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

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

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

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

Direct effects are impacts the action causes and occur at the same time and place. Indirect effects occur because of the action but are later in time or farther removed in distance. Indirect effects may include impacts related to actions that induced changes in population density, ecosystems, and land use changes.

Cumulative impacts, as defined by Council on Environmental Quality (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time. The potential cumulative impacts analyzed below would occur from either TWSP activities over time or from the aggregate effects of those activities combined with the activities of other agencies and private entities.

As discussed in Section 1.5, the USFWS and/or the TPWD are the federal and state entities responsible for managing many of those bird species addressed in this EA. Through ongoing communication with the USFWS and the TPWD, the TWSP can consider the activities of other agencies and private entities to the extent that those agencies know those activities occur. The TWSP does not typically conduct direct damage management activities concurrently with other governmental or private entities at a location but may conduct damage management activities at adjacent sites within the same period.

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

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

All those factors play a role in the dynamics of bird populations. TWSP employees use the WS Decision Model to evaluate damage occurring (including other affected elements and the dynamics of the damaging species) and to determine appropriate strategies to minimize effects on environmental elements. After TWSP personnel apply damage management actions, they subsequently monitor and adjust/cease damage management actions (Slate et al. 1992). This process allows the TWSP to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

With management authority over bird populations, the USFWS and/or the TPWD could adjust take levels, including the take by the TWSP, to achieve population objectives for bird species. Consultation and reporting of take by the TWSP would ensure the USFWS and/or the TPWD had the opportunity to consider the activities conducted by the TWSP. As stated previously, the TWSP would not use or recommend those lethal methods available as population management tools over broad areas. The TWSP would use and recommend lethal methods to reduce the number of birds present at a location where damage was occurring by targeting those birds causing damage or posing threats; therefore, the intent of lethal methods would be to manage those birds causing damage and not to manage entire bird populations.

Because take of most bird species can only legally occur when authorized by the USFWS and/or the TPWD, the USFWS and the TPWD can consider take when determining population objectives for those bird species. Therefore, the USFWS and/or the TPWD could adjust the number of birds that people harvest during the regulated hunting season and the number of birds that people can take for damage management purposes to achieve the population objectives. For most species, take by the TWSP and the authorized take allowed would occur at the discretion of the USFWS and/or the TPWD. Any bird population declines or increases induced through the regulation of take would be the collective objective for bird populations established by the USFWS and/or the TPWD.

As discussed previously, the analysis for magnitude of impact from lethal take can be determined either quantitatively or qualitatively. Quantitative determinations may rely on population estimates, allowable removal levels, and actual removal data. Qualitative determinations may rely on population trend data, when available. Information on bird populations and trends are often derived from several sources including the BBS, the CBC, the Partners in Flight Landbird Population database, available literature, and harvest data. The potential impacts of conducting the alternatives on the populations of target bird species occurs below for each alternative.

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

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

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

A common concern is whether damage management actions would adversely affect the population of a target bird species, especially when the TWSP and other entities use lethal methods. If the TWSP implemented Alternative 1, the potential effects on the populations of target bird species associated with the TWSP use of non-lethal methods would be similar to those potential effects discussed for Alternative 2 because the same non-lethal methods would be available for use by TWSP personnel. To limit redundancy, a discussion on the potential effects associated with the use of non-lethal methods does not occur for Alternative 1 because those potential effects would be similar to those discussed for Alternative 2 but those potential effects could possibly occur if the TWSP implemented Alternative 1. In general, the use of non-lethal methods to disperse, exclude, or capture birds from areas where they are causing damage or posing a threat of damage would have minimal effects on the overall population of a target bird species because those methods generally do not harm birds (see discussion for Alternative 2).

Therefore, the evaluation of potential effects on the populations of target bird species for Alternative 1 will primarily focus on TWSP use of lethal methods because TWSP personnel could use lethal methods to remove an individual bird or a group of birds to alleviate damage. The TWSP would only target an individual bird or a group of birds identified as causing damage or posing a threat to human safety. Therefore, if the TWSP implemented Alternative 1, the TWSP could lethally remove birds, which could potentially have direct, indirect, and cumulative effects on the populations of target bird species. The TWSP would only take migratory bird species protected by the MBTA when authorized by the USFWS and only at authorized levels. Similarly, when required, the TWSP would only take bird species when authorized by the TPWD and only at authorized levels.

A lethal method that the TWSP could employ would be the destruction of active and inactive nests of target bird species. For those species protected from take by the MBTA, the destruction of active nests (those nests containing eggs or nestlings) can only occur when the USFWS permits those activities and only at the levels they permit. People can destroy inactive nests (those nests that do not contain eggs or nestlings) without the need for a depredation permit from the USFWS. In addition, a person may need authorization from the TPWD to take the nests or eggs of protected birds.

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

Impacts due to nest and egg destruction should have little adverse effect on a species' population in Texas. Although there may be reduced fecundity for the individuals affected by nest destruction, this activity would not have long-term effects on breeding adult birds because of the limited number of nests removed and the ability of many bird species to re-nest after a nest failure. The TWSP does not use nest destruction as a population management method. The TWSP uses nest destruction to inhibit nesting in an area experiencing damage due to or associated with the nesting activity and those activities only occur at a localized level. TWSP personnel would not destroy active nests over large geographical areas. Therefore, the TWSP does not anticipate the destruction of active nests would occur at an intensity level that would cause an adverse impact to a species' population. For example, treatment of 95% of all Canada goose eggs each year would result in only a 25% reduction in the population over 10 years (Allan et al. 1995).

If TWSP personnel encounter eggs and/or nestlings in an active nest, the TWSP could destroy the eggs by puncturing, oiling, shaking, or by breaking the eggs open. If TWSP personnel encountered nestlings in an active nest, TWSP personnel would euthanize those nestlings in accordance with WS Directive 2.505. For the purposes of the analysis, the TWSP will consider nestlings euthanized as part of the cumulative take of a target bird species. The TWSP would only destroy active nests when authorized by the USFWS and/or the TPWD, when required, and only at levels authorized. Therefore, the USFWS and/or the TPWD would determine the allowable levels of take to authorize.

IMPACTS ON BIRD POPULATIONS FROM LETHAL TAKE

When addressing birds that are causing damage or posing a threat of damage, the TWSP could use several methods that result in the lethal take of birds (see Appendix B). Table 3.1 shows the number of birds lethally removed by the TWSP to alleviate damage or threats of damage from FY 2017 through FY 2019. From FY 2017 through FY 2019, the TWSP used lethal methods to manage damage caused by 80 bird species in Texas. The annual number of species lethally removed to alleviate damage or threats of damage has ranged from 57 bird species in FY 2017 to 69 species during FY 2019. Table 3.1 also shows the estimated breeding population in Texas, the Central Plains States, and North America for those species that the TWSP addressed using lethal methods.

Table 3.1 - Birds killed by TWSP during bird damage management activities from FY 2017 through FY 2019. Take was estimated for species taken with DRC-1339 and Avitrol.

Species	TWSP Take by Fiscal Year				Estimated Breeding Population		
	FY 2017	FY 2018	FY 2019	Ave	Texas	CPS†	N. Amer.
Blackbirds							
Red-winged Blackbird*	30,322	34,861	19,381	28,188	4,047,000	30,269,800	170,000,000
Brown-headed Cowbird*	91,058	167,734	19,480	92,757	5,214,300	42,242,200	130,000,000
Common Grackle*	3,574	3,865	67	2,502	1,290,000	12,896,000	67,000,000
Great-tailed Grackle*	36	122	75	78	2,700,000	2,900,000	8,200,000
Boat-tailed Grackle*	6	10	0	5	135,000	135,000	2,200,000
Introduced Commensal Birds							
European Starling*	242	339	129	237	1,400,000	4,500,000	93,000,000
Rock Pigeon*	2,099	1,223	1,053	1,458	445,000	1,700,000	16,000,000
House Sparrow*	3	100	3	35	4,900,000	11,500,000	93,000,000
Feral Waterfowl	6	98	15	40	na	na	na
Eurasian Collared-Dove	15	28	4	16	2,000,000	3,700,000	8,700,000
Corvids							
American Crow*	30	31	17	26	930,000	2,100,000	28,000,000
Common Raven*	170	156	97	141	25,400	28,900	8,300,000
Raptors							
Black Vulture	2,342	2,210	2,125	2,226	800,000	836,000	9,600,000
Turkey Vulture	161	108	124	131	2,300,000	3,300,000	8,400,000
Swainson's Hawk	94	69	96	86	110,500	214,000	820,000
American Kestrel	21	32	15	23	47,200	223,400	2,800,000
Crested Caracara	20	23	27	23	98,700	98,700	120,000
Mississippi Kite	2	4	4	3	119,100	334,600	700,000
White-tailed Kite	0	1	0	<1	2,500	2,500	16,000
Red-tailed Hawk	20	23	31	25	144,800	513,500	2,800,000
Sharp-shinned Hawk	0	0	1	<1	1,700	7,400	410,000
Broad-winged Hawk	3	3	0	2	43,400	120,800	1,800,000
Cooper's Hawk	5	4	2	4	46,800	131,900	840,000
Northern Harrier	3	12	9	8	4,800	95,800	820,000
Osprey	1	3	11	5	260	1,700	400,000
Red-shouldered Hawk	2	9	1	4	220,200	322,500	1,800,000
Barn Owl	0	1	0	<1	43,500	53,500	130,000
Great Horned Owl	0	0	7	2	396,400	3,800,000	1,158,400
Peregrine Falcon	0	0	1	<1	200	200	37,000
Native Doves							
Mourning Dove	538	673	572	594	12,800,000	78,029,800	130,000,000
White-winged Dove	35	45	91	57	1,095,000	1,102,300	5,200,000
Grassland Passerines							
Eastern Meadowlark	285	206	99	197	2,691,600	7,974,500	24,000,000
Western Meadowlark	36	69	39	48	2,205,700	27,072,600	95,000,000
Western Kingbird	4	2	5	4	4,641,500	8,042,000	29,000,000

Species	TWSP Take by Fiscal Year				Estimated Breeding Population		
	FY 2017	FY 2018	FY 2019	Ave	Texas	CPS†	N. Amer.
Scissor-tailed Flycatcher	31	24	33	29	4,016,300	5,370,600	7,900,000
Horned Lark	9	3	9	7	2,417,700	13,030,500	100,000,000
Lark Sparrow	0	0	9	3	1,980,800	3,756,800	11,000,000
Chipping Sparrow	0	0	4	1	736,300	6,378,100	230,000,000
Savannah Sparrow	0	7	0	2	nb	5,840,200	170,000,000
House Finch	0	0	3	1	1,818,000	2,463,500	33,000,000
Gulls and Terns							
Laughing Gull	50	61	64	58	456,900	456,900	800,000
Ring-billed Gull	20	69	45	45	1,100	306,400	2,600,000
Franklin's Gull	2	40	0	14	nb	252,400	1,200,000
Herring Gull	35	0	39	25	175	nb	410,000
Caspian Tern	0	0	2	<1	6,600	6,600	64,000
Shorebirds							
Upland Sandpiper	19	38	16	24	2,700	901,600	500,000
Semi-palmated Sandpiper	10	1	0	4	nb	nb	2,300,000
Killdeer	284	283	240	269	310,100	1,726,700	1,000,000
Lesser Yellowlegs	0	0	3	1	nb	nb	400,000
Greater Yellowlegs	0	1	0	<1	nb	nb	100,000
Long-billed Curlew	2	4	6	4	15,600	51,600	160,000
Wading Birds							
Cattle Egret	113	165	966	415	1,573,700	1,675,400	1,00,000
Great Blue Heron	11	6	26	14	84,400	209,600	125,000
Great Egret	13	27	29	23	156,300	211,000	270,000
Yellow-crowned Night-Heron	43	45	13	34	14,000	14,800	110,000
Snowy Egret	26	45	30	34	58,500	70,900	550,000
Little Blue Heron	13	4	9	9	53,100	59,000	260,000
Green Heron	6	1	3	3	49,500	76,800	na
Tricolored Heron	0	0	1	<1	9,300	9,300	290,000
White-faced Ibis	0	1	0	<1	61,700	92,700	150,000
White Ibis	11	40	23	25	203,600	203,800	210,000
Roseate Spoonbill	0	1	1	<1	24,900	24,900	180,000
Waterbirds							
Double-crested Cormorant	59	13	21	31	11,700	156,200	980,000
Waterfowl							
Canada Goose	39	109	417	188	12,600	539,800	5,300,000
Snow Goose	0	1	0	<1	nb	nb	1,200,000
Black-bellied Whistling-Duck	15	6	47	23	207,300	207,500	550,000
Mallard	1	9	11	7	45,000	1,491,800	9,200,000
Mottled Duck	16	16	17	16	25,500	25,500	640,000
Ring-necked Duck	0	0	5	2	nb	11,100	1,500,000
Blue-winged Teal	0	1	4	2	27,400	210,600	8,900,000
Green-wing Teal	0	0	3	1	3,600	29,000	2,900,000
Sandhill Crane	0	0	1	<1	nb	700	750,000
American Coot	0	0	4	1	73,900	621,500	6,000,000
Nighthawks, Swifts, and Swallows							
Cliff Swallow	0	38	139	59	8,126,400	19,841,300	78,000,000

Species	TWSP Take by Fiscal Year				Estimated Breeding Population		
	FY 2017	FY 2018	FY 2019	Ave	Texas	CPS†	N. Amer.
Barn Swallow	86	15	9	37	2,217,000	7,460,400	47,000,000
Common Nighthawks	7	34	4	15	4,050,300	4,465,400	22,000,000
Frugivorous Birds							
American Robin	3	29	15	16	230,400	16,896,500	370,000,000
Other Birds							
Greater Roadrunner	3	2	1	2	531,300	616,000	840,000
Loggerhead Shrike	0	1	0	<1	513,900	888,800	4,600,000
Northern Mockingbird	2	0	1	1	8,069,300	9,890,000	34,000,000

†CPS=Central Plains States; North Dakota, South Dakota, Kansas, Nebraska, Oklahoma, and Texas. *Take was estimated for DRC-1339 and Avitrol use. **nb**=non-breeder **na**=not available

In addition to TWSP take, private landowners and others can take birds to resolve damage problems. This take is needed for a cumulative impact analysis. Nonnative species, such as the rock pigeon, starling, and house sparrow and those under a USFWS Depredation Order, such as blackbirds, magpies, and crows, can be taken without a permit. However, most other migratory birds require a USFWS permit with reporting requirements and resident birds require a TPWD permit. The USFWS provided permitted take for calendar years 2017 to 2019 for Texas and Oklahoma in Region 2 (Katie Wade, Migratory Bird Permit Office, Albuquerque, NM, *unpubl. data,* 2020). Permits were issued for few species and take is included in the analysis for each species. Table 3.2 provides USFWS permitted from 2017 to 2019. In all, private individuals took 49 known species in Texas and Oklahoma under USFWS permits. Private take will be considered with TWSP take to determine cumulative impacts on species.

Table 3.2 - USFWS permitted take in Texas and Oklahoma from 2017 to 2019

Species	2017	2018	2019	Ave
Black Vulture	-	4	409	**138**
Turkey Vulture	83	59	145	**96**
Crested Caracara	-	-	-	**-**
Osprey	-	-	-	**-**
Red-tailed Hawk	-	-	3	**1**
Swainson's Hawk	-	9	5	**5**
Rough-legged Hawk	-	-	-	**-**
Red-shouldered Hawk	-	-	-	**-**
Cooper's Hawk	-	0	0	**0**
Sharp-shinned Hawk	-	-	-	**-**
Northern Harrier	-	-	0	**0**
Mississippi Kite	-	0	-	**0**
American Kestrel	-	3	22	**8**
Great Horned Owl	-	0	0	**0**
Barn Owl	-	-	-	**-**
Barred Owl	-	-	-	**-**
Short-eared Owl	-	-	0	**0**
Upland Sandpiper	-	2	-	**<1**
Killdeer	-	74	14	**29**
Long-billed Dowitcher	-	2	-	**<1**
Baird's Sandpiper	-	-	0	**0**
Least Sandpiper	-	-	-	**-**

Species	2017	2018	2019	Ave
White-faced Ibis	-	-	-	-
Gull spp.	-	5	-	2
Laughing Gull	-	201	-	67
Ring-billed Gull	0	0	0	0
Franklin's Gull	0	2	0	<1
Herring Gull	0	2	0	<1
Bonaparte's Gull	-	-	0	0
California Gull	-	-	0	0
Caspian Tern	-	10	-	3
Forster's Tern	-	19	-	6
Royal Tern	-	19	-	6
Cattle Egret	-	29	0	10
Great Blue Heron	23	335	1	120
Great Egret	-	210	-	70
Snowy Egret	-	126	-	42
Little Blue Heron	-	7	0	2
Green Heron	-	23	-	8
Black-crowned Night-Heron	-	25	-	8
Yellow-crowned Night-Heron	-	6	10	5
Double-crested Cormorant	0	51	0	17
American White Pelican	0	32	0	11
Pied-billed Grebe	-	25	-	8
Black-bellied Whistling-Duck	-	-	-	-
Canada Goose	-	1,648	0	549
Snow Goose	-	-	0	0
Great White-fronted Goose	-	-	-	-
Mallard	-	5	1	2
Gadwall	-	0	0	0
Northern Pintail	-	6	-	2
American Wigeon	-	2	0	<1
Northern Shoveler	-	-	-	-
Blue-winged Teal	-	-	-	-
Green-winged Teal	-	0	0	0
Lesser Scaup	-	-	0	0
Ring-necked Duck	-	0	0	0
Redhead	-	1	-	<1
Common Merganser	-	-	0	0
Hooded Merganser	-	1	-	<1
American Coot	-	278	0	93
Sandhill Crane	-	-	-	-
Mourning Dove	-	266	340	202
White-winged Dove	-	42	-	14
Common/Lesser Nighthawk	-	2	0	<1
Cliff Swallow	-	7	0	2
Barn Swallow	-	24	25	16
Bank Swallow	-	-	-	-
Horned Lark	-	16	0	5

Species	2017	2018	2019	Ave
Western Kingbird	-	0	0	**0**
Eastern Kingbird	-	0	0	**0**
Scissor-tailed Flycatcher	-	13	20	**11**
Meadowlark spp.	-	0	1	**<1**
Eastern Meadowlark	-	204	37	**80**
Western Meadowlark	-	2	0	**<1**
Northern Flicker	-	-	-	**-**
Blue Jay	-	-	-	**-**
Northern Mockingbird	-	5	-	**2**
American Robin	-	-	0	**0**
Northern Cardinal	-	1	-	**<1**
House Finch	-	-	-	**-**

The use of lethal methods could result in local population reductions in the area where damage or threats were occurring because those methods would remove birds from a population. The TWSP often uses lethal methods to reinforce non-lethal methods and to remove birds that TWSP personnel identify as causing damage or posing a threat of damage. The analysis includes the TWSP anticipated annual take level for each species, which the TWSP based on previous requests for assistance associated with the species and in anticipation of future requests for assistance. TWSP anticipated annual take level for each species is not a prescribed take level but is a maximum take level that the TWSP anticipates could occur annually to alleviate damage. The number of birds removed annually by the TWSP using lethal methods would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, the efficacy of methods employed, and the take permitted by the USFWS and/or the TPWD. TWSP personnel would only target the bird or birds that they identify as responsible for causing damage or posing a threat of damage. The potential impacts on the populations of target bird species from the implementation of Alternative 1 occurs below.

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

The red-winged blackbird is one of the most abundant bird species in North America and is a commonly recognized bird that occurs in a variety of habitats (Yasukawa and Searcy 2020). The breeding habitat of red-winged blackbirds includes marshes and upland habitats from southern Alaska and Canada southward to Costa Rica, extending from the Pacific to the Atlantic Coast along with the Caribbean Islands (Yasukawa and Searcy 2020). Red-winged blackbirds are primarily associated with emergent vegetation in freshwater wetlands and upland habitats during the breeding season and will nest in marsh vegetation, roadside ditches, saltwater marshes, rice paddies, hay fields, pastureland, fallow fields, suburban habitats, and urban parks (Yasukawa and Searcy 2020).

In Texas, red-winged blackbirds occur statewide and are present in the state throughout the year (Yasukawa and Searcy 2020). The number of red-winged blackbirds observed along routes surveyed in the state during the BBS has shown a declining trend estimated at -2.1% annually from 1966 through 2019. From 2009 through 2019, the number of red-winged blackbirds observed along BBS routes in the state have also shown a declining trend estimated at -3.2% annually (Sauer et al. 2020). As shown in Table 3.1, using current BBS data, the statewide breeding population is estimated at nearly 4.1 million red-winged blackbirds. From 1970 through 2019, the number of red-winged blackbirds observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -0.9% per year (National Audubon Society 2020).

Northern breeding populations of red-winged blackbirds migrate southward during the migration periods but red-winged blackbirds are common throughout the year in states along the Gulf Coast and parts of the western United States, including Texas (Yasukawa and Searcy 2020). The fall migration period for red-winged blackbirds generally occurs from early October through mid-December, with the peak occurring from mid-October through early December (Yasukawa and Searcy 2020). Migratory red-winged blackbirds are present in their wintering areas until departing on their spring migration from mid-February through mid-May, with the peak occurring from late February through late April (Yasukawa and Searcy 2020).

Most requests for assistance that the TWSP receives in Texas are associated with large mixed species flocks of blackbirds. During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species. Therefore, the number of blackbirds, including red-winged blackbirds, increases substantially in the state as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations (Meanley et al. 1966). Like other blackbirds, nothing visual would distinguish red-winged blackbirds that were from the local breeding population and those red-winged blackbirds that migrate into the state from other areas.

A precise count of the red-winged blackbird population in Texas during the wintering and breeding seasons or across the United States is not currently available. Meanley (1971) estimated that 84% of the blackbirds present in the rice growing states were from breeding populations further north. Therefore, birds killed by the TWSP could originate from breeding population outside of the state. Thus, removing red-winged blackbirds associated with a single roost or cluster of roosts during the winter probably would spread the effects amongst populations of red-winged blackbirds that nest over a wide area (Dolbeer 1978).

Peer et al. (2003) calculated the fall blackbird population in the northern Great Plains of North America by multiplying the breeding population in the region by 1.45 based on work Stehn (1989) conducted. Using this technique, the fall population in the Central Plains States (CPS)[6] could be nearly 44 million red-winged blackbirds based on a breeding population estimated at 30.3 million red-winged blackbirds. Yasukawa and Searcy (2020) summarize the annual and lifetime reproductive success of red-winged blackbirds. Using those reproductive parameters that Yasukawa and Searcy (2020) summarize, additional estimations of the fall population are possible with some assumptions[7]. If the sex ratio of red-winged blackbirds in the CPS was one female for every male[8], every female laid eggs[9], females only produced one successful nest per year[10], and red-winged blackbirds produced an average of 1.2 fledglings per nesting attempt, approximately 18.2 million red-winged blackbirds fledge each year per based on a breeding population estimated at 30.3 million red-winged blackbirds in the CPS. Therefore, a fall population in the CPS could be approximately 48.5 million red-winged blackbirds (see Table 3.3).

Like other bird species, the population of red-winged blackbirds is likely highest following the recruitment of hatch year birds into the population in late summer and early fall (Dolbeer et al. 1976). Conversely, bird populations are likely at their lowest in the winter and early spring as birds begin arriving at their breeding areas (Dolbeer et al. 1976). The annual survival rate of red-winged blackbirds

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[6]The Central Plains States consist of North Dakota, South Dakota, Kansas, Nebraska, Oklahoma, and Texas.

[7]One assumption would be the actual breeding population in the CPS is 30.3 million blackbirds with no mortality occurring during the breeding season (*i.e.*, the breeding population remains constant throughout the breeding season). Adult mortality rates during the breeding season are unknown but likely occur from predation, weather, accidents, competition, illegal take, and other from other factors. Dolbeer et al. (1976) suggests adult survival in red-winged blackbirds is highest in late summer-early fall and does not vary between the sexes.

[8]The exact sex ratio of red-winged blackbirds is unknown and likely varies yearly; however, in general, a one female to one male sex ratio has been suggested (Holcomb and Twiest 1970, Holcomb 1974, Fiala 1981).

[9]Female red-winged blackbirds appear to begin breeding their first year (Holcomb 1974).

[10]Although re-nesting is common after a nest failure early in the breeding season, female red-winged blackbirds rarely successfully produce a second brood (Yasukawa and Searcy 2020).

likely ranges from 50% to 60% of the population (Fankhauser 1967, Fankhauser 1971, Dolbeer 1994). Yasukawa and Searcy (2020) reported the annual survival rate of adult red-winged blackbirds ranged from 42.1% to 62.0%, with a mean life expectancy of 2.14 years. Mortality can occur from many sources, including predation, disease, parasites, weather, availability of food sources, and activities to alleviate damage. Damage management activities are now one of the major sources of adult mortality in red-winged blackbirds (Yasukawa and Searcy 2020). However, a reproductive rate of two to four fledglings per female red-winged blackbird per year can offset their high mortality rate (Dolbeer 1994).

Table 3.3 - Cumulative impact analysis for red-winged blackbirds, which includes red-winged blackbirds killed in Texas by the TWSP, take by WS in the CPS region, and take by private individuals and entities (estimated) from FY 2017 through FY 2019

Parameters	FY 2017	FY 2018	FY 2019	Ave
Estimated CPS Breeding Population	30,300,000	30,300,000	30,300,000	30,300,000
% of Population that are Female	50%	50%	50%	50%
Estimated Number Breeding Females	15,150,000	15,150,000	15,150,000	15,150,000
Average Nests	1	1	1	1
Fledglings per nest	1.2	1.2	1.2	1.2
Annual Fledglings Added to Population	18,180,000	18,180,000	18,180,000	18,180,000
Total CPS Population	48,480,000	48,480,000	48,480,000	48,480,000
TX TWSP Take	30,322	34,861	19,381	28,188
Other CPS WS Take	2,250	12,297	18,911	11,153
Private Take in CPS	25,000	25,000	25,000	25,000
Total Take	57,572	72,158	63,292	64,341
% CPS Post-breeding Pop.	0.1%	0.2%	0.1%	0.1%

In addition, red-winged blackbirds are strongly polygynous (*i.e.*, males mate with several females). Therefore, from one to 15 females may occupy a male's territory during the breeding season with some means reaching 5.0 females per male (Yasukawa and Searcy 2020). The polygynous mating system of red-winged blackbirds results in a large group of males that are capable of breeding but that do not have territories during the breeding season and are often referred to as "*floaters*" (Sawin et al. 2003, Yasukawa and Searcy 2020). This group consists mainly of after-second year males that were unable to secure a territory and second year males that are often smaller and have duller plumage than after-second year males (Yasukawa and Searcy 2020). This floater group travels around during the breeding season looking for vacant territories. This group of males can be difficult to locate during the breeding season, which can make traditional survey methods that rely on sight or sound (*e.g.*, the BBS) incomplete (Sawin et al. 2003).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 28,188 red-winged blackbirds in Texas to alleviate damage and threats of damage with the highest level of take occurring in FY 2018 when the TWSP lethally removed 34,861 red-winged blackbirds in Texas (see Table 3.1, Table 3.3). Across the CPS, WS in other states lethally removed an average of 11,153 red-winged blackbirds from FY 2017 through FY 2019 with the highest level of take occurring in FY 2019 when WS in other states within the CPS lethally removed 18,911 red-winged blackbirds. Activities to alleviate damage associated with red-winged blackbirds also likely occur by entities other than the TWSP. As discussed previously, under certain conditions, people can take red-winged blackbirds without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. It is reasonable to predict that the number of blackbirds lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing blackbirds. Private individuals use firearms primarily as a form of harassment rather than to remove blackbirds, despite some limited take likely occurring. Under a worst-case scenario, the private take of red-winged blackbirds is likely less than 25,000 blackbirds per year in the CPS. Although the actual take of red-winged blackbirds by private individuals is unknown, the TWSP will evaluate the lethal take of 25,000 red-winged blackbirds annually by other entities to evaluate the potential effects on the red-winged blackbird population cumulatively.

An important component to understanding population impacts is whether the annual take by the TWSP and other entities, including take by the TWSP, would be additive to the 38.0% to 57.9% mortality rate that occurs annually or whether take by the TWSP and other entities would occur within the annual mortality rate of blackbirds (*i.e.*, is part of the 38.0% to 57.9% annual mortality and not additive). Some people would claim that lethal removal of blackbirds is pointless because up to 60% of the population dies each year anyway, which implies that any removal by the TWSP and other entities, including take by the TWSP, would be compensatory and not additive to other mortality occurring. As with any population, for annual increases to occur, recruitment into the population must exceed mortality.

At what stage in the annual mortality cycle a mortality event occurs could potentially magnify any effect and reduce the potential for the mortality event to be compensatory. For example, a mortality event that occurred at the lowest population point in the mortality cycle could result in additive mortality (*e.g.*, removing blackbirds as they arrive on their breeding grounds in the spring when the population is likely at the lowest). Conversely, a post-breeding mortality event prior to the fall migration when the blackbird population is likely highest could be compensatory because most mortality likely occurs during the migration periods and during the winter. In addition, a mortality event that affects primarily males, primarily females, or both sexes equally could influence whether mortality was compensatory or additive. As discussed earlier, red-winged blackbirds are a polygynous species, which means males often have more than one female per breeding territory. A large "*floater*" population of males also exists within the red-winged blackbird population that consists of non-breeding males that are capable of reproduction. A mortality event that removed primarily males would likely have little effect on reproduction because other reproductive males could replace those males removed[11]. Nearly all female red-winged blackbirds breed; therefore, a mortality event that removed primarily females would prevent the production of future offspring by those females removed.

Red-winged blackbirds generally exhibit an asynchronous migration pattern (*i.e.*, males and females do not migrate at the same time). In the spring, males begin leaving wintering areas earlier than females; therefore, males tend to arrive in breeding areas to begin establishing territories before females arrive. In the fall, females begin leaving the breeding areas earlier than males (Yasukawa and Searcy 2020).
From 1974 through 1992, Dolbeer et al. (1997) estimated that applications of a wetting agent killed over 5.1 million red-winged blackbirds during the winter in the eastern United States, which equates to approximately 270,000 red-winged blackbirds removed per year. Despite that level of annual lethal removal over the 19-year period, Dolbeer et al. (1997) found no correlations between the numbers of red-winged blackbirds killed each winter and subsequent changes in the breeding population of red-winged blackbirds. Therefore, the findings by Dolbeer et al. (1997) indicate that lethal removal during the winter

[11]In theory, the quality of parental investment provided by males with less breeding experience would likely contribute to a lower reproductive success. Reproductive success could be lower if the amount and quality of parental investment provided by replacement males was lower than would have occurred by those males removed. The parental investment provided by male red-winged blackbirds is generally limited to nest defense and some provisioning of young (Beletsky 1996). However, the amount and quality of parental investment by males could contribute directly to reproductive success (Linz et al. 2014). Studies investigating the effects of increased male contributions to the raising of young have shown mixed outcomes (*e.g.*, see Linz et al. 2014). Linz et al. (2014) found no evidence that the breeding experience of male red-winged blackbirds lead to an increase in the number of fledglings per nest or increased nest survival in a North Dakota population of red-winged blackbirds. The quality of habitat in the breeding territory of a male red-winged blackbird may contribute more to reproductive success than the quality of parental investment by males (Linz et al. 2014).

could be a substitute for natural mortality and does not add to the mortality that occurs annually. Density-dependent factors as regulatory mechanisms often influences bird populations (*e.g*., see Newton 1998), and is a likely factor in the regulation of red-winged blackbird populations (Dolbeer et al. 1976, Blackwell et al. 2003).

As indicated by banding data (Meanley 1971, Dolbeer 1978, Dolbeer 1982, Cummings and Avery 2003), the potential effects associated with a high mortality rate at a single winter roost or cluster of winter roosts in winter would be spread amongst populations of red-winged blackbirds that originate across a wide geographical area (Dolbeer 1978). Therefore, the removal of red-winged blackbirds at winter roosts would not result in large-scale reductions of specific local breeding populations in North America the following summer. In addition, if blackbirds from a local winter roost or cluster of roosts were removed during one winter, red-winged blackbirds from other areas would likely readily repopulate those roosts in subsequent winters if suitable roosting habitat and a food supply continued to exist (Dolbeer 1978).

Despite the high levels of mortality associated with red-winged blackbirds, Yasukawa and Searcy (2020) stated, the "[a]*mount of breeding habitat is key to overall population regulation*." As people have converted woodlands and wetland habitats to agricultural uses, the red-winged blackbird has adapted to nesting in upland pastures, hay fields, and grain fields, which has resulted in substantial population increases in some agricultural areas (Graber and Graber 1963, Weatherhead and Bider 1979, Yasukawa and Searcy 2020). Dolbeer (1976) found the average number of fledglings that red-winged blackbirds nesting in upland habitats produced were similar to the average number of fledglings produced in wetland habitats. The conversion of wetland and upland habitat to agricultural production that requires annual tillage has been associated with long-term declines in the number of breeding blackbirds (Besser et al. 1984). Blackwell and Dolbeer (2001) correlated changes in agricultural practices in Ohio with a decline in the statewide breeding red-winged blackbird population, primarily because of the conversion of alfalfa fields and upland areas used for hay to row crops. The timing of hay harvest can also influence the reproductive success of red-winged blackbirds nesting in upland habitats (Blackwell and Dolbeer 2001). On an intermediate level, drought conditions can severely reduce reproductive success over large areas (Brenner 1966). On a smaller scale, local breeding population size and reproductive success has been correlated with insect biomass (Brenner 1968), locally abundant insect foods, such as periodical cicadas (*Magicicada* spp.) (Strehl and White 1986), and habitat quality (Linz et al. 2014, Yasukawa and Searcy 2020). However, the most important factor regulating local reproductive success is probably predation (Yasukawa and Searcy 2020).

As was discussed previously, approximately 38.0% to 57.9% of the adult red-winged blackbirds die each year (Yasukawa and Searcy 2020), which equates to approximately 17.2 million to 26.2 million red-winged blackbirds dying each year in just the CPS. Under a worst-case scenario, the cumulative lethal removal of red-winged blackbirds by the TWSP and other entities in the CPS could represent 0.1% to 0.2% of the post-breeding population and 0.4% to 0.5% of the annual mortality of red-winged blackbirds in the CPS (see Table 3.3). As discussed previously, there appears to be sufficient evidence based on modeling to suggest that the cumulative annual take of red-winged blackbirds by the TWSP and other entities is likely compensatory and not additive to the normal annual loss of red-winged blackbirds. Therefore, the annual mortality of red-winged blackbirds does not likely increase because of TWSP activities.

The key to the overall population regulation in red-winged blackbirds is the amount of breeding habitat (Besser et al. 1984, Blackwell and Dolbeer 2001, Yasukawa and Searcy 2020). Despite recent surveys showing declines in the red-winged blackbird population, the International Union for Conservation of Nature and Natural Resources (IUCN) has ranked the red-winged blackbird has a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2018*a*). The TWSP would evaluate the potential effects of enacting this alternative on the red-winged blackbird population by monitoring yearly activities; therefore, the TWSP could identify and evaluate any changes occurring within the population of red-winged blackbirds. The TWSP would continue to report the take of red-winged blackbirds to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for red-winged blackbirds.

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

Brown-headed cowbirds are another species of the blackbird family commonly found in mixed species flocks during migration periods. Brown-headed cowbirds are a common summer resident across the United States and southern Canada (Lowther 2020). As people have converted woodlands to agricultural uses, the brown-headed cowbird has expanded its range in the United States. Breeding populations in the northern range of the brown-headed cowbird are migratory with cowbirds present throughout the year in much of the eastern United States and along the west Coast (Lowther 2020). Likely restricted to the range of bison (*Bison bison*) prior to the presence of European settlers, brown-headed cowbirds were probably a common occurrence on the short-grass plains where they fed on insects distributed by foraging bison. As people began clearing forests for agriculture, brown-headed cowbirds expanded their breeding range (Lowther 2020). Brown-headed cowbirds still commonly occur in open grassland habitats but also inhabit urban and residential areas. Unique in their breeding habits, brown-headed cowbirds are brood parasites, meaning they lay their eggs in the nests of other bird species (Lowther 2020). Female brown-headed cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds. Brown-headed cowbirds provide no parental care, with the raising of cowbird young occurring by the host species (Lowther 2020).

Brown-headed cowbirds are highly social and are a common component of mixed-species blackbird flocks that may exceed 1 million birds (Lowther 2020, Peer and Bollinger 2020). In Texas, brown-headed cowbirds occur statewide and are present in most of the state throughout the year (Lowther 2020). The number of brown-headed cowbirds observed in areas of Texas surveyed during the BBS has shown a decreasing trend estimated at -2.0% annually since 1966. From 2009 through 2019, the number of brown-headed cowbirds observed along BBS routes in the state have shown a declining trend estimated at -3.9% per year (Sauer et al. 2020). As shown in Table 3.1, using current BBS data, the statewide breeding population is estimated at nearly 5.2 million brown-headed cowbirds. From 1966 through 2019, the number of brown-headed cowbirds observed in areas of Texas surveyed during the CBC has shown a decreasing trend estimated at -4.3% per year (National Audubon Society 2020). Like other blackbird populations, the brown-headed cowbird population is likely lowest as birds begin arriving in breeding areas following the spring migration and prior to nestlings fledging.

The decline of brown-headed cowbirds is likely related to habitat loss that has affected host species (being a parasitic nester – lays eggs in other bird species' nests). However, during the settlement of North America, the brown-headed cowbird greatly expanded its range from where bison roamed in the central Great Plains eastward as the deciduous forests were opened for agriculture (Lowther 2020). Birds that had previously not been exposed to parasitic nesting became more vulnerable as forest fragmentation increased (Brittingham and Temple 1983). This pattern occurred similarly in the West (Verner and Ritter 1983, Airola 1986). Thus, this species abundance increased greatly during this period, but has become regulated by host numbers.

Northern breeding populations of brown-headed cowbirds migrate southward during the migration periods, but cowbirds are common throughout the year in states along the Gulf Coast and parts of the eastern United States, including Texas (Lowther 2020). The fall migration period for brown-headed cowbirds generally occurs from mid-August through mid-October, with the peak occurring from

September through early October (Lowther 2020). Migratory brown-headed cowbirds are present in their wintering areas until departing on their spring migration from late-February through mid-May with the peak occurring from mid-March through April (Lowther 2020). Therefore, the number of cowbirds increases substantially in the state as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations (Meanley et al. 1966).

Most requests for assistance that the TWSP receives in Texas are associated with large mixed species flocks of blackbirds. During the migration periods, brown-headed cowbirds often form mixed species flocks with other blackbird species. Therefore, the number of blackbirds, including brown-headed cowbirds, increases substantially in the state as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations. Like other blackbirds, nothing visual would distinguish brown-headed cowbirds that were from the local breeding population and those brown-headed cowbirds that migrate into the state from other areas. A precise count of the brown-headed cowbird population in Texas during the wintering and breeding seasons or across the United States is not currently available.

Flocks of blackbirds found in Texas from December through April likely consist of locally breeding brown-headed cowbirds and brown-headed cowbirds that have migrated to the area from northern breeding areas. Meanley (1971) estimated that 84% of the blackbirds, including brown-headed cowbirds, present in the rice growing states were from breeding populations further north. Therefore, birds killed by the TWSP could originate from breeding population outside of the state. Thus, removing brown-headed cowbirds at a single roost or cluster of roosts during the winter probably would spread the effects amongst populations of brown-headed cowbirds that are indigenous to a wide area.

As shown in Table 3.1, using current BBS data, the breeding population in the CPS is estimated at 42.2 million brown-headed cowbirds. As discussed previously, female brown-headed cowbirds lay their eggs in the nests of other bird species and do not provide parental care to offspring; therefore, information on the reproductive success of brown-headed cowbirds is limited. Lowther (2020) summarizes the available information on annual and lifetime reproductive success of brown-headed cowbirds. Using those reproductive parameters that Lowther (2020) summarize, additional estimations of the fall population in the CPS are possible with some assumptions[12]. If the sex ratio of brown-headed cowbirds in the CPS was one female for every male[13], then there are approximately 21.1 million female cowbirds in the CPS. Female cowbirds breed and produce eggs at one year of age; therefore, 31.2 million cowbirds are capable of laying eggs in the CPS. Lowther (2020) reports that female brown-headed cowbirds produce approximately 40 eggs per breeding season; therefore, female brown-headed cowbirds in the CPS produce approximately 844 million eggs per season. However, not all of the eggs laid by female brown-headed cowbirds hatch and reach adulthood. Only 3% of the eggs laid by female brown-headed cowbirds produce adult cowbirds (Lowther 2020). Based on a survival rate of 3%, approximately 25.3 million eggs produce adult brown-headed cowbirds.

If the entire breeding population of 42.2 million brown-headed cowbirds in the CPS survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time, a peak post-breeding fall population in the CPS could be estimated at 67.5 million brown-headed cowbirds each year using reproductive parameters that Lowther (2020) summarizes (see Table 3.4). However, the current fall population of brown-headed cowbirds in the CPS is currently unknown and likely varies between years.

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[12]One assumption would be the actual breeding population in the Mississippi Flyway is nearly 32.3 million cowbirds (Partners in Flight Science Committee 2013) with no mortality occurring during the breeding season (*i.e.*, the breeding population remains constant throughout the breeding season). Adult mortality rates during the breeding season are unknown but likely occur from predation, weather, accidents, competition, illegal take, and other from other factors.

[13]The exact sex ratio of cowbirds is unknown and likely varies yearly; however, in general, a one female to one male sex ratio is likely.

Table 3.4 - Cumulative impact analysis for brown-headed cowbirds, which includes brown-headed cowbirds killed in Texas by the TWSP, take by WS in the CPS region, and take by private individuals and entities (estimated) from FY 2017 through FY 2019

Parameters	FY 2017	FY 2018	FY 2019	Ave
Estimated CPS Breeding Population	42,200,000	42,200,000	42,200,000	42,200,000
% of Population that are Female	50%	50%	50%	50%
Estimated Number Breeding Females	21,100,000	21,100,000	21,100,000	21,100,000
Eggs Produced per Season	40	40	40	40
# Eggs Laid per Season	844,000,000	844,000,000	844,000,000	844,000,000
% Eggs Reaching Adulthood	3%	3%	3%	3%
Annual Fledgings Added to Population	25,320,000	25,320,000	25,320,000	25,320,000
Total CPS Population	67,520,000	67,520,000	67,520,000	67,520,000
TX TWSP Take	91,058	167,734	19,480	92,757
Other CPS WS Take	225	648	163	336
Private Take in CPS	25,000	25,000	25,000	25,000
Total Take	116,283	193,382	44,643	118,093
% CPS Post-breeding Pop.	0.2%	0.3%	0.1%	0.2%

Like other bird species, the population of brown-headed cowbirds is likely highest following the recruitment of hatch year birds into the population in late summer and early fall. Conversely, bird populations are likely at their lowest in the winter and early spring as birds begin arriving at their breeding areas (Dolbeer et al. 1976). The annual survival rate of brown-headed cowbirds likely ranges from 48.5% to 63.0% of the population (Fankhauser 1971, Lowther 2020). With a post-breeding population estimated at 67.5 million cowbirds and a 37.0% to 51.5% mortality rate, approximately 25 million to 34.8 million brown-headed cowbirds die each year.

Although flocks comprised of several species of blackbirds and starlings can cause damage to seeded and sprouting rice, brown-headed cowbirds are one of the blackbird species responsible for most of the damage (Meanley 1971, Cummings et al. 2005). For example, brown-headed cowbirds are often the second most common blackbird species found in major blackbird roosts in the rice-growing region of Louisiana (Meanley 1971). In addition, brown-headed cowbirds appear to be the last blackbird species to leave their wintering grounds and return to their breeding grounds each year (Dolbeer 1982), which likely accounts for the high number of brown-headed cowbirds addressed by WS during activities to reduce damage to sprouting rice.

From FY 2017 through FY 2019, the TWSP has lethally removed an average of 92,757 brown-headed cowbirds in Texas to alleviate damage or threats of damage with the highest level of take occurring in FY 2018 when the TWSP lethally removed 167,734 brown-headed cowbirds in Texas (see Table 3.1, Table 3.4). The TWSP used those take models described previously to calculate the annual lethal removal of brown-headed cowbirds when using the avicide DRC-1339. The models estimate annual take using site-specific parameters for each baiting location. Across the CPS, WS in other states lethally removed an average of 336 brown-headed cowbirds from FY 2017 through FY 2019 with the highest level of take occurring in FY 2018 when WS in other states within the CPS lethally removed 648 brown-headed cowbirds.

Activities to alleviate damage associated with brown-headed cowbirds also likely occur by entities other than WS. As discussed previously, under certain conditions, people can take brown-headed cowbirds without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. It is reasonable to predict that the number of blackbirds lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing blackbirds. Private individuals use firearms primarily as a form of harassment rather than to remove blackbirds, despite some limited take likely occurring. Under a worst-case scenario, the private take of brown-headed cowbirds is likely less than 25,000 blackbirds per year in the CPS. Although the actual take of brown-headed cowbirds by private individuals is unknown, the TWSP will evaluate the lethal take of 25,000 brown-headed cowbirds annually by other entities to evaluate the potential effects on the brown-headed cowbirds population cumulatively.

As was discussed previously, approximately 37.0% to 51.5% of the adult brown-headed cowbirds die each year (Fankhauser 1971, Lowther 2020), which equates to approximately 25 million to 34.8 million brown-headed cowbirds dying each year in just the CPS. Under a worst-case scenario, the cumulative lethal removal of brown-headed cowbirds by the TWSP, WS in other states, and other entities in the CPS could represent 0.1% to 0.3% of the post-breeding population and 0.2% to 0.8% of the annual mortality of brown-headed cowbirds in the CPS (see Table 3.4).

An important component to understanding population impacts is whether the annual take by WS and other entities would be additive to the 37% to 51.5% mortality rate that occurs annually or whether take by WS and other entities would occur within the annual mortality rate of cowbirds. Some people would claim that lethal removal of blackbirds is pointless because up to 50% of the population dies each year anyway, which implies that any removal by WS and other entities would be compensatory and not additive to other mortality occurring (see Section 2.3 for further discussion). As with any population, for annual increases to occur, recruitment into the population must exceed mortality. Density-dependent factors as regulatory mechanisms often influences bird populations (*e.g.*, see Newton 1998), and is a likely factor in the regulation of blackbird populations, including cowbirds.

As indicated by migration patterns, the potential effects associated with a high mortality rate at a single winter roost or cluster of winter roosts in winter would be spread amongst populations of cowbirds that originate across a wide geographical area. Therefore, the removal of cowbirds at winter roosts would not result in large-scale reductions of specific local breeding populations in North America the following summer. In addition, if cowbirds from a local winter roost or cluster of roosts were removed during one winter, cowbirds from other areas would likely readily repopulate those roosts in subsequent winters if suitable roosting habitat and a food supply continued to exist. As discussed previously, the cumulative annual take of brown-headed cowbirds by WS and other entities is likely compensatory and not additive to the normal annual loss of brown-headed cowbirds. Therefore, the annual mortality of brown-headed cowbirds does not likely increase because of WS' activities.

Despite recent surveys showing declines in the brown-headed cowbird population, the IUCN has ranked the brown-headed cowbird as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2018*b*). The TWSP would evaluate the potential effects of enacting this alternative on the brown-headed cowbird population by monitoring yearly activities; therefore, the TWSP could identify and evaluate any changes occurring within the population of brown-headed cowbirds. The TWSP would continue to report the take of brown-headed cowbirds to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for brown-headed cowbirds.

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

The great-tailed grackle is a large blackbird that is similar in appearance to the boat-tailed grackle, but with a much wider range. Prior to 1900, the range of the great-tailed grackle barely extended into Texas from Central America and the northern edge of South America (Johnson and Peer 2020). During the twentieth century, the range of the great-tailed grackle expanded rapidly into the south central and southwestern United States. By the end of the twentieth century, the great-tailed grackle nested in at least 14 states with people reporting occurrences in 21 states. Most of the range expansions occurred after 1960 and coincided with changes in habitat from human expansion, such as irrigation and urbanization (Johnson and Peer 2020). In the United States today, great-tailed grackles occur in many parts of the southwestern and south-central United States from southern California to central Missouri.

As late as 1957, the boat-tailed and great-tailed grackles were considered to be conspecific (*i.e.*, belonging to the same species); however, today, the two are believed be reproductively isolated (Johnson and Peer 2020). Boat-tailed grackles breed along the coastal marshes while the great-tailed grackle prefers drier coastal habitat and typically occurs in areas with scattered trees near standing water (Johnson and Peer 2020). However, unlike the boat-tailed grackle, great-tailed grackles are often far removed from coastal situations (Lowery 1981). Great-tailed grackles nest in trees associated with prairies, agricultural areas, and towns while boat-tailed grackles more frequently occur in marshy areas (Johnson and Peer 2020). The ranges of the two species overlap along the coasts of Texas and Louisiana. The great-tailed grackle is a short-distance, partial migrant that winters throughout most of its breeding range (Johnson and Peer 2020). Only those great-tailed grackles along the northern edge of their range in the United States appear to show migratory movements with most great-tailed grackles being sedentary or only moving short distances (Johnson and Peer 2001).

The number of great-tailed grackles observed in the state along routes surveyed during the BBS have shown an annual increasing trend estimated at 0.6% annually since 1966; however, from 2009 through 2019, the number of great-tailed grackles observed has shown a declining trend estimated at -3.5% annually (Sauer et al. 2020). As shown in Table 3.1, using current BBS data, the statewide breeding population is estimated at 2.7 million great-tailed grackles. As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e.*, birds born that breeding season) join with adults before the fall migration.

Using those reproductive parameters that Johnson and Peer (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for the other blackbird species. As shown in Table 3.1, using current BBS data, the breeding population in the state is estimated at 2.7 million great-tailed grackles. If there were one female for every male in the state population of 2.7 million breeding great-tailed grackles[14], every female laid eggs[15], and females only produced one successful nest per year[16], then great-tailed grackles build approximately 1.4 million nests in the state. Johnson and Peer (2020) reported the mean clutch size of great-tailed grackles is approximately three eggs per nest, with a range of one to five eggs. With a mean clutch size of 3 eggs per nest and 1.4 million nests, great-tailed grackles lay approximately 4.2 million eggs in the state. In Louisiana, Guillory et al. (1981) found that 43.9% to 62.1% of the eggs laid by great-tailed grackles hatched. In Texas, up to 75% of eggs may hatch (Johnson and Peer 2020). If only 43.9% of the 4.2 million eggs hatched, approximately 1.8 million nestlings occur in the state annually. Johnson

[14]The exact sex ratio of common grackles is unknown and likely varies yearly; however, in general, a one female to one male sex ratio is likely.

[15]The age at first breeding in common grackles is unknown.

[16]Although re-nesting can after a nest failure early in the breeding season, female grackles do not generally attempt a second brood (Johnson and Peer 2020).

and Peer (2020) reported that nests with three eggs had a 98% fledging success. Based on those parameters, approximately 1.8 million fledglings successfully leave nests each year. The current fall population of great-tailed grackles in the state is currently unknown. However, if the entire breeding population of 2.7 million great-tailed grackles survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time, a peak post-breeding fall population in the state could be approximately 4.5 million great-tailed grackles using reproductive parameters that Johnson and Peer (2020) summarizes.

There is currently no information on annual adult survivorship for great-tailed grackles (Johnson and Peer 2020). If the annual mortality of adult great-tailed grackles were similar to boat-tailed grackles, the annual adult mortality would range from 14.0% to 30.8%. Based on an annual mortality rate of 14.0% to 30.8% and the estimated post-breeding population, approximately 630,000 to 1.4 million great-tailed grackles likely die each year.

From FY 2017 through FY 2019, the TWSP lethally removed an average of 78 great-tailed grackles per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 122 great-tailed grackles. Across the CPS, WS in other states lethally removed an average of 266 great-tailed grackles from FY 2017 through FY 2019 with the highest level of take occurring in FY 2017 when WS in other states within the CPS lethally removed 296 great-tailed grackles.

Activities to alleviate damage associated with great-tailed grackles could also occur by entities other than WS. As discussed previously, under certain conditions, people can take great-tailed grackles without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of grackles lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of grackles goes unreported. However, some annual take could occur by private individuals. It is reasonable to predict that the number of great-tailed grackles lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing great-tailed grackles. Private individuals use firearms primarily as a form of harassment rather than to remove grackles, despite some limited take likely occurring. Under a worst-case scenario, the private take of great-tailed grackles is likely less than 25,000 blackbirds per year in the CPS. Although the actual take of great-tailed grackles by private individuals is unknown, the TWSP will evaluate the lethal take of 25,000 great-tailed grackles annually by other entities to evaluate the potential effects on the great-tailed grackle population cumulatively. The cumulative lethal removal of great-tailed grackles by WS and other entities in the CPS could represent 0.5% of the post-breeding population (see Table 3.5).

As was discussed previously, approximately 14.0% to 30.8% of the adult great-tailed grackles likely die each year, which equates to approximately 672,000 to 1.5 million great-tailed grackles dying each year in the CPS. Under a worst-case scenario, the cumulative lethal removal of great-tailed grackles by the TWSP, WS in other states, and other entities in the CPS could represent 1.7% to 3.8% of the annual mortality of great-tailed grackles in the CPS.

Table 3.5 - Cumulative impact analysis for great-tailed grackles, which includes great-tailed grackles killed in Texas by the TWSP, take by WS in the CPS region, and take by private individuals and entities (estimated) from FY 2017 through FY 2019

Parameters	FY 2017	FY 2018	FY 2019	Ave
Estimated CPS Breeding Population	2,900,000	2,900,000	2,900,000	2,900,000
% of Population that are Female	50%	50%	50%	50%
Estimated Number Breeding Females	1,450,000	1,450,000	1,450,000	1,450,000

Average Nests Per Season	1	1	1	1
Average Number of Eggs	3	3	3	3
Number of Eggs Produced Annually	4,350,000	4,350,000	4,350,000	4,350,000
Lowest % of Eggs Hatch	43.9%	43.9%	43.9%	43.9%
Number of Eggs Hatch	1,910,000	1,910,000	1,910,000	1,910,000
% Eggs that Fledge	98%	98%	98%	98%
Total CPS Population	4,800,000	4,800,000	4,800,000	4,800,000
TX TWSP Take	36	122	75	78
Other CPS WS Take	296	227	274	266
Private Take in CPS	25,000	25,000	25,000	25,000
Total Take	25,332	25,349	25,349	25,344
% CPS Post-breeding Pop.	0.5%	0.5%	0.5%	0.5%

The IUCN has ranked the great-tailed grackle as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the population trend appears to be stable*" (BirdLife International 2018*c*). The TWSP would monitor activities to evaluate the potential effects on the populations of great-tailed grackles associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of great-tailed grackles. The TWSP would continue to report the take of great-tailed grackles to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for great-tailed grackles.

COMMON GRACKLE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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

The common grackle has an extremely varied diet, which includes insects, crayfish, frogs, other small aquatic life, mice, nestling birds, eggs, sprouting and ripened grains, seeds, and fruits (Peer and Bollinger 2020). During the migration periods, common grackles can occur in mixed species flocks of blackbirds and are commonly seen foraging and roosting in flocks with other blackbird species (Peer and Bollinger 2020). Common grackles are a permanent resident of Texas with grackles present in most of the state throughout the year (Peer and Bollinger 2020). Large numbers of nesting grackles can occur in open woodlands, swamps, marshes, pine forests, hammocks, and suburban areas.

In Texas, the number of common grackles observed in the state along routes surveyed during the BBS have shown an annual increasing trend estimated at 1.4% annually since 1966. However, from 2009 through 2019, the number of common grackles observed in areas of the state surveyed during the BBS has shown an annual declining trend estimated at -3.6% per year (Sauer et al. 2020). As shown in Table 3.1, using current BBS data, the statewide breeding population is estimated at 1.3 million common grackles. As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e.*, birds born that breeding season) join with adults before the fall migration.

The fall migration period for common grackles generally occurs from late August through early December, with the peak occurring from mid-October through mid-November (Peer and Bollinger 2020). Migratory common grackles are present in their wintering areas until departing on their spring migration, which generally occurs from mid-February through the end of April with the peak occurring from late February through the end of March (Peer and Bollinger 20). Therefore, the number of common grackles increases substantially in the state as northern breeding populations migrate southward during the fall to winter in the southern United States, which augments local breeding populations (Meanley et al. 1966). Like other blackbirds, nothing visual would distinguish common grackles that were from the local breeding population and those grackles that migrate into the rice growing area from other areas. The number of common grackles observed in areas of the state surveyed during the CBC has shown a declining trend from 1970 through 2019, which was estimated at -2.2% per year (National Audubon Society 2020).

As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e.*, birds born that breeding season) join with adults before the fall migration. Peer et al. (2003) calculated the fall blackbird population in the northern Great Plains of North America by multiplying the breeding population in the region by 1.45 based on work Stehn (1989) conducted. Using this technique, the fall population in Texas could be 1.9 million common grackles based on a breeding population estimated at 1.3 million grackles.

Using those reproductive parameters that Peer and Bollinger (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for red-winged blackbirds. If there were one female for every male in the state population of 1.3 million breeding grackles[17], every female laid eggs[18], and females only produced one successful nest per year[19], then common grackles build approximately 650,000 nests in the state. Peer and Bollinger (2020) reported the mean clutch size of common grackles is approximately five eggs per nest, with a range of one to seven eggs. With a mean clutch size of five eggs per nest and 650,000 nests, common grackles lay approximately 3.3 million eggs in the state. Peer and Bollinger (2020) estimated the number of eggs that produced fledglings at 33.0 to 65.0%. Based on those parameters, approximately 1.1 million fledglings successfully leave nests each year. The current fall population of common grackles in Texas is currently unknown. However, a peak post-breeding fall population in Texas could be approximately 2.4 million common grackles using the average number of fledglings that successfully leave nests that Peer and Bollinger (2020) summarize. The peak post-breeding population would only occur if the entire breeding population of 1.3 million common grackles survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time.

Common grackles have a 51.6% adult annual survivorship (Peer and Bollinger 2020). Like other blackbird species, mortality can occur from many sources, including predation, disease, parasites, weather, and availability of food sources. The common grackle population is likely lowest as birds begin arriving in breeding areas following the spring migration and prior to the fledging of nestlings. Therefore, the breeding population estimate likely represents the population low.

From FY 2017 through FY 2019, the TWSP lethally removed an average of 2,502 common grackles per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 3,865 common grackles. Across the CPS, WS in other states lethally removed an average of 776 common grackles from FY 2017 through FY 2019 with

[17]The exact sex ratio of common grackles is unknown and likely varies yearly; however, in general, a one female to one male sex ratio is likely.

[18]The age at first breeding in common grackles is unknown (Peer and Bollinger 2020).

[19]Although re-nesting can occur after a nest failure early in the breeding season, female grackles do not generally attempt a second brood (Peer and Bollinger 2020).

the highest level of take occurring in FY 2018 when WS in other states within the CPS lethally removed 1,182 common grackles (see Table 3.6).

Activities to alleviate damage associated with common grackles could also occur by entities other than WS. As discussed previously, under certain conditions, people can take common grackles without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of grackles lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of grackles goes unreported. However, some annual take could occur by private individuals. It is reasonable to predict that the number of common grackles lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing common grackles. Private individuals use firearms primarily as a form of harassment rather than to remove grackles, despite some limited take likely occurring. Under a worst-case scenario, the private take of common grackles is likely less than 25,000 blackbirds per year in the CPS. Although the actual take of common grackles by private individuals is unknown, the TWSP will evaluate the lethal take of 25,000 common grackles annually by other entities to evaluate the potential effects on the common grackle population cumulatively. The cumulative lethal removal of common grackles by WS and other entities in the CPS could represent 0.1% of the post-breeding population (see Table 3.6).

Approximately 48% of the adult common grackles likely die each year, which equates to approximately 11.3 million common grackles dying each year in the CPS. Under a worst-case scenario, the cumulative lethal removal of common grackles by the TWSP, WS in other states, and other entities in the CPS could represent 0.2% to 0.3% of the annual mortality of common grackles in the CPS.

Table 3.6 - Cumulative impact analysis for common grackles, which includes common grackles killed in Texas by the TWSP, take by WS in the CPS region, and take by private individuals and entities (estimated) from FY 2017 through FY 2019

Parameters	FY 2017	FY 2018	FY 2019	Ave
Estimated CPS Breeding Population	12,900,000	12,900,000	12,900,000	12,900,000
% of Population that are Female	50%	50%	50%	50%
Estimated Number Breeding Females	6,450,000	6,450,000	6,450,000	6,450,000
Average Nests Per Season	1	1	1	1
Average Number of Eggs	5	5	5	5
Number of Eggs Produced Annually	32,250,000	32,250,000	32,250,000	32,250,000
% Eggs that Fledge	33%	33%	33%	33%
Number of Fledglings	10,643,000	10,643,000	10,643,000	10,643,000
Total CPS Population	23,543,000	23,543,000	23,543,000	23,543,000
TX TWSP Take	3,574	3,865	67	2,502
Other CPS WS Take	212	1,182	935	776
Private Take in CPS	25,000	25,000	25,000	25,000
Total Take	28,786	30,047	26,002	28,278
% CPS Post-breeding Pop.	0.1%	0.1%	0.1%	0.1%

Similar to red-winged blackbirds, an important component to understanding population impacts is whether the annual take by WS and other entities would be additive to the 48% annual mortality that occurs or whether take by WS and other entities would occur within the annual mortality rate of grackles. Some people would claim that lethal removal of blackbirds is pointless because nearly 52% of the population dies each year anyway, which implies that any removal by WS and other entities would be compensatory and not additive to other mortality occurring. At what stage in the annual mortality cycle a mortality event occurs could potentially magnify any effect and reduce the potential for the mortality event to be compensatory. As with any population, for annual increases to occur, recruitment into the population must exceed mortality.

From 1974 through 1992, Dolbeer et al. (1997) estimated that applications of a wetting agent killed over 18.3 million common grackles during the winter in the eastern United States, which equates to approximately 963,200 common grackles removed per year. Despite that level of annual lethal removal over the 19-year period, Dolbeer et al. (1997) found no correlations between the numbers of grackles killed each winter and subsequent changes in the breeding population of common grackles. Therefore, the findings by Dolbeer et al. (1997) indicate that lethal removal in the winter could be a substitute for natural mortality and does not add to the mortality that occurs annually.

In addition, a high mortality rate at a single winter roost or cluster of winter roosts would spread the potential effects across populations of common grackles that originated across a wide geographical area. Therefore, the removal of grackles at winter roosts would not result in large-scale reductions of specific local breeding populations in North America the following summer.

Land clearing and the associated expansion of agricultural production since European settlement began in North America that created additional breeding habitat is likely responsible for a "*dramatic*" increase in the number of common grackles (Peer and Bollinger 2020). In addition, Robbins et al. (1986) attributed increases in the number of common grackles observed during the BBS from 1965 to 1979, in part, on the trend toward mechanical harvesting of crops, which leaves more waste grain. The increased availability of waste grains from mechanical harvest, in part, resulted in increased winter survival of common grackles and other blackbirds (Robbins et al. 1986).

Based on the declining population trends for the common grackle, the IUCN has designated the common grackle as "*near threatened*" (BirdLife International 2018*d*). The IUCN assigned the ranking based on a rapidly declining population trend in North America (BirdLife International 2018*d*). Although the IUCN ranks the common grackle as "*near threatened*", the USFWS has not classified the common grackle as an endangered or threatened species pursuant to the ESA. The TWSP would monitor activities to evaluate the potential effects on the populations of common grackles associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of common grackles. The TWSP would continue to report the take of common grackles to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for common grackles.

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

The boat-tailed grackle is a large, conspicuous blackbird with a long tail and iridescent blue-green plumage (Post et al. 2020). The boat-tailed grackle is a coastal species, residing from the Gulf coast of Texas to the coasts of the eastern United States, as far north as Long Island. It seldom resides far inland, except in Florida, where it is widespread across the peninsula. In Texas, boat-tailed grackles are primarily residents of the coastal marshes along the southeast coastline (Post et al. 2020). They build their nests in colonies between stalks of marsh vegetation, in bushes, such as mangrove, or in the top branches of trees that grow on the cheniers (Lowery 1981).

In Texas, the number of boat-tailed grackles observed in the state along routes surveyed during the BBS have shown an annual increasing trend estimated at 7.0% annually since 1966. From 2009 through 2019, the number of boat-tailed grackles observed in areas of the state surveyed during the BBS has shown an annual increasing trend estimated at 12.1% per year (Sauer et al. 2020). As shown in Table 3.1, using current BBS data, the statewide breeding population is estimated at 135,000 boat-tailed grackles. As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e*., birds born that breeding season) join with adults before the fall migration.

Based on banding data, boat-tailed grackle populations are relatively sedentary, with little movement during the traditional fall and spring migration periods, except for breeding populations along the northern Atlantic coast that tend to move southward along the coast during the fall migration period (Post et al. 2020). Overall, winter movements are "*poorly understood*", but may be related to the availability of food during the winter (Post et al. 2020).

Using those reproductive parameters that Post et al. (2020) summarizes and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for red-winged blackbirds. If there were one female for every male in the state population of 135,000 breeding boat-tailed grackles, every female laid eggs, and females only produced one successful nest per year, then boat-tailed grackles build approximately 67,500 nests in the state. Post (1995) found that boat-tailed grackles produced a mean of 1.32 fledglings from all nests. If boat-tailed grackles in Texas produced 1.32 fledglings per nest, the 67,500 nests in Texas produce 89,100 fledglings. If all of the fledglings were recruited into the breeding population and no adult mortality occurred during the breeding season, the post-breeding population in Texas would be approximately 224,100 boat-tailed grackles. The current fall population of boat-tailed grackles in Texas is currently unknown. However, a peak post-breeding fall population in Texas could be approximately 224,100 grackles using the average number of fledglings that successfully leave nests that Post et al. (2020) summarize. The peak post-breeding population would only occur if the entire breeding population of 135,000 boat-tailed grackles survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time.

The annual survival of adult boat-tailed grackles can range from 69.2% to 86.0% (Post et al. 2020). Like other blackbirds, mortality can occur from many sources, including predation, disease, parasites, weather, and availability of food sources. Based on the annual mortality rate and the estimated post-breeding population, approximately 31,400 to 69,000 boat-tailed grackles likely die each year. The boat-tailed grackle population is likely lowest in the spring prior to the fledging of nestlings. Therefore, the breeding population estimate likely represents the population low.

From FY 2017 through FY 2019, the TWSP lethally removed an average of two boat-tailed grackles per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed six boat-tailed grackles. No take of boat-tailed grackles occurred by WS in the other CPS from FY 2017 through FY 2019. Activities to alleviate damage associated with boat-tailed grackles could also occur by entities other than WS. As discussed previously, under certain conditions, people can take boat-tailed grackles without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of grackles lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of grackles goes unreported. However, some annual take could occur by private individuals. It is reasonable to predict that the number of boat-tailed grackles lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing boat-tailed grackles. Private individuals use firearms primarily as a form of harassment rather than to remove grackles, despite some limited take likely occurring. Under a worst-case scenario, the private take of boat-tailed grackles is likely less than 1,000 boat-tailed grackles per year in the CPS. Although the actual take of boat-tailed grackles by private individuals is unknown, the TWSP will evaluate the lethal take of 1,000 boat-tailed grackles annually by other entities to evaluate the potential effects on the boat-tailed grackle population cumulatively. The cumulative lethal removal of boat-tailed grackles by WS and other entities in the CPS could represent 0.5% of the post-breeding population.

Approximately 14% to 30.8% of the adult boat-tailed grackles likely die each year, which equates to approximately 31,400 to 69,000 boat-tailed grackles dying each year in the CPS. Under a worst-case scenario, the cumulative lethal removal of common grackles by the TWSP, WS in other states, and other entities in the CPS could represent 1.5% to 3.2% of the annual mortality of boat-tailed grackles in the CPS.

The IUCN has ranked the boat-tailed grackle as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the population trend appears to be increasing*" (BirdLife International 2016*a*). The TWSP would monitor activities to evaluate the potential effects on the populations of boat-tailed grackles associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of boat-tailed grackles. The TWSP would continue to report the take of boat-tailed grackles to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for boat-tailed grackles.

BREWER'S BLACKBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Historically, Brewer's blackbirds were a common social species in the open habitats, farmsteads, and urbanized areas of western North America (Martin 2020). Nesting records of the Brewer's blackbird in eastern North America did not exist prior to 1914. Beginning in 1914 and continuing for the next 40 years, nesting populations of Brewer's blackbirds expanded eastward across the northern United States and southern Canada into the Great Lakes region, which represented a range expansion of nearly 750 miles (Martin 2020). The clearing of forest and the conversion of areas to agricultural production aided the range expansion. Today, breeding populations of Brewer's blackbirds occur across much of the western United States and the southern half of western Canada with breeding populations extending across northern Minnesota and the southern edge of Canada into the Great Lakes region (Martin 2020).

As the breeding range of the Brewer's blackbird extended eastward, the wintering areas associated with this blackbird species also expanded eastward. With breeding populations historically occurring in western North America, the movements and migration patterns were restricted to the western United States. However, since the breeding range of this blackbird species now occurs in northern portions of the eastern United States and southern Canada, Brewer's blackbirds now occur in the south central and southeastern United States during the winter migration periods (Martin 2020). Martin (2020) described the winter and fall migration patterns of Brewer's blackbird, especially those from the northern portion of their range, as "*nomadic*" due to their shifting patterns and the timing of migratory movements. In general, large numbers of Brewer's blackbirds begin arriving in wintering areas around the middle of October through mid-November. In the spring, Brewer's blackbirds begin leaving wintering areas in March, with some individuals lingering into April (Martin 2020). Brewer's blackbirds often associate with other blackbird species during migration periods (Martin 2020). In Texas, Brewer's blackbirds occur statewide during the winter. From 1970 through 2019, the number of Brewer's blackbirds observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -3.4% per year (National Audubon Society 2020).

No breeding populations of Brewer's blackbirds occur in Texas or the southern United States (Martin 2020). Across all survey routes, the number of Brewer's blackbirds observed in areas surveyed during the BBS has shown a declining trend estimated at -1.6% per year from 1966 and 2019, with a -2.9% annual decline occurring from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in the CPS can be estimated at 794,400 Brewer's blackbirds with the North America population estimated at 23 million Brewer's blackbirds. As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e.*, birds born that breeding season) join with adults before the fall migration.

If there were one female for every male in the CPS population of 794,400 Brewer's blackbirds, every female laid eggs, and the entire breeding population only built one nest per year, then Brewer's blackbirds build approximately 397,200 nests in the CPS. Martin (2020) reported the mean clutch size of Brewer's blackbirds is approximately five eggs per nest. With a clutch size of five eggs per nest and 397,200 nests, Brewer's blackbirds lay approximately 2.0 million eggs in the CPS. Martin (2020) reported that 62.7% of eggs laid hatched; therefore, of the 2.0 million eggs laid in the CPS, approximately 1.2 million of the eggs hatch each year. Of the eggs that hatch, 62.7% also fledge successfully (Martin 2020). If 62.7% of the nestlings that hatch leave the nest, then approximately 781,000 nestlings would fledge successfully. La Rivers (1944) estimated that approximately 50% of fledglings die or are killed within one month of leaving the nest. The current fall population of Brewer's blackbirds in the CPS is currently unknown; however, a fall population in the CPS could be approximately 1.2 million Brewer's blackbirds using reproductive parameters that Martin (2020) summarizes and a 50% mortality rate for fledglings within a month of leaving the nest.

The annual survival rate of adult Brewer's blackbirds can range from 30% to 54% (Martin 2020). Mortality can occur from many sources, including predation, disease, parasites, weather, and availability of food sources. Like other blackbird populations, the Brewer's blackbird population is likely lowest as birds begin arriving in breeding areas following the spring migration and prior to nestlings fledging. Therefore, the breeding population estimate of 794,400 Brewer's blackbirds likely represents the population low.

No lethal take of Brewer's blackbirds by the TWSP occurred from FY 2017 through FY 2019. However, the TWSP could address Brewer's blackbirds if they were causing damage or posing a threat of damage and if they were part of mixed species flock of blackbirds. From FY 2017 through FY 2019, WS in other states only lethally removed Brewer's blackbird in FY 2019. In FY 2019, WS in other states lethally removed 136 Brewer's blackbirds to alleviate damage or threats of damage.

With a post-breeding population estimated at 1.2 million Brewer's blackbirds and a 46% to 70% mortality rate, approximately 552,000 to 840,000 Brewer's blackbirds die each year. In the CPS, the lethal removal of 136 Brewer's blackbirds in FY 2019 represented 0.01% of the estimated post-breeding population estimated at 1.2 million Brewer's blackbirds and 0.2% to 0.3% of the number of Brewer's blackbirds that could die each year. Annual take would have to reach 12,000 Brewer's blackbirds to represent 1% of a post-breeding population estimated at 1.2 million Brewer's blackbirds.

Activities to alleviate damage associated with blackbirds, including Brewer's blackbirds, could also occur by entities other than WS. As discussed previously, under certain conditions, people can take Brewer's blackbirds without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. It is reasonable to predict that the number of blackbirds lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing blackbirds. Private individuals use firearms primarily as a form of harassment rather than to remove blackbirds, despite some limited take likely occurring. As discussed previously, annual cumulative take would have to reach 12,000 Brewer's blackbirds to represent 1% of a post-breeding population. However, WS does not anticipate cumulative take to reach 12,000 Brewer's blackbirds given the limited cumulative take that has occurred previously.

Despite recent surveys showing declines in the Brewer's blackbird population, the IUCN has ranked the Brewer's blackbird as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2016*b*). The TWSP would monitor activities to evaluate the potential effects on the populations of Brewer's blackbirds associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of Brewer's blackbirds. The TWSP would continue to report the take of Brewer's blackbirds to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for Brewer's blackbirds.

BRONZED COWBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The bronzed cowbird, like other cowbirds, is a brood parasite that breeds in southern portions of Arizona, New Mexico, and Texas. It prefers open habitats and human settlements, which favored its range expansion northward into the United States in the 1950s (Ellison and Lowther 2020). In Texas, bronze cowbirds nest in southern Texas and can be found throughout the year in the extreme southern portion of Texas (Ellison and Lowther 2020).

The number of bronzed cowbirds observed along routes surveyed in the state during the BBS has shown a declining trend estimated at -0.7% annually from 1966 through 2019. From 2009 through 2019, the number of bronze cowbirds observed along BBS routes in the state have also shown a declining trend estimated at -2.6% annually (Sauer et al. 2020). Using current BBS data, the statewide breeding population is estimated at 455,100 bronzed cowbirds. From 1970 through 2019, the number of bronzed cowbirds observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 0.4% per year (National Audubon Society 2020).

Not much is known about the reproduction parameters for bronzed cowbirds (Ellison and Lowther 2020). For the purpose of estimating the post-breeding population for this EA and because reproductive parameters for bronzed cowbirds is limited, the TWSP will use those parameters described for the brown-headed cowbird. Ellison and Lowther (2020) stated, "*Many aspects of the Bronzed Cowbird's breeding biology are probably similar to those of the Brown-headed Cowbird*". For purposes of this analysis, the TWSP will estimate the sex ratio of bronzed cowbirds in the state to be one female for every male and that all females produce eggs during the nesting season. If the sex ratio of bronzed cowbirds in the state was one female for every male and all females produce eggs during the nesting season, there are approximately 227,550 female bronzed cowbirds in Texas. If bronzed cowbirds are similar to brown-headed cowbirds, female bronzed cowbirds lay approximately 40 eggs per nesting season but only 3% of the eggs laid reach adulthood. Using those parameters, female bronzed cowbirds lay approximately 9.1 million eggs in Texas but only 273,000 reach adulthood. Therefore, a post-breeding population in Texas could be estimated at 728,100 bronzed cowbirds.

No lethal take of bronzed cowbirds by the TWSP occurred from FY 2017 through FY 2019. However, the TWSP could address bronzed cowbirds if they were causing damage or posing a threat of damage and if they were part of mixed species flock of blackbirds. Activities to alleviate damage associated with blackbirds, including bronzed cowbirds, could also occur by entities other than the TWSP. As discussed previously, under certain conditions, people can take bronzed cowbirds without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. It is reasonable to predict that the number of blackbirds lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing blackbirds. Private individuals use firearms primarily as a form of harassment rather than to remove blackbirds, despite some limited take likely occurring. Annual take would have to reach 7,300 bronzed cowbirds to represent 1% of a post-breeding population estimated at 728,100 bronzed cowbirds. However, WS does not anticipate cumulative take to reach 7,300 bronzed cowbirds given the limited cumulative take that has occurred previously.

The IUCN has ranked the bronzed cowbird as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2017*a*). The TWSP would monitor activities to evaluate the potential effects on the populations of bronzed cowbirds associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of bronzed cowbirds. The TWSP would continue to report the take of bronzed cowbirds to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for bronzed cowbirds.

RUSTY BLACKBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The rusty blackbird is one of the most rapidly declining bird species in North America (Greenberg et al. 2011, Avery 2020). Avery (2020) summarizes the potential factors that may be influencing the current decline in the rusty blackbird population, which may include loss of wintering habitat, contaminants on the breeding grounds, damage management activities targeting other blackbird species, and increasing disturbance to breeding habitats in the boreal forest. Disease factors may also be contributing to the population decline (Barnard et al. 2010, Greenberg and Matsuoka 2010).

The rusty blackbird is one of the most ecologically specialized of the blackbird species in North America, both in its feeding habits and habitat uses (Avery 2020). During the nesting season, rusty blackbirds occur across the wet forests of Alaska and Canada, with breeding populations also occurring in some of the wet forested regions of the northeastern United States (Avery 2020). Trend data from the BBS shows an annual decline of -2.6% across all survey routes from 1966 through 2019; however, from 2009 through 2019, the number of rusty blackbirds observed across all routes surveyed in Canada and the United States shows an increasing trend estimated at 0.4% per year (Sauer et al. 2020)[20]. Partners in Flight (2020) estimated the breeding population in North America at 6.8 million rusty blackbirds, with a United States breeding population estimated at 930,000 rusty blackbirds.

The fall migration period for rusty blackbirds begins in early September and ends in early December (Avery 2020). Rusty blackbirds winter in the southern and east-central portions of the United States, including Texas; however, their distribution across their wintering range is spotty (Avery 2020). From 1970 through 2019, the number of rusty blackbirds observed in all areas surveyed in Canada and the United States during the CBC has shown a declining trend estimated at -2.3% per year (National Audubon Society 2020). Similar to the BBS trend, from 2009 through 2019, the number of rusty blackbirds observed in all areas surveyed in Canada and the United States during the CBC has shown an increasing trend estimated at 1.3% per year (National Audubon Society 2020). The number of rusty blackbirds observed in areas of Texas surveyed during the CBC has shown declining trends estimated at -3.7% from 1970 through 2019 and -8.5% from 2009 through 2019 (National Audubon Society 2020). No winter population estimates are available (Avery 2020). The spring migration back to nesting areas for rusty blackbirds begins in late February and ends in mid-May (Avery 2020).

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

DeLeon (2012) indicated surveys for rusty blackbirds present in Louisiana should occur from early November through late March and that peak populations of rusty blackbirds in Louisiana occurred from early January through late February. Survey seasons conducted by DeLeon (2012) "…*started with low numbers of* [rusty blackbirds] *until early January, then ended abruptly in late February or early March with departure of all birds*." During surveys in the Mississippi Alluvial Valley conducted by Luscier et al. (2010), surveyors detected an average of 26 ± 8 (range 1-160) rusty blackbirds at sites surveyed during 2006, 19 ± 5 rusty blackbirds (range 1-100) during 2007, and an average of 27± 8 (range 1-1,000) rusty blackbirds at survey sites during 2008. DeLeon (2012) found the average flock size of rusty blackbirds in areas of Louisiana surveyed was 20.6 ± 3.4 rusty blackbirds in 2010 and 19.7 ± 3.5 rusty blackbirds during 2011.

The habitat of the rusty blackbird through its winter range typically consists of swamps, wet woodlands, and pond edges (Rosenberg et al. 1991, Luscier et al. 2010, Greenberg et al. 2011, Avery 2020). Small flocks may feed in open fields, often near marshland (Burleigh 1958). On their wintering grounds, rusty blackbirds typically forage in areas with shallow water (Luscier et al. 2010, Greenberg et al. 2011, DeLeon 2012, Avery 2020). DeLeon (2012) suggested rusty blackbirds selected wintering habitat based on the availability of shallow water and speculated the presence of shallow water and prey availability could have a greater impact on rusty blackbird populations than changes in forested wetlands alone. The ephemeral nature of some shallow water and moist soil habitats may provide some explanation for the annual variability in the presence or absence of rusty blackbirds in wintering areas (Luscier et al. 2010, DeLeon 2012, Avery 2013). Greenberg et al. (2011) stated "*Rusty blackbirds appeared to depend on two distinct dietary items: (1) small acorns and pecans, which are often eaten while associating with common grackles, whose large, strong bills are able to crack nutshells; and (2) invertebrates picked from water or soil, or captured after flipping leaf litter and floating vegetation*." Luscier et al. (2010) found rusty blackbirds in agricultural fields adjacent to wetlands and bottomland forest near national wildlife refuges and wildlife management areas but wintering rusty blackbirds were not typically associated with large open agricultural fields that lacked nearby forests or wetlands.

Rusty blackbirds may associate with other blackbird species during the migration periods and during the winter season but tend to prefer more woodland roosts and forage areas than the other blackbird species (Avery 2020). Greenberg et al. (2011) stated, '*Most rusty blackbirds are found either in single-species roosts or mixed with some red-winged blackbirds*." Rusty blackbirds usually comprise less than 1% of large mixed-species blackbird roosts (Neff and Meanley 1952, Meanly 1971, White et al. 1985, Stickley 1987, Dolbeer et al. 1997, Avery 2020). Meanley (1971) considered the rusty blackbird to be of "*minor importance*" when considering damage to rice, with the species doing little to no damage to growing rice.

WS' programs nationwide lethally removed an average of one rusty blackbird per year from FY 2017 through FY 2019. No lethal take of rusty blackbirds has occurred by the TWSP or by WS in the CPS from FY 2017 through FY 2019. The TWSP anticipates addressing rusty blackbirds infrequently and in low numbers. Rusty blackbirds are not a target species when using the avicide DRC-1339. Therefore, the TWSP would consider rusty blackbirds as non-target animals when conducting activities to alleviate damage. As per label requirements of DRC-1339, the TWSP would monitor for the presence of non-target animals feeding on pre-bait prior to baiting areas, including the presence of rusty blackbirds. Like other non-target animals, if TWSP employees observed rusty blackbirds feeding on pre-bait, the TWSP would abandon those sites or continue to pre-bait those locations until TWSP employees no longer observed rusty blackbirds per the label requirements of the avicide DRC-1339. If TWSP employees observed rusty blackbirds in flocks feeding at baited sites, the TWSP would abandon those sites or the TWSP could substitute untreated pre-bait until employees no longer observed rusty blackbirds feeding at the site.

The effects associated with damage management activities targeting other blackbird species on the overall population of rusty blackbirds are unknown (Avery 2020). However, Greenberg and Droege (1999) speculated that damage management activities associated with other blackbird species were not an important cause of the species' decline. Based on the use patterns of methods, including the label requirements of the avicide DRC-1339, and the absence or small numbers of rusty blackbirds in mixed-species flocks of blackbirds, activities under this alternative are not likely to have effects on the rusty blackbird population. Under this alternative, the TWSP would continue monitoring activities to evaluate the potential effects on the populations of target bird species, including rusty blackbirds. The monitoring process would allow WS to adapt and modify activities to avoid any potential effects on the rusty blackbird population.

The take of rusty blackbirds can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of rusty blackbirds by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for rusty blackbirds.

YELLOW-HEADED BLACKBIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The breeding habitat of yellow-headed blackbirds includes deep-water, emergent wetlands within prairie and mountain meadows in the Western and Central United States and Canada (Twedt and Crawford 2020). Wintering populations of yellow-headed blackbirds range from the southern portion of Arizona, New Mexico, and Texas south through Mexico (Twedt and Crawford 2020). Breeding populations of yellow-headed blackbirds migrate southward during the migration period in late August and early September and return north in April and May. During the migration periods, small flocks of yellow-headed blackbirds form mixed species flocks with red-winged blackbirds and other blackbird species, congregating in staging areas (Twedt and Crawford 2020).

In Texas, yellow-headed blackbirds occur during the breeding season in extreme northern portion of the state near the panhandle portion of Oklahoma. In addition, yellow-headed blackbirds occur statewide during the migration periods as yellow-headed blackbirds migrate between breeding and wintering areas. Yellow-headed blackbirds also winter in western Texas and along the southern edge of the state (Twedt and Crawford 2020). From 1966 through 2019, the number of yellow-headed blackbirds observed in areas of Texas surveyed during the BBS has shown an increasing trend estimated at 1.7% annually. However, from 2009 through 2019, the number of yellow-headed blackbirds observed in areas of the state surveyed during the BBS has shown a declining trend estimated at -7.1% per year (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 2,803 yellow-headed blackbirds with CPS breeding population estimated at nearly 4.2 million yellow-headed blackbirds. From 1970 through 2019, the number of yellow-headed blackbirds observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 10.0% per year (National Audubon Society 2020). The number of yellow-headed blackbirds that migrate through and winter in Texas is unknown.

As with the other blackbird species addressed by the TWSP, the population likely peaks during the late summer after the breeding season when hatch year birds (*i.e.*, birds born that breeding season) join with adults before the fall migration. Most requests involving yellow-headed blackbirds occur during the fall migration period as mixed species flocks of blackbirds, including yellow-headed blackbirds, migrate through and winter in the state. Peer et al. (2003) calculated the breeding population in the northern Great Plains of North America to be over 11.6 million yellow-headed blackbirds and the fall population to be over 16.8 million yellow-headed blackbirds. Peer et al. (2003) calculated the fall blackbird population in the northern Great Plains of North America by multiplying the breeding population in the region by 1.45 based on work Stehn (1989) conducted. Using this technique, the fall post-breeding population in the CPS could be nearly 6.1 million yellow-headed blackbirds based on a breeding population estimated at nearly 4.2 million yellow-headed blackbirds.

Using those reproductive parameters that Twedt and Crawford (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for red-winged blackbirds. If there were one female for every male in the population of 4.2 million breeding yellow-headed blackbirds, every female laid eggs, and females only produced one successful nest per year, then yellow-headed blackbirds build approximately 2.1 million nests in the CPS. The number of fledglings per nest appears to vary from 1 to 2 fledgling per nest (Twedt and Crawford 2020). Based on one fledgling per nest, approximately 2.1 million fledglings successfully leave nests each year. A peak post-breeding fall population in the CPS could be approximately 6.3 million yellow-headed blackbirds using the average number of fledglings that successfully leave nests that Twedt and Crawford (2020) summarize. The peak post-breeding population would only occur if the entire breeding population of 4.2 million yellow-headed blackbirds survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time. The number of yellow-headed blackbird that winter in Texas or pass through Texas during the migration periods is unknown.

No lethal take of yellow-headed blackbirds by the TWSP occurred from FY 2017 through FY 2019. However, the TWSP could address yellow-headed blackbirds if they were causing damage or posing a threat of damage and if they were part of mixed species flock of blackbirds. From FY 2017 through FY 2019, WS in other states only lethally removed yellow-headed blackbirds in FY 2018 and FY 2019. In FY 2018, WS in other states lethally removed one yellow-headed blackbird and in FY 2019, WS in other states lethally removed 83 yellow-headed blackbirds to alleviate damage or threats of damage. Activities to alleviate damage associated with blackbirds, including yellow-headed blackbirds, could also occur by entities other than WS. As discussed previously, under certain conditions, people can take yellow-headed blackbirds without the need for a depredation permit pursuant to 50 CFR 21.43. Although private individuals are required to report the number and species of blackbirds lethally removed to the USFWS, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of blackbirds goes unreported. However, some annual take is likely to occur by private individuals. It is reasonable to predict that the number of blackbirds lethally removed by private individuals is minimal because the primary method that people use to alleviate damage would be shooting, which has limitations for killing blackbirds. Private individuals use firearms primarily as a form of harassment rather than to remove blackbirds, despite some limited take likely occurring. Annual take would have to reach 63,000 yellow-headed blackbirds to represent 1% of a post-breeding population estimated at 6.3 million yellow-headed blackbirds. However, WS does not anticipate cumulative take to reach 63,000 yellow-headed blackbirds given the limited cumulative take that has occurred previously.

The IUCN has ranked the yellow-headed blackbird as a species of "*least concern*" based on the "*species…extremely large range…*", "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2016*c*). The TWSP would monitor activities to evaluate the potential effects on the populations of yellow-headed blackbirds associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of yellow-headed blackbirds. The TWSP would continue to report the take of yellow-headed blackbirds to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for yellow-headed blackbirds.

EUROPEAN STARLING POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

As their common name implies, European starlings are native to Europe. Colonization of North America by the European starling began in 1890 when a person with good intentions released 80 starlings into Central Park within New York City. The released birds were able to exploit the resources in the area and have since spread throughout the continent. By 1918, the distribution range of migrant juveniles extended from Ohio to Alabama. By 1926, the distribution of starlings in the United States had moved westward and encompassed an area from Illinois to Texas. Continued westward expansion had occurred by 1941 with populations expanding from Idaho to New Mexico. By 1946, the range of starlings had expanded to California and western Canadian coasts (Miller 1975). In just 50 years, the starling had colonized the United States and expanded into Canada and Mexico. After 80 years from the initial introduction, the starling had become one of the most common birds in North America (Feare 1984, Cabe 2020).

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

In Texas, starlings occur statewide and throughout the year (Cabe 2020). From 1966 through 2019, the number of starlings observed along routes surveyed during the BBS has shown an increasing trend in the state estimated at 1.2% annually. However, from 2009 through 2019, starlings have shown a declining trend in the state estimated at -0.5% per year (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at over 1.4 million European starlings. However, it must be noted that large numbers of starlings occur in urban areas and BBS routes often do not account for these populations because most BBS routes are more often run in areas that are rural. Thus, BBS data are more likely to reflect the number of starlings in rural areas and not include the urban populations which would likely be the higher number. From 1970 through 2019, the number of European starlings observed in those areas of the state surveyed during the CBC has shown a declining trend estimated at -0.2% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 237 European starlings per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 339 European starlings. The take of 339 European starlings would represent 0.02% of the estimated breeding population. However, most requests to address large roosts occur during migration periods and during the winter when the population likely increases above the 1.4 million starlings estimated to nest in the state. The increase in the statewide population is a result of migrants arriving in the state and the presence of juveniles in the population. Homan et al. (2017) indicated that annual mortality of European starlings ranges from 40% to 50% and could vary from 30% to 80% depending on location and weather conditions. An estimated 60 to 75 million European starlings die from natural causes each year in North America (Homan et al. 2017). Causes of mortality include disease, predation, and starvation, but none of those activities likely regulates the population of European starlings (Homan et al. 2017). Homan et al. (2017) indicated the major factor limiting the European starling population was the availability of nest sites. The annual lethal removal of European starlings by the national WS program, including those European starlings lethally removed annually in Texas, are a small percentage of the number of European starlings that die from natural causes (Homan et al. 2017).

Because European starlings are a non-native species in North America, the MBTA does not afford European starlings protection from take. A depredation permit from the USFWS is not required for people to take European starlings and there are no requirements to report the take of European starlings to the USFWS; therefore, the number of European starlings that other entities lethally remove in Texas is unknown. Annual take would have to reach 14,000 European starlings to represent 1% of the breeding population in Texas estimated at 1.4 million European starlings.

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

ROCK PIGEON POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Rock pigeons are a non-indigenous species that European settlers first introduced into the United States as a domestic bird for sport, carrying messages, and as a source of food (Schorger 1952, Lowther and Johnston 2020). Many of those birds escaped and eventually formed the feral pigeon populations that now occur throughout the United States, southern Canada, and Mexico (Lowther and Johnston 2020). Rock pigeons are non-migratory and are closely associated with people, where human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994, Lowther and Johnston 2020). Thus, pigeons commonly occur around city buildings, bridges, parks, farmyards, grain elevators, feed mills, and other manmade structures (Williams and Corrigan 1994, Lowther and Johnston 2020). Additionally, although pigeons are primarily grain and seed eaters, they will readily feed on garbage, livestock manure, spilled grains, insects, and any other available bits of food (Williams and Corrigan 1994, Lowther and Johnston 2020).

In Texas, pigeons occur statewide throughout the year (Lowther and Johnston 2020). The number of rock pigeons observed along routes surveyed during the BBS in the state have shown an increasing trend since 1966, which has been estimated at 0.6% annually, with a 1.9% annual increase from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at over 445,300 rock pigeons. However, it must be noted that large numbers of rock pigeons occur in urban areas and BBS routes often do not account for these populations because most BBS routes are more often run in areas that are rural. Thus, BBS data are more likely to reflect the number of rock pigeons in rural areas and not include the urban populations which would likely be the higher number.

From FY 2017 through FY 2019, the TWSP lethally removed an average of 1,458 rock pigeons per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 2,099 rock pigeons. The take of 2,099 rock pigeons would represent 0.5% of the estimated breeding population. Because rock pigeons are a non-native species in North America, the MBTA does not afford rock pigeons protection from take. A depredation permit from the USFWS is not required for people to take rock pigeons and there are no requirements to report the take of rock pigeons to the USFWS; therefore, the number of rock pigeons that other entities lethally remove in Texas is unknown. Annual take would have to reach nearly 4,500 rock pigeons to represent 1% of the breeding population in Texas estimated at 445,300 rock pigeons.

Activities associated with rock pigeons would occur pursuant to Executive Order 13112 and Executive Order 13751, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and associated damage.

HOUSE SPARROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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

In Texas, the number of house sparrows observed in areas surveyed during the BBS has shown a downward trend estimated at -3.2% annually since 1966 (Sauer et al. 2020). From 2009 through 2019, the number of house sparrows observed along BBS routes in the state has also shown a declining trend estimated at -4.7% annually (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at over 4.9 million house sparrows. However, it must be noted that large numbers of house sparrows occur in urban areas and BBS routes often do not account for these populations because most BBS routes are more often run in areas that are rural. Thus, BBS data are more likely to reflect the number of house sparrows in rural areas and not include the urban populations which would likely be the higher number. From 1970 through 2019, the number of house sparrows observed annually in areas of Texas surveyed during the CBC has shown a declining trend estimated at -2.2% per year (National Audubon Society 2020).

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

From FY 2017 through FY 2019, the TWSP lethally removed an average of 35 house sparrows per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 100 house sparrows. The take of 100 house sparrows would represent 0.002% of the estimated breeding population. Because house sparrows are a non-native species in North America, the MBTA does not afford house sparrows protection from take. A depredation permit from the USFWS is not required for people to take house sparrows and there are no requirements to report the take of house sparrows to the USFWS; therefore, the number of house sparrows that other entities lethally remove in Texas is unknown. Annual take would have to reach 49,000 house sparrows to represent 1% of the breeding population in Texas estimated at 4.9 million house sparrows.

Activities associated with rock pigeons would occur pursuant to Executive Order 13112 and Executive Order 13751, which states that each federal agency whose actions may affect the status of invasive species shall reduce invasions of exotic species and associated damage.

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

The Eurasian collared-dove is another species that is not native to North America. The first introductions of the Eurasian collared-dove to North America occurred in the Bahamas during the mid-1970s. Since the introductions in the Bahamas, Eurasian collared-doves have quickly expanded their range throughout North America and Central America. Eurasian collared-doves occur primarily in urban, suburban, and agricultural areas (Romagosa 2020). Outside of the breeding season, Eurasian collared-doves tend to be gregarious and can mix with flocks of mourning doves (Romagosa 2020).

Eurasian collared-doves occur statewide throughout the year in Texas (Romagosa 2020). Since 1966, data from the BBS indicates the breeding population of Eurasian collared-doves has increased annually in Texas at an estimated rate of 16.6%, with an annual increase of 3.5% occurring from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at nearly 2 million Eurasian collared-doves. The number of Eurasian collared-doves observed in areas of the state surveyed during the CBC has shown an increasing trend in the state from 1970 to 2019 estimated at 43.0% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 16 Eurasian collared-doves per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 28 Eurasian collared-doves. The take of 28 Eurasian collared-doves would represent 0.001% of the estimated breeding population. Because Eurasian collared-doves are a non-native species in North America, the MBTA does not afford Eurasian collared-doves protection from take. A depredation permit from the USFWS is not required for people to take Eurasian collared-doves and there are no requirements to report the take of Eurasian collared-doves to the USFWS; therefore, the number of Eurasian collared-doves that other entities lethally remove in Texas is unknown. Annual take would have to reach 20,000 Eurasian collared-doves to represent 1% of the breeding population in Texas estimated at 2 million Eurasian collared-doves.

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

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

FERAL POULTRY, WATERFOWL, AND OTHER DOMESTIC SPECIES POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Free-ranging or feral domestic fowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, swans, peafowl, chickens, and other fowl. Examples of domestic waterfowl include, but are not limited to mute swans, Muscovy ducks, pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, Egyptian geese, khaki Campbell ducks, embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy ducks, and mallard-Muscovy hybrids.

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

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

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

Feral domestic ducks, geese, swans, peafowl, chickens, and other fowl are non-indigenous species considered by many wildlife biologists and ornithologists to be an undesirable component of North American wild and native ecosystems. Any reduction in the number of those domestic waterfowl species could provide some benefit to other native bird species because they compete with native wildlife for resources. Domestic and feral waterfowl usually occur near water, such as ponds, lakes, retaining pools, and waterways. Domestic and feral fowl generally reside in the same area throughout the year with little to no migration occurring. Currently, there are no population estimates for domestic and feral fowl in Texas. Federal and state laws do not protect domestic and feral fowl from take and neither the USFWS nor the TPWD consider domestic waterfowl for population goal requirements for wild waterfowl, except for certain portions of the Muscovy duck population.

Because Muscovy ducks now occur naturally in southern Texas, the USFWS has added Muscovy ducks to the list of migratory birds provided protections under the MBTA; however, people have introduced the domesticated Muscovy duck into other parts of the United States where Muscovy ducks are not native, including Texas. The USFWS now prohibits sale, transfer, or propagation of Muscovy ducks for hunting and any other purpose other than food production and allows their removal in locations where the species does not occur naturally in the United States. The USFWS has revised 50 CFR 21.14 (permit exceptions for captive-bred migratory waterfowl other than mallards), 50 CFR 21.25 (waterfowl sale and disposal permits), and has added 50 CFR 21.54, a control order to allow people to address Muscovy ducks, their nests, and eggs without the need for a depredation permit.

People introduced mute swans to North America in the 1800s for their esthetic value (Ciaranca et al. 2020). The bright, orange-red bill distinguishes the mute swan from the native trumpeter swans and tundra swans, both of which have black bills. This adaptable species can occur in a variety of aquatic habitats from municipal parks, coastal ponds, lakes, and slow-moving rivers (Ciaranca et al. 2020). Some concerns exist regarding the effects on native ecosystems (*e.g.*, overgrazing of aquatic vegetation, displacing native waterfowl, and contamination of water supplies with fecal waste) from mute swans

(Ciaranca et al. 2020). Due to the species' non-native status, the MBTA does not afford protection to the species and people can remove mute swans at any time without a depredation permit from the USFWS.

Several species of domestic waterfowl are common in parks and lakes in Texas, as well as chickens and other gallinaceous birds. These species are often released at parks and other areas intentionally by owners as ornamentals or by people who can no longer keep them. They are often released without landowner permission. Their numbers can grow and often surpass the carrying capacity of the area. The various species of waterfowl can create severe problems including damage to landscaping and grass, water contamination, disease, and hybridizing with wild waterfowl. The chickens and other poultry are more of a nuisance and typically do not cause as much damage as waterfowl. The TWSP lethally removed an average of 35 ducks and 5 geese from FY 2017 through FY 2019 (see Table 3.1). No other feral domestic poultry were taken from FY 2017 through FY 2019, but the TWSP has addressed feral chickens, guineas, and peafowl in the past. Additionally, the TWSP has captured feral ducks and feral geese and gave them to people that raised them (*e.g*., farmers). The number of feral fowl present in the state is currently unknown; however, because feral fowl often compete with native wildlife species for resources, any reduction of the feral fowl population in the state, even to the extent of complete eradication from the natural environment, could provide some benefit.

EXOTIC BIRD POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Texas has many exotic birds that have escaped captivity or have been intentionally released. Some of those species can damage different resources and the TWSP may be contacted to conduct activities to alleviate damage or threats of damage associated with those species. The TWSP did not lethally take any exotic bird species from FY 2017 through FY 2019 but did take one monk parakeet in the past. Thus, only one exotic bird, other than those discussed above, has been taken by TWSP. The take of these species has no effect on the human environment because they are not indigenous components of ecosystems in Texas. In fact, for most species, it would be seen as beneficial for their removal so a population does not get started, as with the monk parakeet, which has caused thousands of dollars damage to the power industry. TWSP expects that the take of exotics will remain fairly low because most do not have established populations.

AMERICAN CROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

American crows have a wide range, are extremely abundant, and are found all across the United States and Canada (Verbeek and Caffrey 2020). America crows occur in a variety of habitats, particularly areas with scattered trees and small woodlots. The range and population of American crows expanded as European settlers began clearing forests, planting trees around homesteads in the prairies, and tilling the soil for agricultural production (Verbeek and Caffrey 2020). The American crow population has increased throughout its range, especially in more urbanized environments and western states (Marzluff et al. 2001).

American crows are present throughout the year in eastern Texas (Verbeek and Caffrey 2020). From 1966 through 2019, the number of American crows observed along routes surveyed in Texas during the BBS has shown a stable trend, with a -2.9% annual decline occurring from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at 930,000 American crows. The number of American crows present in Texas increases each year during the winter migration period as crows that nest farther north spend the winter in the state. Winter numbers likely are affected by climatic conditions such as colder winters in states further north. Estimates on historical roosts showed millions of crows concentrated in communal roosts throughout the southern tier of states (Johnson 1994). However, the number of American crows present in a roost varies from roost to roost and from year to year. The arrival of wintering crows in Texas coincides with the harvest of several important agricultural commodities (*e.g*., pecans and peanuts) that are damaged by crows. The number of American crows observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019, estimated at 0.6% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 43 American crows per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 83 American crows. The take of 83 American crows by the TWSP would represent 0.01% of the estimated breeding population in Texas. Take by the TWSP would have to increase to 9,300 American crows to represent 1% of the of the breeding population in Texas.

The current fall population of American crows in the state is currently unknown. However, using those reproductive parameters that Verbeek and Caffrey (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for other bird species. For American crows, the analysis will use one female for every male for the state breeding population of estimated at 930,000 American crows. Using a 1:1 sex ratio, there are approximately 465,000 female America crows that nest in the state. Verbeek and Caffrey (2020) reported 65.6% of the American crow consisted of adults; therefore, approximately 305,040 adult female American crows occur in the state and likely nest.

In general, American crows only produce one brood per season but may renest if their first attempt fails. Verbeek and Caffrey (2020) reported that the mean number of fledglings per nest in urban areas was 1.62 fledglings with a 1.64 fledglings per nest in rural areas. Using 1.62 fledglings per nest and 305,040 nests in the state, a peak post-breeding fall population in the state could be approximately 1.4 million American crows using those parameters that Verbeek and Caffrey (2020) summarize. The peak post-breeding population would only occur if the entire breeding population of 930,000 American crows survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time. Take by the TWSP would have to increase to nearly 14,000 American crows to represent 1% of the of the post-breeding population in Texas. Many of the activities conducted by the TWSP would occur in the fall and winter when American crows that nest further north and winter in Texas would also be present in the state; therefore, the fall and winter population in Texas is likely higher than the post-breeding population estimate.

As discussed previously, people can take blackbirds, including American crows, without a depredation permit from the USFWS under the blackbird depredation order (see 50 CFR 21.43). Pursuant to the blackbird depredation order, the USFWS requires that people report the number of American crows they take each year. However, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of American crows pursuant to the depredation order goes unreported. The number of American crows lethally removed by private individuals to alleviate damage is likely minimal because the primary method that people use to alleviate damage is shooting, which has limitations for killing crows. Private individuals use firearms primarily as a form of hazing rather than to remove crows, despite some limited take likely occurring. In addition, many states allow people to harvest American crows during annual hunting seasons; however, no American crow hunting season exists in Texas.

The TWSP would monitor activities to evaluate the potential effects on the populations of American crows associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of American crows. The TWSP would continue to report the take of American crows to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for American crows.

COMMON RAVEN POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The common raven, the largest bodied of the passerines, is widely distributed throughout the Holarctic Regions of the world including Europe, Asia, and North America (Goodwin 1986, Boarman and Heinrich 2020). In Texas, common ravens are most common in west (Big Bend area) and central Texas (San Angelo to Del Rio) with some found in the far north area of the panhandle. In most areas, common ravens are year-round residents with little evidence of migration from radio-tagged or marked populations in North America (Goodwin 1986, Boarman and Heinrich 2020). However, the species has been known to move into areas just outside its range during the non-breeding season. Further, there is some question as to whether some of the birds in flocks of floaters may be migrants (Boarman and Heinrich 2020). Floaters are primarily immature and non-breeding common ravens (*i.e*., fledglings, 1- and 2-year old ravens) that typically will band together in flocks of 50 or more. These flocks tend to be loose-knit and wide-ranging (Goodwin 1986).

From 1966 through 2019, the number of common ravens observed along routes surveyed in Texas during the BBS has shown an increasing trend estimated at 1.5%, with a 4.0% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at 25,400 common ravens. The number of common ravens observed in areas of the state surveyed during the CBC has shown an increasing trend from 1970 through 2019, estimated at 4.6% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 142 common ravens per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 170 common ravens. The take of 170 common ravens by the TWSP would represent 0.7% of the estimated breeding population in Texas.

The current fall population of common ravens in Texas is currently unknown. However, using those reproductive parameters that Boarman and Heinrich (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for other bird species. For common ravens, the analysis will use one female for every male for the state breeding population of estimated at 25,400 common ravens. Using a 1:1 sex ratio, there are approximately 12,700 female common ravens in the state. In general, common ravens only produce one brood per season but may renest if their first attempt fails. Common ravens do not breed until their third year, though some unsuccessful attempts to nest have been documented for 2-year old ravens (Boarman and Heinrich 2020). The percentage of the common raven population that nests each year is unknown. Verbeek and Caffrey (2020) reported 65.6% of the American crow consisted of adults. If the common raven population is similar, then approximately 8,331 adult female common ravens occur in the state and likely nest.

Common ravens have one nest per year, renesting if the first attempt fails, with a typical clutch size of 3 to 7 eggs, averaging 5.3 eggs (Boarman and Heinrich 2020). Therefore, if 8,331 female common ravens lay an average of 5.3 eggs per nest, there are 44,154 eggs laid per year in Texas. Fledgling success (number fledged per number of eggs) varies in common raven populations, but the lowest fledgling success rate reported by Boarman and Heinrich (2020) was 31% in a Wyoming study. If only 31% of the 44,154 eggs fledge, then approximately 13,687 fledglings are recruited into the common raven population in Texas during the fall. If 13,687 fledglings are recruited into the breeding population, then the fall population would be 39,087 common ravens. The peak post-breeding population would only occur if the entire breeding population of 25,400 common ravens survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time. Take by the TWSP would have to increase to nearly 390 common ravens to represent 1% of the of the post-breeding population in Texas.

The TWSP would monitor activities to evaluate the potential effects on the populations of common ravens associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of common ravens. The TWSP would continue to report the take of common ravens to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for common ravens.

CHIHUAHUAN RAVEN POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Chihuahuan ravens tend to be more widely distributed and gregarious, even during the breeding season, and inhabit lower elevations than common ravens. They can be found from the panhandle to south Texas along the Rio Grande Valley and west. Ravens are considered migratory birds and managed under the Migratory Bird Treaty Act by USFWS (Dwyer et al. 2020). From 1966 through 2019, the number of Chihuahuan ravens observed along routes surveyed in Texas during the BBS has shown a decreasing trend estimated at -1.0%, with a -0.6% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current data from the BBS, the breeding population in Texas is estimated at 59,620 Chihuahuan ravens. The number of Chihuahuan ravens observed in areas of the state surveyed during the CBC has shown a declining trend from 1970 through 2019, estimated at -4.3% per year (National Audubon Society 2020).

The current fall population of Chihuahuan ravens in Texas is currently unknown. However, using those reproductive parameters that Dwyer et al. (2020) summarize and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for other bird species. For Chihuahuan ravens, the analysis will use one female for every male for the state breeding population of estimated at 59,620 Chihuahuan ravens. Using a 1:1 sex ratio, there are approximately 29,810 female Chihuahuan ravens in the state. In general, Chihuahuan ravens only produce one brood per season. The percentage of the Chihuahuan raven population that nests each year is unknown. Verbeek and Caffrey (2020) reported 65.6% of the American crow consisted of adults. If the Chihuahuan raven population is similar, then approximately 19,555 adult female Chihuahuan ravens occur in the state and likely nest.

In Texas, Chihuahuan ravens averaged 5.2 eggs per nest with a 1.9 fledged chicks per nest (Dwyer et al. 2020). Therefore, if 19,555 female Chihuahuan ravens lay an average of 5.2 eggs per nest, there are 101,686 eggs laid per year in Texas; however, if only 1.9 chicks fledge per nest, then 37,155 Chihuahuan ravens fledge each fall. If 37,155 Chihuahuan raven fledglings are recruited into the breeding population, then the fall population would be 96,775 Chihuahuan ravens. The peak post-breeding population would only occur if the entire breeding population of 59,620 Chihuahuan ravens survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time.

From FY 2017 through FY 2019, no lethal take of Chihuahuan ravens occurred by the TWSP. However, the TWSP could address Chihuahuan ravens to alleviate damage or threats of damage in the state. Take by the TWSP would have to increase to nearly 968 Chihuahuan ravens to represent 1% of the of the post-breeding population in Texas. The TWSP would monitor activities to evaluate the potential effects on the populations of Chihuahuan ravens associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of Chihuahuan ravens. The TWSP would continue to report the take of Chihuahuan ravens to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for Chihuahuan ravens.

FISH CROW POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Historically, the fish crow occurred in the coastal and tidewater areas of the southeastern United (McGowan 2020). However, fish crows have adapted well to human altered environments and have expanded their range to include areas along the coast of the eastern United States as far north as Maine. Fish crows occur throughout the year in extreme eastern Texas slightly west of the border with Louisiana, Arkansas, and Oklahoma (McGowan 2020).

From 1966 through 2019, the number of fish crows observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 6.4% per year with a 5.4% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 8,942 fish crows. From 1970 through 2019, the number of fish crows counted in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 0.3% per year (National Audubon Society 2020).

The current fall population of fish crows in Texas is currently unknown. However, using those reproductive parameters that McGowan (2020) summarizes and based on several assumptions, additional estimations of the fall population are possible. Those assumptions would be similar to those discussed for other bird species. For fish crows, the analysis will use one female for every male for the state breeding population of estimated at 8,942 fish crows. Using a 1:1 sex ratio, there are approximately 4,472 female fish crows in the state. In general, fish crows only produce one brood per season. The percentage of the fish crow population that nests each year is unknown. Verbeek and Caffrey (2020) reported 65.6% of the American crow consisted of adults. If the fish crow population is similar, then approximately 2,933 adult female fish crows occur in the state and likely nest.

McGowan (2020) reported the number of fledglings produced per total number of nests averaged 1.4 in Florida and 1.2 in central New York. If only 1.2 chicks fledge per nest, then 3,520 fish crows fledge each fall. If 3,520 fish crow fledglings are recruited into the breeding population, then the fall population would be 12,462 fish crows. The peak post-breeding population would only occur if the entire breeding population of 8,942 fish crows survived until all the fledglings were recruited into the population and all the fledglings were recruited at the same time.

From FY 2017 through FY 2019, no lethal take of fish crows occurred by the TWSP. However, the TWSP could address fish crows to alleviate damage or threats of damage in the state. Take by the TWSP would have to increase to nearly 125 fish crows to represent 1% of the of the post-breeding population in Texas.

As discussed previously, people can take blackbirds, including fish crows, without a depredation permit from the USFWS under the blackbird depredation order (see 50 CFR 21.43). Pursuant to the blackbird depredation order, the USFWS requires that people report the number of fish crows they take each year. However, it is unknown whether the reported take accurately reflects the actual take because it is likely that some take of fish crows pursuant to the depredation order goes unreported. The number of fish crows lethally removed by private individuals to alleviate damage is likely minimal because the primary method that people use to alleviate damage is shooting, which has limitations for killing crows. Private individuals use firearms primarily as a form of hazing rather than to remove crows, despite some limited take likely occurring. In addition, many states allow people to harvest fish crows during annual hunting seasons; however, no fish crow hunting season exists in Texas.

The TWSP would monitor activities to evaluate the potential effects on the populations of Chihuahuan ravens associated with activities conducted by the TWSP; therefore, the TWSP could identify and monitor any changes in the population of Chihuahuan ravens. The TWSP would continue to report the take of Chihuahuan ravens to the USFWS; therefore, the USFWS would have the opportunity to monitor take and consider take in any population objectives they establish for Chihuahuan ravens.

JAY POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Texas hosts six species of jays that are fairly common at some point in the year, which have the potential to cause damage. The blue jay, Woodhouse's scrub-jay, and the green jay are the most common jay species in Texas. The blue jay occurs in eastern Texas, the Woodhouse's scrub-jay occurs in western Texas, and the green jay occurs in south Texas. Those species occur throughout the year in Texas. The Steller's jay occurs through the year in extreme western Texas, the pinyon jay is an erratic visitor to the panhandle and western Texas, and the Mexican jay is a resident along the upper Rio Grande Valley. Table 3.7 shows the estimated breeding populations for each jay species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas. The USFWS (2021*a*) considers the pinyon jay and the Woodhouse's scrub-jay to be birds of conservation concern. Those species are likely declining because of habitat modifications and losses (Curry et al. 2020, Johnson and Balda 2020).

Table 3.7 – Texas breeding population estimates and trend data for several jay species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Blue Jay	600,018	0.2%	-1.1%	0.2%	0.3%
Woodhouse's Scrub-jay	33,931	-3.1%	-3.1%	-0.6%	-5.8%
Green Jay	51,338	6.4%	3.9%	3.9%	2.4%
Steller's Jay	211	-	-	0.1%	-3.3%
Pinyon Jay	-	-	-	-17.2	-12.0%
Mexican Jay	10,552	-	-	-2.4%	-2.3%

From FY 2017 through FY 2019, no take of jays occurred by the TWSP. Of the six jay species that could occur in Texas, the TWSP is likely to only receive requests for assistance to address blue jays that are causing damage or posing a threat of damage. Annual take would have to reach 6,000 blue jays to represent 1% of a breeding population estimated at 600,018 blue jays in Texas. The TWSP could address other jay species if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers. The take of jay species can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of jays by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for the six jay species that could occur in Texas.

BLACK-BILLED MAGPIE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

In North America, the black-billed magpie occurs over much of western United States and Canada (Trost 2020). Black-billed magpies prefer thickets in riparian areas that are often associated with open meadows, grasslands, or sagebrush. During the winter, black-billed magpies occupy similar habitats but often occur near habitats manipulated by people, such as livestock feedlots, barnyards, landfills, sewage lagoons, and grain elevators (Trost 2020).

Black-billed magpies occur infrequently in north and west Texas and when they do occur in Texas, it is primarily during the winter (Trost 2020). Because black-billed magpies rarely occur in Texas, trend data from the BBS and the CBC are not available for Texas. Across all routes surveyed during the BBS, the number of black-billed magpies observed has shown a declining trend estimated at -0.3% from 1966 through 2019 (Sauer et al. 2020). From 1970 through 2019, the number of black-billed magpies observed in areas surveyed during the CBC has shown an increasing trend estimated at 0.4% per year (National Audubon Society 2020). Black-billed magpies are showing declines across much of the north-central United States. The West Nile virus may be the main contributing factor to the decline (Brenner and Jorgensen 2020).

From FY 2017 through FY 2019, no take of black-billed magpies occurred by the TWSP. The TWSP could address other black-billed magpies if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing black-billed magpies infrequently and in low numbers. Like other blackbird species, the take of black-billed magpies can occur under the blackbird depredation order, which allows people to take blackbirds, including black-billed magpies, when those species are committing damage without the need for a depredation permit from the USFWS. Similarly, the take of black-billed magpies can occur without prior authorization from the TPWD. Due to recent population declines, the Central Flyway Council has requested the USFWS to consider removing the black-billed magpie from the list of species included in the blackbird depredation order. If the USFWS removed the black-billed magpie from list of species included in the blackbird depredation order, all take would require a depredation permit from the USFWS and, in Texas, the TPWD may then require authorization. Therefore, if USFWS removed black-billed magpies from the blackbird depredation order, any take by WS would occur pursuant to depredation permits issued by the USFWS and, if required, authorizations provided by the TPWD.

The number of black-billed magpies lethally removed by private individuals to alleviate damage is likely minimal because the primary method that people use to alleviate damage is shooting, which has limitations for killing black-billed magpies. Private individuals use firearms primarily as a form of harassment rather than to remove magpies, despite some limited take likely occurring. In addition, black-billed magpies do not frequently occur in the state.

BLACK VULTURE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Historically, black vultures occurred in the southeastern United States along with Texas, parts of Arizona, and Mexico (Buckley 2020). However, black vultures are expanding their range northward in the eastern United States and now occur as far north as Vermont and New Hampshire (Wilbur 1983, Rabenold and Decker 1989, Buckley 2020). In winter, black vultures migrate south from the most northern part of their range but are a locally resident species throughout much of their range (Parmalee and Parmalee 1967, Rabenold and Decker 1989). Black vultures occur in virtually all habitats but are most abundant where forest interrupts open land. Nesting occurs in caves, crevices among rocks, brush piles, thickets, abandoned buildings, and in hollow logs, stumps, and tree trunks (Buckley 2020).

In Texas, black vultures occur throughout the year primarily in the eastern half of the state (Buckley 2020). According to BBS trend data provided by the Sauer et al. (2020), the number of black vultures observed in the state during the breeding season has increased at an annual rate of 5.1% since 1966, with a 2.0% annual increase occurring from 2009 through 2019. Using current BBS data, the statewide breeding population is estimated to be 797,949 black vultures. From 1970 through 2019, the number of black vultures observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 6.2% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 2,226 black vultures per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 2,342 black vultures. The TWSP anticipates future take of black vultures to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 2,342 black vultures by the TWSP represented 0.3% of the breeding population in Texas estimated at 797,949 black vultures.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of black vultures in Texas. From 2017 through 2019, entities issued depredation permits to take black vultures reported an average take of 138 black vultures per year in Texas and Oklahoma with the highest reported annual take occurring in 2019 when entities reported the lethal take of 409 black vultures in Texas and Oklahoma (see Table 3.2). The cumulative lethal take of black vultures would have to increase to nearly 8,000 black vultures to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state.

The take of black vultures can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of black vultures by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for black vultures in Texas.

TURKEY VULTURE POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Turkey vultures occur throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenhold and Decker 1989, Kirk and Mossman 2020). Turkey vultures prefer areas that include a mix of farmland and forest. Turkey vultures nest on the ground in thickets, stumps, hollow logs, or abandoned buildings (Kirk and Mossman 2020). Turkey vultures often roost in large groups near homes or other buildings where they can cause property damage from droppings or by pulling and tearing shingles. Turkey vultures feed on a wide range of wild and domestic carrion (Kirk and Mossman 2020).

Turkey vultures occur statewide throughout the year in Texas (Kirk and Mossman 2020). According to BBS trend data provided by the Sauer et al. (2020), the number of turkey vultures observed in the state during the breeding season has increased at an annual rate of 0.7% since 1966; however, from 2009 through 2019, the number of turkey vultures observed along routes surveyed during the BBS has shown a declining trend estimated at -0.5% per year. Using current BBS data, the statewide breeding population is estimated to be over 2.3 million turkey vultures. From 1970 through 2019, the number of turkey vultures observed in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 2.6% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 131 turkey vultures per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 160 turkey vultures. The TWSP anticipates future take of turkey vultures to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 160 turkey vultures by the TWSP represented 0.01% of the breeding population in Texas estimated at over 2.3 million turkey vultures.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of turkey vultures in Texas. From 2017 through 2019, entities issued depredation permits to take turkey vultures reported an average take of 96 turkey vultures per year in Texas and Oklahoma with the highest reported annual take occurring in 2019 when entities reported the lethal take of 145 turkey vultures in Texas and Oklahoma (see Table 3.2). The cumulative lethal take of turkey vultures would have to increase to over 23,000 turkey vultures to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state.

The take of turkey vultures can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of turkey vultures by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for turkey vultures in Texas.

CRESTED CARACARA POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Crested caracaras occur primarily in parts of Mexico, Central America, and northern South America; however, their range does extend into south central Texas, along the Arizona-Mexico border, and central Florida (Morrison and Dwyer 2020). The crested caracara is associated with open habitats consisting of grasslands, prairies, pastures, or deserts with scattered taller trees, shrubs, or cactus. Crested caracaras are similar to vultures in feeding behaviors, often scavenging with them, but are more closely related to the falcons. They scavenge frequently, but spend a lot of time hunting for insects, other invertebrates, and small vertebrates especially when they walk along the ground (Morrison and Dwyer 2020).

From 1966 through 2019, the number of crested caracaras observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 5.6% per year with a 4.4% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 98,685 crested caracaras. From 1970 through 2019, the number of crested caracaras counted in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 9.5% per year (National Audubon Society 2020). The crested caracara population has likely increased as a result of habitat modifications, such as land-clearing (Morrison and Dwyer 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 23 crested caracaras per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 27 crested caracaras. The TWSP anticipates future take of crested caracaras to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 27 crested caracaras by the TWSP represented 0.03% of the breeding population in Texas estimated at 98,685 crested caracaras.

In addition to the take by the TWSP, the USFWS could issue depredation permits to other entities for the take of crested caracaras in Texas. From 2017 through 2019, no reported take of crested caracaras occurred in Texas and Oklahoma (see Table 3.2). The cumulative lethal take of black vultures would have to increase to nearly 1,000 crested caracaras to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state.

The take of crested caracaras can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of crested caracaras by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for crested caracaras in Texas.

SWAINSON'S HAWK POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The Swainson's hawk nests in grass-dominated vegetation, sparse shrublands, and open woodlands from eastern Alaska and western Canada southward through the western United States and northern Mexico (Bechard et al. 2020). During the fall, Swainson's hawks migrate from their nesting areas to winter areas in southern South America. Swainson's hawks often forage and migrate in flocks, which can number in the thousands (Bechard et al. 2020).

In Texas, Swainson's hawks nest in west Texas and migrate through the state as Swainson's hawks move between nesting areas further north and their wintering areas in southern South America (Bechard et al. 2020). From 1966 through 2019, the number of Swainson's hawks observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 1.2% per year with a 2.0% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 110,525 Swainson's hawks. From 1970 through 2019, the number of Swainson's hawks counted in areas of the state surveyed during the CBC has also shown a declining trend estimated at -3.8% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 86 Swainson's hawks per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 96 Swainson's hawks. The TWSP anticipates future take of Swainson's hawks to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 96 Swainson's hawks by the TWSP represented 0.09% of the breeding population in Texas estimated at 110,525 Swainson's hawks.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of Swainson's hawks in Texas. From 2017 through 2019, entities issued depredation permits to take Swainson's hawks reported an average take of five Swainson's hawks per year in Texas and Oklahoma with the highest reported annual take occurring in 2019 when entities reported the lethal take of nine Swainson's hawks in Texas and Oklahoma (see Table 3.2). The cumulative lethal take of Swainson's hawks would have to increase to over 1,100 Swainson's hawks to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state.

The take of Swainson's hawks can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of Swainson's hawks by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for Swainson's hawks in Texas.

RED-TAILED HAWK POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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 2020). Red-tailed hawks are capable of exploiting a broad range of habitats with the availability of structures for perching, nesting, and the availability of prey items being the key factors. Red-tailed hawks commonly occur in open areas interspersed with patches of trees or other similar structures. Populations of red-tailed hawks in North America showed increasing trends during the mid- to late-1900s. The conversion of forested areas to more open environments for agricultural production likely contributed to the increase in population (Preston and Beane 2020).

In Texas, red-tailed hawks occur statewide throughout the year (Preston and Beane 2020). From 1966 through 2019, the number of Swainson's hawks observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 1.3% per year with a 0.4% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 144,758 red-tailed hawks. From 1970 through 2019, the number of red-tailed hawks counted in areas of the state surveyed during the CBC has also shown an increasing trend estimated at 1.1% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 25 red-tailed hawks per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 31 red-tailed hawks. The TWSP anticipates future take of red-tailed hawks to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 31 red-tailed hawks by the TWSP represented 0.02% of the breeding population in Texas estimated at 144,758 red-tailed hawks.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of red-tailed hawks in Texas. From 2017 through 2019, entities issued depredation permits to take red-tailed hawks reported an average take of one red-tailed hawk per year in Texas and Oklahoma with the highest reported annual take occurring in 2019 when entities reported the lethal take of three red-tailed hawks in Texas and Oklahoma (see Table 3.2). The cumulative lethal take of red-tailed hawks would have to increase to over 1,400 red-tailed hawks to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state.

The take of red-tailed hawks can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of red-tailed hawks by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for red-tailed hawks in Texas.

ADDITIONAL BUTEO SPECIES POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

In addition to Swainson's hawks and red-tailed hawks, there are additional buteo species in Texas that the TWSP could address when they cause damage or pose threats of damage. Buteo species are raptors with "*broad wings*" that they use for soaring. Those buteo species that could occur in Texas include red-shouldered hawks, broad-winged hawks, white-tailed hawks, zone-tailed hawks, ferruginous hawks, and rough-legged hawks. Although not a buteo species, the Harris's hawk also occurs in Texas and is similar to those buteo species that could occur in Texas.

The red-shouldered hawk occurs throughout the year in eastern Texas while the broad-winged hawk nests in extreme eastern Texas and migrates through eastern Texas during the migration periods. The white-tailed hawk occurs in extreme southeastern Texas throughout the year while the zone-tailed hawk nests in southwest Texas. The ferruginous hawk and the rough-legged hawk winter throughout most of Texas and the Harris's hawk occurs throughout the year in southern Texas. Table 3.8 shows the estimated breeding populations for each species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas. The USFWS (2021*a*) considers the ferruginous hawk and the Harris's hawk to be birds of conservation concern.

Table 3.8 - Texas breeding population estimates and trend data for several buteo species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Red-shouldered Hawk	220,207	1.7%	1.5%	2.1%	0.5%
Broad-winged Hawk	43,377	1.2%	0.9%	8.0%	10.9%
White-tailed Hawk	10,310	0.8%	0.0%	5.7%	3.1%
Zone-tailed Hawk	1,918	3.0%	3.7%	5.5%	4.8%
Ferruginous Hawk	447	-0.6%	-0.7%	-0.03%	-1.7%
Rough-legged Hawk	-	-	-	-3.6%	-1.5%
Harris's Hawk	32,634	-2.3%	-6.1%	-0.6%	-0.5%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of four red-shouldered hawks per year and two broad-winged hawks per year to alleviate damage or threats of damage. The highest annual take of red-shouldered hawks occurred in FY 2018 when the TWSP lethally removed nine red-shouldered hawks. The highest annual take of broad-winged hawks by the TWSP occurred in FY 2017 and FY 2018 when the TWSP lethally removed three broad-winged hawks. No take of white-tailed hawks, zone-tailed hawks, ferruginous hawks, rough-legged hawks, or Harris's hawks occurred by the TWSP from FY 2017 through FY 2019.

The take of nine red-shouldered hawks by the TWSP represented 0.004% of the breeding population in Texas estimated at 220,207 red-shouldered hawks and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking red-shouldered hawks in Texas from 2017 through 2019. The cumulative annual take of red-shouldered hawks would have to increase to over 2,200 red-shouldered hawks to represent 1% of the estimated breeding population in Texas. The take of three broad-winged hawks by the TWSP represented 0.007% of the breeding population in Texas estimated at 43,377 broad-winged hawks. The USFWS did not receive reports of other entities taking broad-winged hawks in Texas from 2017 through 2019. The cumulative annual take of broad-winged hawks would have to increase to nearly 434 broad-winged hawks to represent 1% of the estimated breeding population in Texas. The TWSP anticipates future take of red-shouldered hawks and broad-winged hawks to alleviate damage or threats of damage in the state to be similar to previous take levels.

The TWSP could address other buteo species and Harris's hawks if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers. The take of buteo species and Harris's hawks can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

FALCONS AND ACCIPITER POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Several species of falcons (powerful flying hunters with pointed wings often flying fast to capture prey mid-air) and accipiters (woodland hunters with short rounded wings) inhabit Texas. Most are adapted to capture birds or insects while flying. Those species of falcons that regularly occur in Texas include American kestrels, merlins, prairie falcons, and peregrine falcons. Those species of accipiters that regularly occur in Texas include sharp-shinned hawks and Cooper's hawks.

American kestrels occur throughout the year in northern and western Texas and statewide during the winter and migration periods. Merlins occur statewide during the winter and the migration periods. Prairie falcons occur throughout the year in western Texas and nearly statewide during the migration periods and during the winter. Peregrine falcons occur throughout the year in western Texas and along coastal areas during the migration periods and during the winter. Sharp-shinned hawks occur statewide during the migration periods and during the winter while Cooper's hawks occur throughout the year throughout most of Texas but do occur statewide during the winter and during the migration periods.

The gyrfalcon and the collared forest-falcon have also occasionally occurred in Texas. However, the gyrfalcons nests in extreme northern North America and winters throughout Canada and northern portions of the United States while the collared forest-falcon occurs throughout the year in South America and along the coastal areas of Central America and southern Mexico. The Aplomado falcon also occurs in extreme western Texas. The USFWS has designated the Aplomado falcon as an endangered species pursuant to the ESA. The TWSP would not address the Aplomado falcon without obtaining the appropriate authorizations from the USFWS, including the necessary authorizations and consultation required by the ESA. Table 3.9 shows the estimated breeding populations for each species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.9 - Texas breeding population estimates and trend data for several falcon and accipter species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
American Kestrel	47,225	-0.1%	-0.3%	0.2%	0.6%
Merlin	-	-	-	3.7%	3.1%
Prairie Falcon	884	1.5%	1.4%	2.2%	1.9%
Peregrine Falcon	199	2.5%	0.2%	5.4%	3.5%
Sharp-shinned Hawk	1,745	0.1%	-0.2%	1.5%	-1.4%
Cooper's Hawk	46,815	2.8%	0.9%	3.4%	2.4%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of 23 American kestrels per year and four Cooper's hawks per year to alleviate damage or threats of damage. The highest annual take of American kestrels occurred in FY 2018 when the TWSP lethally removed 32 American kestrels. The highest annual take of Cooper's hawks by the TWSP occurred in FY 2017 when the TWSP lethally removed five Cooper's hawks. In FY 2019, the TWSP lethally removed one sharp-shinned hawk and one peregrine falcon to alleviate damage or alleviate threats of damage. No take of sharp-shinned hawks or peregrine falcons occurred by the TWSP during FY 2017 and FY 2018. No take of merlins, prairie falcons, gyrfalcons, or collared forest-falcon occurred by the TWSP from FY 2017 through FY 2019.

The take of 32 American kestrels by the TWSP represented 0.07% of the breeding population in Texas estimated at 47,225 American kestrels and would be a much lower percentage of the fall post-breeding population. The USFWS received reports of other entities taking American kestrels in Texas from 2017 through 2019. From 2017 through 2019, other entities reported the take of an average of eight American kestrels per year with the highest reported annual take occurring in 2019 when other entities lethally removed 22 American kestrels. The cumulative take of 32 American kestrels and 22 American kestrels by other entities would represent 0.1% of the estimated breeding population in Texas. The cumulative annual take of American kestrels would have to increase to over 472 American kestrels to represent 1% of the estimated breeding population in Texas.

The take of five Cooper's hawk by the TWSP represented 0.01% of the breeding population in Texas estimated at 46,815 Cooper's hawks and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking Cooper's hawks in Texas from 2017 through 2019. The cumulative annual take of Cooper's hawks would have to increase to over 468 Cooper's hawks to represent 1% of the estimated breeding population in Texas. The take of one sharp-shinned hawk by the TWSP represented 0.06% of the breeding population in Texas estimated at 1,745 sharp-shinned hawks and the take of one peregrine falcon by the TWSP represented 0.5% of the breeding population in Texas estimated at 199 peregrine falcons. Take by the TWSP would be a much lower percentage of the fall post-breeding population. The TWSP could address merlins, prairie falcons, gyrfalcons, or collared forest-falcon if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers.

The TWSP anticipates future take of falcons and accipters to alleviate damage or threats of damage in the state to be similar to previous take levels. The take of falcons and accipters can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

KITES AND HARRIER POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Three species of kites regularly occur in Texas, the Mississippi kite, white-tailed kite, and swallow-tailed kite (see Table C-1 in Appendix C). Three additional species of kites can occur in Texas but are accidental species, including the hook-billed kite, snail kite, and double-toothed kite (see Table C-3 in Appendix C). However, the hook-billed kite is encountered frequently along the lower Rio Grande River. The northern harrier occurs nests in northern Texas and occurs statewide during the non-breeding seasons. Most kite and harrier species that occur in Texas hunt from the air for insects and small vertebrates. Most are found in grasslands or wooded environments with open areas. Thus, they are sometimes encountered in airport environments, especially the harrier, and may be hazardous to aircraft. The USFWS (2021*a*) considers the swallow-tailed kite and northern harriers to be birds of conservation concern. Table 3.10 shows the estimated breeding populations for each species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.10 - Texas breeding population estimates and trend data for several kite and harrier species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Mississippi Kite	119,116	1.2%	-2.2%	-	-
White-tailed Kite	2,500	-0.3%	-1.7%	0.1%	-2.9%
Swallow-tailed Kite	148	5.9%	6.1%	-	-
Hook-billed Kite	-	-	-	-	-
Snail Kite	-	-	-	-	-
Double-toothed Kite	-	-	-	-	-
Northern Harrier	4,838	0.4%	0.4%	-0.9%	-2.9%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of three Mississippi kites per year and eight norther harriers per year to alleviate damage or threats of damage. The highest annual take of Mississippi kites occurred in FY 2018 and FY 2019 when the TWSP lethally removed four Mississippi kites each year. The highest annual take of northern harriers by the TWSP occurred in FY 2018 when the TWSP lethally removed 12 northern harriers. In FY 2018, the TWSP lethally removed one white-tailed kite to alleviate damage or alleviate threats of damage. No take of white-tailed kites occurred by the TWSP during FY 2017 and FY 2019. No take of swallow-tailed kites, hook-billed kites, snail kites, and double-toothed kites occurred by the TWSP from FY 2017 through FY 2019.

The take of four Mississippi kites by the TWSP represented 0.003% of the breeding population in Texas estimated at 119,116 Mississippi kites and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking Mississippi kites in Texas from 2017 through 2019. The cumulative annual take of Mississippi kites would have to increase to nearly 1,200 Mississippi kites to represent 1% of the estimated breeding population in Texas.

The take of 12 northern harriers by the TWSP represented 0.3% of the breeding population in Texas estimated at 4,838 northern harriers and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking northern harriers in Texas from 2017 through 2019. The cumulative annual take would have to increase to nearly 50 northern harriers to represent 1% of the estimated breeding population in Texas. The take of one white-tailed kite by the TWSP represented 0.04% of the breeding population in Texas estimated at 2,500 white-tailed kites. Take by the TWSP would be a much lower percentage of the fall post-breeding population. The TWSP could address swallow-tailed kites, hook-billed kites, snail kites, and double-toothed kites if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers.

The TWSP anticipates future take of kites and harriers to alleviate damage or threats of damage in the state to be similar to previous take levels. The take of kites and harriers can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

EAGLES AND OSPREY POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Golden eagles, bald eagles, and osprey occur in Texas. Golden eagles are distributed at low densities across much of the western United States. In Texas, the greatest densities of golden eagles occur in winter in north and west Texas. During summer months, their greatest densities occur in western Texas. Bald eagles are also mostly winter visitors in Texas with some breeding primarily in east Texas. Under an MOU with USFWS, WS responds to complaints involving bald and golden eagles. Ospreys are primarily winter visitors with some breeding along the coast. Table 3.11 shows the estimated breeding populations for each species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.11 - Texas breeding population estimates and trend data for eagles and the osprey

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Golden Eagle	94	0.1%	-0.2%	-3.3%	-1.4%
Bald Eagle	1,595	10.2%	12.2%	1.8%	2.7%
Osprey	257	1.5%	2.4%	8.4%	4.8%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of five ospreys per year to alleviate damage or threats of damage. The highest annual take of ospreys occurred in FY 2019 when the TWSP lethally removed 11 ospreys. The take of 11 ospreys by the TWSP represented 4.3% of the breeding population in Texas estimated at 257 ospreys and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking ospreys in Texas from 2017 through 2019. The TWSP anticipates future take of ospreys to alleviate damage or threats of damage in the state to be similar to previous take levels.

The take of ospreys can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of ospreys by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for ospreys that could occur in Texas.

No take of golden eagles or bald eagles occurred by the TWSP from FY 2017 through FY 2019. The TWSP did respond to two livestock damage requests involving bald eagles from FY 2017 through FY 2019. During one request for assistance, the TWSP verified losses for compensation and during a second request, the TWSP provided supplemental feed (deer carcasses) to preclude lamb losses until the wintering eagles moved away. Given the definition of "*molest*" and "*disturb*" under the Bald and Golden Eagle Protection Act as described in Section 1.7, the use of hazing methods to disperse eagles causing damage or posing threats of damage could constitute "*take*" as defined under the Act, which would require a permit from the USFWS to conduct those types of activities. WS would work with the USFWS to determine when hazing an eagle constitutes take and requires a permit from the USFWS. When determined a permit is necessary to haze eagles, WS and/or the entity seeking assistance could apply for a permit allowing for the hazing of golden eagles and/or bald eagles that are causing damage (*e.g.*, feeding on livestock) or posing a threat of damage (*e.g.*, posing an aircraft strike risk). If the USFWS did not issue a permit to take eagles that were causing damage or posing a threat of damage when the USFWS and/or WS determined that take could occur, WS would not conduct activities associated with those eagles. WS would only conduct activities when take could occur after the USFWS issued a permit to WS or to the entity seeking assistance allowing for the harassment of eagles. If the USFWS issued a permit to an entity seeking assistance, WS could work as a subpermittee under the permit issued to that entity. WS would abide by all measures and stipulations provided by the USFWS in permits issued for the harassment of eagles. Conducting activities pursuant to permits issued by the USFWS would ensure any direct effects associated with taking eagles would not occur at a level that would adversely affect the eagle population. The USFWS has evaluated impacts on the golden eagle and bald eagle population associated with the issuance of permits (see USFWS 2016*b*, USFWS 2016*c*). Therefore, the TWSP would coordinate with the USFWS to ensure the take of eagles occurred in compliance with the Bald and Golden Eagle Protection Act through the established permitting process.

OWL POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Texas is home to 12 species of owls (see Table C-1 and Table C-2 in Appendix C) with eight species that have the potential to cause damage (see Table C-1 in Appendix C). Additionally, five species of owls have been accidentally found or are rare in Texas (see Table C-3 in Appendix C). Most requests for assistance that the TWSP receives are associated with great horned owls, barred owls, and barn owls. The other 5 species found in Table C-1 of Appendix C are mostly a strike risk at airports. The barn owl, eastern screech-owl, burrowing owl, and great horned owl occur nearly statewide throughout the year in Texas. The barred owl occurs throughout the year in eastern Texas. The western screech-owl is likely found in remote areas of west Texas year-round, but not found on any BBS routes. The other two species of owls are seasonal in Texas during the winter, the short-eared owl and long-eared owl. The USFWS

(2021*a*) considers the burrowing owl, long-eared owl, and the short-eared owl to be birds of conservation concern. Table 3.12 shows the estimated breeding populations for each of the eight owl species that could cause damage in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.12 - Texas breeding population estimates and trend data for several owl species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Barn Owl	43,490	3.3%	4.2%	0.6%	2.3%
Western Screech-Owl	-	-	-	-0.1%	0.4%
Eastern Screech-Owl	89,185	-1.4%	-0.04%	-1.0	-0.9%
Great Horned Owl	396,444	0.0%	-0.2%	-0.2%	-0.1%
Burrowing Owl	158,118	0.2%	3.5%	-1.4%	0.7%
Barred Owl	289,694	0.7%	0.7%	-0.4%	-0.5%
Long-eared Owl	-	-	-	-0.3%	-1.3%
Short-eared Owl	-	-	-	-1.9%	0.2%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed one barn owl during FY 2018 and seven great horned owls during FY 2019. No take of barn owls occurred by the TWSP during FY 2017 and FY 2019 and no take of great horned owls occurred by the TWSP during FY 2017 and FY 2018. No take of western screech-owls, eastern screech-owls, burrowing owls, barred owls, long-eared owls, or short-eared owls occurred by the TWSP from FY 2017 through FY 2019.

The take of one barn owl by the TWSP represented 0.002% of the breeding population in Texas estimated at 43,490 barn owls and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking barn owls in Texas from 2017 through 2019. The cumulative annual take of Mississippi kites would have to increase to nearly 435 barn owls to represent 1% of the estimated breeding population in Texas.

The take of seven great horned owls by the TWSP represented 0.002% of the breeding population in Texas estimated at 396,444 great horned owls and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking great horned owls in Texas from 2017 through 2019. The cumulative annual take would have to increase to nearly 3,964 great horned owls to represent 1% of the estimated breeding population in Texas. The TWSP could address other owl species if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers.

The TWSP anticipates future take of owls to alleviate damage or threats of damage in the state to be similar to previous take levels. The take of owls can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

SHRIKE POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The shrike species that occur in Texas are the loggerhead shrike and the northern shrike. The loggerhead shrike occurs statewide throughout the year in Texas. From 1966 through 2019, the number of loggerhead shrikes observed along routes surveyed in Texas during the BBS has shown a declining trend estimated at -2.5% per year. From 2009 through 2019, the number of loggerhead shrikes observed along routes surveyed in Texas during the BBS has shown an increasing trend estimated at 0.7% per year (Sauer et al. 2020). Using current BBS data, the breeding population of the loggerhead shrike in Texas is estimated at 513,891 loggerhead shrikes. From 1970 through 2019, the number of loggerhead shrikes observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -3.0 per year (National Audubon Society 2020). The USFWS (2021*a*) considers the loggerhead shrikes in the eastern population to be a bird of conservation concern.

The northern shrike nests in northern Canada and nearly statewide in Alaska. During the winter, northern shrikes occur in northern Texas. From 1970 through 2019, the number of northern shrikes observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -1.9% per year (National Audubon Society 2020). From FY 2017 through FY 2019, no take of northern shrikes occurred by the TWSP and the USFWS did not receive reports of other entities taking northern shrikes in Texas. From FY 2017 through FY 2019, the TWSP lethally removed one loggerhead shrike during FY 2018 to alleviate damage or threats of damage. The lethal take of one loggerhead shrike by the TWSP represented 0.0002% of the breeding population estimated at 513,891 loggerhead shrikes. The USFWS did not receive reports of other entities taking loggerhead shrikes from 2017 through 2019. The cumulative annual take of loggerhead shrikes would have to increase to nearly 5,140 loggerhead shrikes to represent 1% of the estimated breeding population in Texas.

The TWSP could address shrikes if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers. The take of shrikes can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

NATIVE DOVES AND PIGEON POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

There are seven native dove and pigeon species that have the potential to cause damage in Texas (see Table C-1 in Appendix C). Those seven species include the red-billed pigeon, band-tailed pigeon, white-winged dove, mourning dove, Inca dove, common ground dove, and the white-tipped dove. Additionally, three native species of doves and pigeons have been accidentally found or are rare in Texas (see Table C-3 in Appendix C). Those species include the white-crowned pigeon, ruddy ground dove, and the ruddy quail-dove. Most requests for assistance that the TWSP receives are associated with mourning doves and white-winged doves and primarily at airports. The TWSP could address other native dove and pigeon species found in Table C-1 of Appendix C but anticipates activities associated with those species to be infrequent.

The red-billed pigeon nests along the border with Mexico in extreme southern Texas while the band-tailed pigeon occurs throughout the year in extreme west Texas. Mourning doves are present statewide throughout the year in Texas. Similarly, Inca dove occur nearly statewide and throughout the year in Texas. while the white-winged dove nests in southern and western Texas with white-winged doves present throughout the year in extreme southeastern and southwestern Texas. The common ground dove is present in the southern half of Texas throughout the year. White-tipped doves are present throughout the year in extreme southern Texas. Table 3.13 shows the estimated breeding populations for five of the native dove species that could cause damage in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas. Population data from the BBS and CBC for the other native pigeon and dove species is currently not available for Texas.

Table 3.13 - Texas breeding population estimates and trend data for several dove species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
White-winged Dove	1,094,973	4.4%	1.5%	12.8%	9.0%
Mourning Dove	12,822,373	-1.0%	-1.3%	0.5%	-1.7%
Inca Dove	312,801	1.3%	-6.9%	0.7%	-2.5%
Common Ground-Dove	663,099	0.1%	-3.7%	-0.4%	-9.0%
White-tipped Dove	61,718	5.9%	-4.8%	2.3%	1.7%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of 594 mourning doves per year and 57 white-winged doves per year to alleviate damage or threats of damage. The highest annual take of mourning doves occurred in FY 2018 when the TWSP lethally removed 673 mourning doves. The highest annual take of white-twinged doves by the TWSP occurred in FY 2019 when the TWSP lethally removed 91 white-winged doves. No take of other native pigeon or dove species occurred by the TWSP from FY 2017 through FY 2019.

The take of 673 mourning doves by the TWSP represented 0.005% of the breeding population in Texas estimated at over 12.8 million mourning doves and would be a much lower percentage of the fall post-breeding population and the migratory population. The USFWS received reports of other entities taking mourning doves in Texas from 2017 through 2019. From 2017 through 2019, other entities reported the take of an average of 202 mourning doves per year with the highest reported annual take occurring in 2019 when other entities lethally removed 340 mourning doves. The cumulative take of 673 mourning doves by the TWSP and 340 mourning doves by other entities would represent 0.008% of the estimated breeding population in Texas. The cumulative annual take of mourning doves would have to increase to over 128,000 mourning doves to represent 1% of the estimated breeding population in Texas.

The take of 91 white-winged doves by the TWSP represented 0.008% of the breeding population in Texas estimated at nearly 1.1 million white-winged doves and would be a much lower percentage of the fall post-breeding population. The USFWS received reports of other entities taking white-winged doves in Texas from 2017 through 2019. From 2017 through 2019, other entities reported the take of 42 white-winged doves in 2018. No take of white-winged doves was reported in 2017 or 2019. The cumulative take of 91 white-winged doves by the TWSP and 42 white-winged doves by other entities would represent 0.01% of the estimated breeding population in Texas. The cumulative annual take of white-winged doves would have to increase to nearly 11,000 white-winged doves to represent 1% of the estimated breeding population in Texas. The TWSP could address other native pigeon and dove species if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers.

Many states have regulated annual hunting seasons for several dove species with generous bag limits, including Texas. In Texas, hunters can harvest mourning doves, white-winged doves, and white-tipped doves during annual hunting seasons. Hunters harvested nearly 10.4 million mourning doves in the United States during the 2018 hunting season and nearly 10 million mourning doves during the 2019 hunting season (Raftovich et al. 2020, Seamans 2020). Hunters in Texas harvested a nearly 3 million mourning doves during the 2018 hunting season and nearly 3.4 million mourning doves in the state during the 2019 hunting season (Raftovich et al. 2020, Seamans 2020). Hunters in Texas harvested a nearly 1.5 million white-winged doves during the 2018 hunting season and nearly 1.6 million white-winged doves in the state during the 2019 hunting season (Raftovich et al. 2020, Seamans 2020). Harvest data for white-tipped doves is currently not available. The cumulative take of mourning doves and white-winged doves by the TWSP and other entities to alleviate damage is likely to be a small percentage of the number of mourning doves and white-winged doves harvested annually in the state. For example, the highest annual take of mourning doves by the TWSP (673 mourning doves) plus the highest annual take of mourning doves reported by other entities (340 mourning doves) represented 0.03% of the mourning doves harvested in Texas during 2018 and 2019. Similarly, the highest annual take of white-winged doves by the TWSP (91 white-winged doves) plus the highest annual take of white-winged doves reported by other entities (42 white-winged doves) represented 0.009% of the white-winged doves harvested in Texas during 2018 and 0.008% of the white-winged doves harvested in Texas during 2019.

The TWSP anticipates future take of native dove and pigeon species to alleviate damage or threats of damage in the state to be similar to previous take levels. The take of native dove and pigeon species can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

GRASSLAND PASSERINE SPECIES POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

As discussed in Section 1.2, several species of passerines frequent grassland habitats that could cause damage or pose a threat of damage in Texas, primarily at airports. As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP has addressed several passerine species that frequent grassland habitats including eastern meadowlarks, western meadowlarks, western kingbirds, scissor-tailed flycatchers, horned larks, lark sparrows, chipping sparrows, Savannah sparrows, and house finches. In addition to those species, the TWSP could address other passerine species identified in Table C-1 found in Appendix C. Table 3.14 shows the estimated breeding populations for those grassland passerines addressed by the TWSP from FY 2017 through FY 2019 using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.14 - Texas breeding population estimates and trend data for several grassland passerine species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Eastern Meadowlark	2,691,631	-3.1%	-4.6%	-3.1%	-3.3%
Western Meadowlark	2,205,722	-1.9%	-5.8%	-3.2%	1.1%
Western Kingbird	4,641,507	2.2%	-2.8%	-0.9%	-0.5%
Scissor-tailed Flycatcher	4,016,294	-1.1%	-2.0%	10.0%	13.6%
Horned Lark	2,417,704	-1.7%	0.4%	-4.0%	-3.4%
Lark Sparrow	1,980,761	-2.2%	-0.9%	-2.9%	-1.6%
Chipping Sparrow	736,311	-0.9%	2.3%	2.5%	1.7%
Savannah Sparrow	-	-	-	1.6%	-0.6%
House Finch	1,818,083	0.1%	-0.2%	0.8%	-0.5%

Many populations of grassland species are declining across their ranges, primarily from the loss off grassland habitats as people convert those areas to agricultural production and from development (USFWS 2021*a*). For example, the eastern meadowlark epitomizes the open habitats of the central United States. As shown in Table 3.14, population trend data from the BBS and the CBC show declining population trends in Texas with similar trends occurring across their ranged. The declining trends associated with the BBS and the CBC surveys are likely associated with habitat loss across the range of the eastern meadowlark (Jaster et al. 2020). Based on the declining population trends across their range, the International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as a species that is "*near threatened*" (BirdLife International 2020). The International Union for Conservation of Nature and Natural Resources assigned the ranking based on a rapidly declining population trend in North America (BirdLife International 2020). Although the International Union for Conservation of Nature and Natural Resources ranks the eastern meadowlark as "*near threatened*", the USFWS has not classified the eastern meadowlark as an endangered or threatened species pursuant to the ESA.

As shown in Table 3.15, the take of passerine species by the TWSP that are often associated with grassland habitats has been of low magnitude compared to the species' breeding population estimate. Similarly, the cumulative take (*i.e.*, highest TWSP annual take plus highest annual take by other entities) of those species has been of low magnitude. Take by the TWSP and cumulative take would be an even lower percentage of the post-breeding populations of those species and a lower percentage of the number of those species that migrate through or winter in Texas. The TWSP anticipates future take of grassland passerine species to alleviate damage or threats of damage in the state to be similar to previous take levels. The TWSP could take additional grassland passerine species but anticipates activities associated with those species to be infrequent. The TWSP anticipates the cumulative take of those species to be of low magnitude when compared to a species' population.

Table 3.15 – Cumulative impact on populations of several grassland passerine species

Species	TWSP Highest Take	Population Estimate	TWSP Impact on Population	Highest Cumulative Take	Cumulative Impact on Population
Eastern Meadowlark	285	2,691,631	**0.01%**	489	**0.02%**
Western Meadowlark	69	2,205,722	**0.003%**	71	**0.003%**
Western Kingbird	5	4,641,507	**0.0001%**	5	**0.0001%**
Scissor-tailed Flycatcher	33	4,016,294	**0.0008%**	53	**0.001%**
Horned Lark	9	2,417,704	**0.0004%**	25	**0.001%**
Lark Sparrow	9	1,980,761	**0.0005%**	9	**0.0005%**
Chipping Sparrow	4	736,311	**0.0005%**	4	**0.0005%**
Savannah Sparrow	7	-	**-**	7	**-**
House Finch	3	1,818,083	**0.0002%**	3	**0.0002%**

The take of native passerine species can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

GULL POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Only one species of gull, the laughing gull, is found year-round in Texas. Four species of gulls, the ring-billed gull, herring gull, Bonaparte's gull, and Franklin's gulls, commonly migrate through or winter in Texas coming from their northern breeding grounds. Requests for assistance are primarily associated with those five gull species. An additional five species of gulls are much less common but do occur in

Texas during migration or winter. Those five species include the Sabine's gull, California gull, Thayer's gull, lesser black-backed gull, and glaucous gull.

From 1966 through 2019, the number of laughing gulls observed along routes surveyed in Texas during the BBS has shown an increasing trend estimated at 1.1% per year (Sauer et al. 2020). Based on current BBS data, the number of laughing gulls observed in the state during the nesting season is estimated at 456,926 laughing gulls. Since 1966, the number of laughing gulls observed in areas of the state observed during the CBC has shown an increasing trend estimated at 3.2% with a 1.2% annual increase from 2009 through 2019 (National Audubon Society 2020).

A small number of ring-billed gulls and herring gulls can also be present in the state during the nesting season; however, those gulls are likely non-breeding gulls. As discussed previously, ring-billed gulls, herring gulls, Bonaparte's gulls, and Franklin's gulls are also present in all or part of the state during the migration periods or winter within the state. Since 1966, the number of ring-billed gulls observed in areas of the state observed during the CBC has shown an increasing trend estimated at 2.1% with a 0.7% annual increase from 2009 through 2019. The number of herring gulls observed in areas of the state observed during the CBC has shown a declining trend since 1966 estimated at -0.7% with a -0.1% annual decline from 2009 through 2019. Bonaparte's gulls observed in areas of the state surveyed during the CBC are showing an increasing trend since 1966 estimated at 3.4% per year; however, from 2009 through 2019, the number of Bonaparte's gulls observed has shown a declining trend estimated at -6.1% per year. Since 1966, the number of Franklin's gulls observed in areas of the state observed during the CBC has shown a declining trend estimated at -2.0% with a -1.1% annual decline from 2009 through 2019.

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of 58 laughing gulls per year and 45 ring-billed gulls per year to alleviate damage or threats of damage. The highest annual take of laughing gulls occurred in FY 2019 when the TWSP lethally removed 64 laughing gulls. The highest annual take of ring-billed gulls by the TWSP occurred in FY 2018 when the TWSP lethally removed 69 ring-billed gulls. In addition, the TWSP lethally removed an average of 14 Franklins gulls per year from FY 2017 through FY 2019 and an average of 25 herring gulls per year from FY 2017 through FY 2019. The highest annual take of Franklin's gulls occurred in FY 2018 when the TWSP lethally removed 40 Franklin's gulls and the highest take of herring gulls occurred in FY 2019 when the TWSP lethally removed 39 herring gulls. No take of other gull species occurred by the TWSP from FY 2017 through FY 2019.

The take of 64 laughing gulls by the TWSP represented 0.01% of the breeding population in Texas estimated at nearly 456,926 laughing gulls and would be a much lower percentage of the fall post-breeding population. The USFWS received reports of other entities taking laughing gulls in Texas and Oklahoma from 2017 through 2019 (see Table 3.2). From 2017 through 2019, other entities reported the take of 201 laughing gulls in 2018. No take of laughing gulls was reported in 2017 or 2019. The cumulative take of 64 laughing gulls by the TWSP and 201 laughing gulls by other entities would represent 0.06% of the estimated breeding population in Texas. The cumulative annual take of laughing gulls would have to increase to nearly 4,600 laughing gulls to represent 1% of the estimated breeding population in Texas.

As discussed previously, a small number of ring-billed gulls and herring gulls can also be present in the state during the nesting season; however, those gulls are likely non-breeding gulls. The number of ring-billed gulls, Bonaparte's gulls, Franklin's gulls, herring gulls that migrate through the state or winter in the state is unknown. In the CPS, the nesting population of ring-billed gulls is estimated at 306,371 gulls while the Franklin's gull nesting population is estimated at 252,390 gulls. Herring gulls do not nest in the CPS but their nesting population have been estimated to be 410,000 herring gulls in North America.

Similarly, Bonaparte's gulls do not nest in the CPS but their nesting population has been estimated at 390,000 Bonaparte's gulls in North America.

The take of 69 ring-billed gulls by the TWSP represented 0.02% of the breeding population in the CPS estimated at nearly 306,400 ring-billed gulls and would be a much lower percentage of the fall post-breeding population. The USFWS did not receive reports of other entities taking ring-billed gulls in Texas and Oklahoma from 2017 through 2019 (see Table 3.2). The take of 40 Franklin's gulls by the TWSP represented 0.02% of the breeding population in the CPS estimated at nearly 252,400 Franklin's gulls and would be a much lower percentage of the fall post-breeding population. The USFWS received reports of other entities taking Franklin's gulls in Texas and Oklahoma from 2017 through 2019 (see Table 3.2). From 2017 through 2019, other entities reported the take of two Franklin's gulls in 2018. No take of Franklin's gulls was reported in 2017 or 2019. The cumulative take of 40 Franklin's gulls by the TWSP and two Franklin's gulls by other entities would represent 0.02% of the estimated breeding population in the CPS and would be a much lower percentage of the fall post-breeding population. The take of 39 herring gulls by the TWSP represented 0.009% of the breeding population in North America estimated at nearly 410,000 herring gulls and would be a much lower percentage of the fall post-breeding population. The USFWS received reports of other entities taking herring gulls in Texas and Oklahoma from 2017 through 2019 (see Table 3.2). From 2017 through 2019, other entities reported the take of two herring gulls in 2018. No take of herring gulls was reported in 2017 or 2019. The cumulative take of 39 herring gulls by the TWSP and two herring gulls by other entities would represent 0.01% of the estimated breeding population in North America and would be a much lower percentage of the fall post-breeding population. The TWSP could address other gull species if they cause damage or pose a threat of damage in the state but the TWSP anticipates addressing those species infrequently and in low numbers.

The take of gull species can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

TERNS, JAEGERS, AND SIMILAR SPECIES POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Texas hosts 12 tern species including the closely related black skimmer and jaegers (see Appendix C). The most common tern species that occur throughout the year, primarily along the coast, are the gull-billed tern, Caspian tern, Forster's tern, royal tern, and black skimmer. The least tern is found along the coast and locally inland during the breeding season and migration. The sooty tern is an uncommon breeder on isolated islands off the Texas coast. The black tern and common tern are common during migration, the Sandwich tern is uncommon year-round, and the jaegers are uncommon winter visitors. In addition, eight species, including noddies, skua, and jaeger, have accidentally been found in Texas (see Table C-3 in Appendix C). The TWSP would primarily address terns and similar species at airports in the state where they pose an aircraft strike risk (see Section 1.2 and Appendix E).

Table 3.16 shows the estimated breeding populations for each species in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas. The USFWS (2021*a*) has designated the least tern, gull-billed tern, black tern, common tern, Forster's tern, sandwich tern, and black skimmer as bird species of concern. As indicated in Table 3.16, many of the populations are showing declining trends in Texas. The interior population of least terns was recently delisted from the list of wildlife species designated as threatened or endangered by the USFWS pursuant to the ESA, including the interior least tern population in Texas (86 FR 2564-2581). Those least terns found within 50 miles of the coast in Texas were not considered part of the interior population.

Table 3.16 - Texas breeding population estimates and trend data for several tern, jaeger, and similar species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Gull-billed Tern	7,518	1.3%	-	-1.9%	-0.7%
Caspian Tern	6,621	-0.2%	-	-1.9%	-0.8%
Forster's Tern	13,017	-1.0%	-	1.7%	-2.5%
Royal Tern	10,548	1.7%	-	0.7%	0.7%
Black Skimmer	-	-0.3%	-	0.2%	-1.2%
Least Tern	7,294	0.2%	-	-	-
Sooty Tern	-	-	-	-	-
Black Tern	-	-	-	-	-
Common Tern	1,010	-2.0%	-	-6.3%	-6.3%
Sandwich Tern	21,545	-	-	1.1%	1.7%
Pomarine Jaeger	-	-	-	-0.7%	0.8%
Parasitic Jaeger	-	-	-	-2.8%	-2.7%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed two Caspian terns during FY 2019. No lethal take of Caspian terns occurred by the TWSP during FY 2017 and FY 2018. The take of two Caspian terns by the TWSP represented 0.03% of the breeding population in Texas estimated at 6,621 Caspian terns and would be a much lower percentage of the fall post-breeding population. The USFWS did receive reports of other entities taking Caspian terns in Texas from 2017 through 2019. During 2018, other entities reported the lethal removal of 10 Caspian terns in Texas and Oklahoma. The cumulative take of two Caspian terns by the TWSP and the lethal take of 10 Caspian terns by other entities would represent 0.2% of the estimated breeding population in Texas.

No take of other terns, jaegers, noddies, or skuas occurred by the TWSP from FY 2017 through FY 2019 but the TWSP could address those species if they cause damage or pose a threat of damage in the state. The TWSP anticipates addressing those species infrequently and in low numbers and primarily using non-lethal dispersal methods. Other entities also reported the lethal take of 19 Forster's terns and 19 royal terns during 2018 in Texas and Oklahoma. Cumulative lethal take would have to reach 75 gull-billed terns, 66 Caspian terns, 130 Forster's terns, 106 royal terns, 73 least terns, 10 common terns, and 216 sandwich terns to represent 1% of the estimated breeding populations of those species in Texas. However, the TWSP anticipates future take of terns, skimmers, jaegers, noddies, and skuas to alleviate damage or threats of damage in the state to be similar to previous take levels.

The take of terns, skimmers, jaegers, noddies, and skuas can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species that could occur in Texas.

UPLAND SANDPIPER POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Unlike most shorebirds that are associated with water, upland sandpipers prefer grassland habitats (Houston et al. 2020). The upland sandpiper nests from the prairie regions of south-central Canada and the northern United States extending from the Rocky Mountains across the Great Lakes region into the northeastern United States. Isolated breeding populations also occur in the high-altitude meadows west of the Rocky Mountains with breeding populations also occurring in Alaska and extreme northwest Canada (Houston et al. 2020). Upland sandpipers nest in loose colonies and feed, rest, and fly in small groups. As soon as hatchlings are able to fly, birds begin to form small flocks of 10 to 25 individuals. Upland sandpipers migrate from their nesting areas in the United States and Canada to wintering areas in South America (Houston et al. 2020).

Breeding populations likely expanded eastward as settlers cleared forests for agricultural purposes and was a locally common breeder in the northeastern United States around the 1860s. However, populations soon began a rapid decline from excessive market hunting and habitat loss across their breeding and wintering range (Houston et al. 2020). Although populations began to rebound following a prohibition on hunting sandpipers in the early 1900s, populations have not reached prior levels as habitat loss accelerated due to the conversion of native grasslands to farmland, changes in agricultural practices, and human development (Houston et al. 2020).

In Texas, upland sandpipers primarily pass through the state during the migration periods as they move between their nesting areas farther north and their wintering areas farther south (Houston et al. 2020). However, some upland sandpipers may be present in the state during the nesting season. Across all routes surveyed in the state during the BBS, the number of upland sandpipers observed has shown a declining trend estimated at -0.5% since 1966. However, from 2009 through 2019, the number of upland sandpipers observed in areas of the state surveyed during the BBS has shown an increasing trend estimated at 1.4% per year (Sauer et al. 2020). Using current BBS data, the number present in the state during the nesting season was estimated at 2,693 upland sandpipers. Because upland sandpipers overwinter in South America, trend data from areas of the state surveyed during the CBC is not available (National Audubon Society 2020).

Brown et al. (2001) ranked the upland sandpiper as a "*species of high concern*" and reported the upland sandpiper population in North America to be 350,000 upland sandpipers with a target population objective of 470,000 upland sandpipers. Morrison et al. (2006) also reported a population in North America estimated at 350,000 upland sandpipers. Houston et al. (2020) calculated a population at 1.1 million upland sandpipers. Andres et al. (2012) recommended estimating the population at 750,000 upland sandpipers. The United States Shorebird Conservation Plan Partnership (2016) continued to estimate the population at 750,000 upland sandpipers. The United States Shorebird Conservation Plan Partnership (2016) indicated the upland sandpiper was a species of "*least concern.*" The International Union for Conservation of Nature and Natural Resources also ranked the upland sandpiper as a species of "*least concern*" based on the "*species…extremely large range…*," "*…the population trend appears to be increasing,*" and "*…the population size is extremely large…*" (BirdLife International 2016*d*). The USFWS (2021*a*) considers the upland sandpiper to be a bird species of concern in certain regions of the United States.

From FY 2017 through FY 2019, the TWSP lethally removed an average of 24 upland sandpipers per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2018 when the TWSP lethally removed 38 upland sandpipers. The lethal take of 38 upland sandpipers by the TWSP represented 1.4% of the population present in Texas during the nesting season estimated at 2,693 upland sandpipers. The number of upland sandpipers that migrate through Texas is unknown.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of upland sandpipers in Texas. From 2017 through 2019, entities issued depredation permits to take upland sandpipers reported the take of two upland sandpipers in Texas and Oklahoma during 2018 (see Table 3.2). The cumulative take of 38 upland sandpipers by the TWSP and the lethal take of two upland sandpipers by other entities would represent 1.5% of the estimated breeding population in Texas. However, the take of upland sandpipers by the TWSP and other entities is likely to occur during the migration periods when the number of upland sandpipers present in the state increases. Therefore, the cumulative take by the TWSP and other entities is likely to represent a smaller percentage of the estimated number of upland sandpipers present in the state during the nesting season.

The take of upland sandpipers can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of upland sandpipers by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for upland sandpipers.

KILLDEER POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Killdeer occur over much of North America from the Gulf of Alaska southward throughout the United States and extending from the Atlantic Coast to the Pacific Coast (Hayman et al. 1986, Jackson and Jackson 2020). Although killdeer are technically in the family of shorebirds, they are unusual shorebirds in that they often nest and live far from water. Killdeer commonly occur in a variety of open areas, even concrete or asphalt parking lots at shopping malls, as well as fields and beaches, ponds, lakes, roadside ditches, mudflats, airports, pastures, and gravel roads and levees but they seldom occur in large flocks.

In Texas, killdeer occur statewide and throughout the year (Jackson and Jackson 2020). Since 1966, the number of killdeer observed during the breeding season in the state has shown an annual declining trend estimated at -1.0%, with a -0.8% annual decrease occurring from 2009 through 2019 (Sauer et al. 2020). The number of killdeer observed in areas of the state surveyed during the CBC has shown a declining trend from 1970 through 2019, estimated at -0.8% per year with a -1.2% annual decline occurring from 2009 through 2019 (National Audubon Society 2020). Using current BBS data, the breeding population in the state during the nesting season was estimated at 310,050 killdeer.

The International Union for Conservation of Nature and Natural Resources ranks the killdeer as a species of "*least concern*" based on the "*species…extremely large range…*," "*…the population size is extremely large…*", and "*the decline is not believed to be sufficiently rapid*" (BirdLife International 2016*e*). The United States Shorebird Conservation Plan Partnership (2016) indicated the killdeer was a species of "*moderate concern*".

From FY 2017 through FY 2019, the TWSP lethally removed an average of 269 killdeer per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 284 killdeer. The lethal take of 284 killdeer by the TWSP represented 0.09% of the breeding population in Texas estimated at 310,050 killdeer and would be an even small number of the post-breeding population and the number of killdeer that migrate through and winter in the state. The number of killdeer that migrate through or winter in Texas is unknown.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of killdeer in Texas. From 2017 through 2019, entities issued depredation permits to take upland sandpipers reported the take of 74 killdeer in Texas and Oklahoma during 2018 and 14 killdeer during 2019 (see Table 3.2). The cumulative take of 284 killdeer by the TWSP and the lethal take of 74 killdeer by other entities would represent 0.1% of the estimated breeding population in Texas. However, the some take of killdeer by the TWSP and other entities is likely to occur during the migration periods and during the winter when the number of killdeer present in the state increases. Therefore, the cumulative take by the TWSP and other entities is likely to represent a smaller percentage of the estimated breeding population in the state.

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

GREATER AND LESSER YELLOWLEGS POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Lesser yellowlegs nest across northern Canada and throughout most of Alaska and winter along the coastal areas of the southern United States, throughout most of Mexico, the Caribbean, and South America (Tibbitts and Moskoff 2020). Greater yellowlegs nest throughout southern Canada and southern Alaska and winter in similar areas as lesser yellowlegs (Elphick and Tibbitts 2020). In Texas, greater and lesser yellowlegs pass through the state during the migration periods but some do winter along the coastal areas of the state with the greater yellowlegs found further inland than lesser yellowlegs (Elphick and Tibbitts 2020, Tibbitts and Moskoff 2020).

Since 1970, the number of lesser yellowlegs observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -0.7% per year with a -0.8% per year decline occurring from 2009 through 2019. Since 1970, the number of greater yellowlegs observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 0.9% per year; however, from 2009 through 2019, the number observed has shown a downward trend estimated at -0.1% per year. Wetlands International (2021) estimates the population to be 400,000 lesser yellowlegs and 100,000 greater yellowlegs in North America.

From FY 2017 through FY 2019, the TWSP lethally removed an average of one lesser yellowlegs per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed three lesser yellowlegs. In FY 2018, the TWSP lethally removed one greater yellowlegs in Texas to alleviate damage and threats of damage. No take of greater yellowlegs occurred by the TWSP in FY 2017 and FY 2019. From FY 2017 through FY 2019, no take of lesser yellowlegs or greater yellowlegs occurred by WS in other CPS. Cumulative lethal take would have to reach 4,000 lesser yellowlegs and 1,000 greater yellowlegs to represent 1% of the estimated populations of those species.

The take of lesser yellowlegs and greater yellowlegs can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of lesser yellowlegs and greater yellowlegs by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for lesser yellowlegs and greater yellowlegs.

ADDITIONAL SHOREBIRD SPECIES POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

There are additional shorebird species in Texas that the TWSP could address when they cause damage or pose threats of damage (see Table C-1 and Table C-2 in Appendix C). However, from FY 2017 through FY 2019, the TWSP has only addressed semipalmated sandpipers and long-billed curlews to alleviate damage or threats of damage. The semipalmated sandpiper nests in the extreme portions of Canada and Alaska but migrates through the United States east of the Rocky Mountains to winter in the Caribbean and along the coasts of South America. In Texas, semipalmated sandpipers migrate through the state during the migration periods (Hicklin and Gratto-Trevor 2020). Wetlands International (2021) estimates the population to be 2.3 million semipalmated sandpipers. Overall, the number of semipalmated sandpipers observed in areas of the state surveyed during the CBC has shown a declining trend especially the number of semipalmated sandpipers observed in the late 1960s and 1970s. However, semipalmated sandpipers are only occasionally observed in areas surveyed in the state during the CBC and in low numbers (National Audubon Society 2020). BirdLife International (2016*f*) has classified the semipalmated sandpipers as "*near threatened*". The International Union for Conservation of Nature and Natural Resources assigned the ranking based on a rapidly declining population trend in North America (BirdLife International 2016*f*). Although the International Union for Conservation of Nature and Natural Resources ranks the semipalmated sandpiper as "*near threatened*", the USFWS has not classified the semipalmated sandpiper as an endangered or threatened species pursuant to the ESA.

Long-billed curlews nest in the short-grass or mixed prairie habitats of the Great Plains, Great Basin, and valleys of the western United States and southwest Canada. Non-breeding populations occur along the southern coastlines in the United States, throughout most of Mexico, and along part of the Central American coastline. In Texas, non-breeding long-billed curlews occur along the coastal areas of the state (Dugger and Dugger 2020). From 1966 through 2019, the number of long-billed curlews observed along routes surveyed in the state during the BBS has shown a declining trend estimated at -1.0% per year. However, from 2009 through 2019, the number of long-billed curlews observed has shown an increasing trend estimated at 2.7% per year (Sauer et al. 2020). Using current BBS data, the number in the state during the nesting season is estimated at 15,600 long-billed curlews. From 1970 through 2019, the number of long-billed curlews observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 0.9% per year with a 4.1% annual increase occurring from 2009 through 2019 (National Audubon Society 2020).

The TWSP lethally removed 10 semipalmated sandpipers during FY 2017 and one semipalmated sandpiper in FY 2018. No take of semipalmated sandpipers occurred by the TWSP in FY 2019. On average, the TWSP lethally removed four long-billed curlews to alleviate damage from FY 2017 through FY 2019. The highest annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed six long-billed curlews. The take of six long-billed curlews by the TWSP represented 0.04% of the estimated number of long-billed curlews that occur in the state during the nesting season. Cumulative lethal take would have to reach nearly 160 long-billed curlews to represent 1% of the estimated population present in Texas during the non-breeding season.

No take of other shorebirds occurred by the TWSP from FY 2017 through FY 2019 but the TWSP could address additional species if they cause damage or pose a threat of damage in the state. Many other species of shorebirds inhabit Texas commonly (34) and accidentally (14). The TWSP anticipates addressing those species infrequently and in low numbers and primarily using non-lethal dispersal methods. The USFWS considers the piping plover and the Eskimo curlew as threatened or endangered species pursuant to the ESA. The TWSP would not conduct activities involving piping plovers and Eskimo curlews without the appropriate authorizations and/or permits from the USFWS, which includes harassment and other non-lethal methods that could result in "*take*" as defined by the ESA.

The take of shorebirds can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of shorebirds by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for shorebirds.

CATTLE EGRET POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The cattle egret is a relatively new arrival to the North American continent with the first record for the continental United States occurring in south Florida in 1941 (Telfair II 2020). Today, cattle egrets occur across much of North America, including Oklahoma (Telfair II 2020). As their name implies, cattle egrets are closely associated with cattle where they feed on invertebrates disturbed by foraging livestock, primarily grasshoppers, crickets, and flies. Cattle egrets also consume fish, frogs, and birds, including eggs and nestlings (Telfair II 2020).

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

Along routes surveyed in Texas during the BBS, the number of cattle egrets observed has shown an increasing trend estimated at 0.2% annually from 1966 through 2019. However, from 2009 through 2019, the number of cattle egrets observed in areas of the state surveyed during the BBS has shown a declining trend estimated at -5.0% annually (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at nearly 1.6 million cattle egrets. From 1970 through 2019, the number of cattle egrets observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -1.5% per year. However, from 2009 through 2019, the number of cattle egrets observed has shown an increasing trend estimated at 8.5% per year (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 415 cattle egrets per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 966 cattle egrets. The TWSP anticipates future take of cattle egrets to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 966 cattle egrets by the TWSP represented 0.06% of the breeding population in Texas estimated at 1,573,700 cattle egrets.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of cattle egrets in Texas. From 2017 through 2019, entities issued depredation permits to take cattle egrets reported an average take of 10 cattle egrets per year in Texas and Oklahoma with the highest reported annual take occurring in 2018 when entities reported the lethal take of 29 cattle egrets in Texas and Oklahoma (see Table 3.2). The cumulative take of 995 cattle egrets would represent 0.06% of the estimated population in Texas. The cumulative lethal take of cattle egrets would have to increase to over 15,700 cattle egrets to represent 1% of the estimated population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state and the number of cattle egrets that migrate through or winter in Texas.

The take of cattle egrets can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of cattle egrets by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for cattle egrets in Texas.

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

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

In Texas, great blue herons occur statewide throughout the year (Vennesland and Butler 2020). Since 1966, the number of great blue herons observed along routes surveyed during the BBS has shown an increasing trend estimated at 1.1% per year. However, from 2009 through 2019, the number of great blue herons observed along routes in Texas surveyed during the BBS has shown a declining trend estimated at -1.1% per year (Sauer et al. 2020). Using current BBS data, the breeding population in Texas is estimated at 84,400 great blue herons. The number of great blue herons observed in areas of the state surveyed during the CBC is showing an increasing trend estimated at 0.5% per year from 1970 through 2019 but a -1.6% annual decline occurring from 2009 through 2019 (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 14 great blue herons per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 26 great blue herons. The TWSP anticipates future take of great blue herons to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 26 great blue herons by the TWSP represented 0.03% of the breeding population in Texas estimated at 84,400 great blue herons.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of great blue herons in Texas. From 2017 through 2019, entities issued depredation permits to take great blue herons reported an average take of 120 great blue herons per year in Texas and Oklahoma with the highest reported annual take occurring in 2018 when entities reported the lethal take of 335 great blue herons in Texas and Oklahoma (see Table 3.2). The cumulative take of 361 great blue herons would represent 0.4% of the estimated population in Texas. The cumulative lethal take of great blue herons would have to increase to 844 great blue herons to represent 1% of the estimated population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state and the number of great blue herons that migrate through or winter in Texas.

The take of great blue herons can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of great blue herons by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for great blue herons in Texas.

ADDITIONAL WADING BIRDS POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

In addition to cattle egrets and great blue herons, the TWSP could address other wading birds when those species cause damage or pose a threat of damage. In total, wading birds include 17 species of herons, egrets, ibises, and bitterns regularly found in Texas (see Table C-1 in Appendix C) and the accidentally occurring greater flamingo, jabiru, and bare-throated tiger-heron (see Table C-3 in Appendix C). Great egrets, snowy egrets, and yellow-crowned night-herons are the wading bird species that the TWSP is most likely to address based on previous requests for assistance. However, the TWSP could address additional species of wading birds. From FY 2017 through FY 2019, the TWSP has addressed several species of wading birds. Table 3.17 shows the estimated breeding populations for each species addressed by the TWSP from FY 2017 through FY 2019 using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.17 - Texas breeding population estimates and trend data for several wading bird species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Great Egret	156,300	1.8%	-0.8%	3.1%	2.8%
Yellow-crowned Night-Heron	14,000	0.1%	0.2%	1.0%	3.3%
Snowy Egret	58,500	1.1%	1.6%	1.9%	1.8%
Little Blue Heron	53,100	-0.5%	-3.2%	0.9%	2.3%
Green Heron	49,500	-1.3%	-1.1%	-0.3%	-1.4%
Tricolored Heron	9,300	-1.9%	-2.0%	-0.7%	4.5%
White-faced Ibis	61,700	-3.6%	-5.6%	1.6%	5.2%
White Ibis	203,600	7.8%	0.0%	10.2%	6.8%
Roseate Spoonbill	24,900	2.5%	3.6%	5.9%	5.3%

As shown in Table 3.18, the take of wading birds by the TWSP has been of low magnitude compared to the species' breeding population estimate. Similarly, the cumulative take (*i.e.*, highest TWSP annual take plus highest annual take by other entities) of those species has been of low magnitude. Take by the TWSP and cumulative take would be an even lower percentage of the post-breeding populations of those species and a lower percentage of the number of those species that migrate through or winter in Texas. The TWSP anticipates future take of wading species to alleviate damage or threats of damage in the state to be similar to previous take levels. The TWSP could take additional wading birds but anticipates activities associated with those species to be infrequent. The TWSP anticipates the cumulative take of those species to be of low magnitude when compared to a species' population.

Table 3.18 - Cumulative impact on populations of several wading bird species

Species	TWSP Highest Take	Population Estimate	TWSP Impact on Population	Highest Cumulative Take	Cumulative Impact on Population
Great Egret	29	156,300	**0.02%**	239	**0.2%**
Yellow-crowned Night-Heron	45	14,000	**0.3%**	55	**0.4%**
Snowy Egret	45	58,500	**0.08%**	171	**0.3%**
Little Blue Heron	13	53,100	**0.02%**	20	**0.04%**
Green Heron	6	49,500	**0.01%**	29	**0.06%**
Tricolored Heron	1	9,300	**0.01%**	1	**0.01%**

White-faced Ibis	1	61,700	**0.002%**	1	**0.002%**
White Ibis	40	203,600	**0.02%**	40	**0.02%**
Roseate Spoonbill	1	24,900	**0.004%**	1	**0.004%**

The take of wading birds can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of wading birds by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for wading birds.

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

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Dorr et al. 2020). Since the late 1970s, the double-crested cormorant population has increased in many regions of North America (Wires et al 2001, Dorr et al. 2020). Jackson and Jackson (1995) and Wires et al. (2001) suggested that the current double-crested cormorant resurgence might be, at least in part, a population recovery following years of pesticide-induced reproductive suppression and unregulated take prior to protection under the MBTA.

In Texas, double-crested cormorants are primarily present in the state during the migration periods and winter months near bodies of water (Dorr et al. 2020). Since 1966, the number of double-crested cormorants observed along routes surveyed during the BBS has shown an increasing trend estimated at 3.7% per year. From 2009 through 2019, the number of double-crested cormorants observed along routes in Texas surveyed during the BBS has shown an increasing trend estimated at 3.8% per year (Sauer et al. 2020). Using current BBS data, the population of double-crested cormorants in Texas during the nesting season is estimated at 11,700 double-crested cormorants. The number of double-crested cormorants observed in areas of the state surveyed during the CBC is showing an increasing trend estimated at 6.8% per year from 1970 through 2019 but a -0.8% annual decline occurring from 2009 through 2019 (National Audubon Society 2020).

Wetlands International (2021) estimated the continental population to range from 1,078,280 to 1,160,590 double-crested cormorants. The USFWS (2020*b*) estimated the population to range from 752,116 to 805,232 double-crested cormorants with 472,784 to 485,384 double-crested cormorants occurring in the Mississippi and Central Flyways. BirdLife International (2018*e*) considers the double-crested cormorant to be a species of "*least concern*" with an increasing population trend. In the North American Waterbird Conservation Plan, Kushlan et al. (2002) ranked the double-crested cormorant as a species "*not currently at risk.*"

From FY 2017 through FY 2019, the TWSP lethally removed an average of 31 double-crested cormorants per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2017 when the TWSP lethally removed 59 double-crested cormorants. The TWSP anticipates future take of double-crested cormorants to alleviate damage or threats of damage in the state to be similar to previous take levels. The lethal take of 59 double-crested cormorants by the TWSP represented 0.5% of the double-crested cormorant population present in Texas during the nesting season, which was estimated at 11,700 double-crested cormorants.

In addition to the take by the TWSP, the USFWS has issued depredation permits to other entities for the take of double-crested cormorants in Texas. From 2017 through 2019, entities issued depredation permits to take double-crested cormorants reported the lethal take of 51 double-crested cormorants in Texas and

Oklahoma during 2018 (see Table 3.2). The cumulative take of 110 double-crested cormorants would represent 0.9% of the estimated population present in Texas during the nesting season. The cumulative lethal take of double-crested cormorants would have to increase to 117 double-crested cormorants to represent 1% of the estimated population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state and the number of double-crested cormorants that migrate through or winter in Texas.

The take of double-crested cormorants can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of double-crested cormorants by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for double-crested cormorants in Texas.

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

The USFWS would authorize take within the allowable take limits predicted by the Potential Take Limit model. A Potential Take Limit model uses population abundance and demographic information to estimate annual take levels that meet a management objective to ensure the long-term sustainability of a population. Therefore, the level of take authorization that occurs within Texas, including TWSP authorized take, would occur within allowable take predicted by the model and used by the USFWS to maintain the double-crested cormorant population.

ADDITIONAL WATERBIRD POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

In addition to double-crested cormorants, the TWSP could also address other waterbird species when they are associated with requests for assistance to manage damage or threats of damage. Other waterbird species that the TWSP could address include pelicans, loons, grebes, neotropic cormorants, anhingas, boobies, gannets, and frigatebirds. Of those waterbirds, the TWSP anticipates addressing primarily American white pelicans and brown pelicans along the coasts to reduce aircraft strike risks but could address other waterbirds infrequently and in low numbers.

From FY 2017 through FY 2019, the TWSP did not take waterbird species other than double-crested cormorants. The USFWS has issued depredation permits for other entities to take American white pelicans and pied-billed grebes from 2017 through 2019. In 2018, other entities lethally removed 32 American white pelicans and 25 pied-billed grebes in Texas and Oklahoma pursuant to depredation permits issued by the USFWS. No take of American white pelicans and pied-billed grebes were reported by other entities in 2017 and 2019. Table 3.19 shows the estimated breeding populations for American white pelicans, brown pelicans, and pied-billed grebes using current BBS data along with current trend data from the BBS and CBC conducted in Texas. Cumulative take would have to reach 72 American white pelicans, 328 brown pelicans, and 180 pied-billed grebes to represent 1% of the estimated breeding population in Texas. Cumulative lethal take is likely to represent an even lower percentage of the fall post-breeding population in the state and the number of those species that migrate through or winter in Texas.

Table 3.19 - Texas breeding population estimates and trend data for pelicans and pied-billed grebes

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
American White Pelican	7,168	3.4%	-4.3%	5.7%	10.8%
Brown Pelican	32,746	16.1%	15.4%	19.8%	0.6%
Pied-billed Grebes	17,968	0.4%	-	1.4%	0.7%

The TWSP could also infrequently address additional waterbird species, including other grebe species, neotropic cormorants, anhingas, loons, boobies, gannets, and magnificent frigatebirds (see Appendix C). The TWSP could address those species when they pose aircraft strike risks at airports in Texas. When addressing those species, the TWSP anticipates the potential to take a few individuals annually when non-lethal methods are no longer effective at dispersing those species. The TWSP anticipates the lethal take of other grebe species, neotropic cormorants, anhingas, and common loons to be less than 10 individuals from each of those species per year. For magnificent frigatebirds, masked boobies, and other accidental waterbird species, the TWSP anticipates annual take to be less than five individuals per species. Based on the infrequency of take and the low magnitude of take, the TWSP does not anticipate the take of those species to occur at a level that would adversely affect those species' populations.

The TWSP anticipates addressing waterbirds infrequently and in low numbers and primarily using non-lethal dispersal methods. The take of waterbirds can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of waterbirds by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for waterbirds.

CANADA AND CACKLING GOOSE POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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

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

Historically, the breeding range of Canada geese occurred along the northern portion of the United States and across most of Canada and they migrated south to spend the winter in more temperate climates (Mowbray et al. 2020*a*). Canada geese did not historically breed in many of the states in the southern

United States. Overharvest and habitat loss nearly extirpated the native breeding populations of Canada geese in the United States following settlement in the 19th century (Mowbray et al. 2020*a*). In the mid-1900s, state and federal agencies began efforts to restore historic breeding populations and to establish breeding populations of Canada geese in new locations. Canada goose restoration efforts began in the Central Flyway as early as 1936 when Nebraska's first captive flock was established. Between 1938 and 1941, captive, breeding flocks were being maintained at four National Wildlife Refuges in North and South Dakota. Over the next four decades, captive flocks were established in most Central Flyway states as well as Alberta and Saskatchewan. At the end of the 20th century, more than 120,000 Canada geese had been released in the Central Flyway as part of restoration efforts (Gabig 2000).

Due to those restoration efforts, Canada geese are now present in the state during the nesting season. Canada geese are also present in the state during the fall and spring migration periods and during the winter (Mowbray et al. 2020*a*) along with cackling geese (Mowbray et al. 2020*b*). The Canada geese present in the state during the nesting period are part of the Great Plains population, which consists of Canada geese from restoration efforts in Saskatchewan, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (USFWS 2020*c*). Canada and cackling geese that nest farther north augment the population of Canada geese in the state during the migration periods and during the winter. Canada geese that occur in the state during the migration periods and during the winter are primarily from the Western Prairie population (*i.e*., Canada geese that nest in eastern Saskatchewan and western Manitoba) and the Great Plains population (USFWS 2020*c*). Cackling geese that may be present in the state during the migration periods and during the winter are part of the Midcontinent population (USFWS 2020*c*).

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

- *Resident Canada Geese*

Canada geese are "*resident*" (also sometimes referred to as "*temperate breeding*") when they nest within the lower 48 states and the District of Columbia or that reside within the contiguous United States in the months of April, May, June, July, or August (see 50 CFR 20.11, 50 CFR 21.3) (Rusch et al. 1995, Ankney 1996). Resident Canada geese can have a relatively high nesting success compared to migratory Canada geese (Mowbray et al. 2020*a*). Resident Canada geese nest in traditional sites (*e.g*., along shorelines, on islands and peninsulas, small ponds, lakes, and reservoirs), as well as on rooftops, adjacent to roadways, swimming pools, and in parking lots, playgrounds, planters, and abandoned property (*e.g*., tires, automobiles).

During much of the year, the majority of Canada geese present in Texas would be resident geese, not migratory. However, when migrant populations are present in the state, distinguishing a resident Canada goose from a migratory Canada/cackling goose by appearance can be difficult. Most requests for assistance received by WS in Texas to address damage caused by Canada geese occurred during those months when geese present in the state are resident geese. Resident Canada geese molt and are flightless from mid-June through mid-July each year. Molting is the process whereby geese annually replace their primary and secondary flight (wing) feathers (Welty 1982). Portions of a flock of geese can be flightless from about one week before until two weeks after the primary molt period because individual birds molt at slightly different times. When geese are flightless, WS personnel are able to live-capture target geese by slowly guiding them into corral traps.

As stated previously, distinguishing between resident and migratory Canada geese is not possible through visual identification. Based on the type of damage that occurred, the locations where requests for assistance occurred, and the months that WS received those requests, the Canada geese addressed by the TWSP previously to alleviate damage were likely resident geese (*i.e.*, geese present in the state throughout the year). To evaluate a worst-case scenario, the analysis will evaluate all take of Canada geese by the TWSP annually as though all of those Canada geese were resident Canada geese. Most requests for assistance received by the TWSP are associated with airports and urban areas where Canada geese are present throughout the year. Therefore, the TWSP anticipates future requests for assistance to involve primarily resident Canada geese.

Using current BBS data, the resident Canada goose population in the state is estimated at 12,600 Canada geese. When Gabig (2000) released the resident Canada goose management plan for the Central Flyway, the statewide resident Canada goose population likely ranged from 750 to 3,000 Canada geese with a population objective of 750 resident Canada geese. In Texas, the number of resident Canada geese observed along routes surveyed during the BBS have shown an increasing trend estimated at 13.7% annually from 1966 through 2019, and 13.6% annually from 2009 through 2019 (Sauer et al. 2020).

From FY 2017 through FY 2019, the TWSP lethally removed an average of 188 Canada geese per year in Texas to alleviate damage and threats of damage. The highest level of annual take by the TWSP occurred in FY 2019 when the TWSP lethally removed 417 Canada geese. Based on previous requests for assistance and the increasing breeding population trends in Texas, the TWSP anticipates taking up to 2,000 Canada geese annually in the state. If the statewide resident Canada goose population were 12,600 Canada geese, the take of 2,000 resident Canada geese by the TWSP would represent 15.9% of the population. In addition to the take by the TWSP, other entities reported the take of 1,648 Canada geese in Texas and Oklahoma during 2018 (see Table 3.2). The cumulative take of 3,648 Canada geese would represent 29.0% of the estimated population present in Texas during the nesting season. Cumulative lethal take is likely to represent an even lower percentage of the population in the state because the take of 1,658 Canada geese by other entities represents take in Texas and Oklahoma and is likely to represent some migratory Canada geese.

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

In 2018, the Raftovich et al. (2020) estimates that hunters harvested 1,000 Canada geese in Texas during the early September hunting for resident Canada geese and 4,000 Canada geese during 2019. During the regular hunting season for waterfowl in the state, hunters harvested 70,300 Canada geese in 2018 and 53,600 in 2019 (Raftovich et al. 2020).

Therefore, any removal by WS to alleviate damage would be occurring along with harvest during the September hunting season, harvest during the regular waterfowl hunting season, and lethal take by other entities. Data collected from 2009 through 2019 during the BBS continues to show an increasing population trend for resident Canada geese in the state estimated at 13.6% annually (Sauer et al. 2020), which indicates that cumulative take of resident Canada geese has not caused the population to decline in the state. The current population estimate of 12,600 adult resident Canada geese in the state exceeds the population objective of 750 resident geese in the state indicated by Gabig (2000).

➢ *Migratory Canada/Cackling Geese*

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

The USFWS (2019) estimated the Western Prairie and the Great Plains populations at 1,443,000 Canada geese in 2019, which was similar to the population estimate of 1,350,000 Canada geese in 2018. Over the last 10 years, the Western Prairie and the Great Plains population increased an average of 2% per year (USFWS 2019). In 2020, the USFWS (2020*c*) estimated the Midcontinent population at 2,802,000 geese, which was a 12% increase from the 2019 estimate of 2,499,000 geese; however, the 10-year trend shows a 6% annual decline. The number of Canada/cackling geese observed in the state during the CBC has shown an increasing trend from 1970 through 2019 estimated at 7.6% per year (National Audubon Society 2020). The number of migratory Canada geese and cackling geese present in the state during the winter or during the spring and fall migration is unknown. In addition, both resident and migratory Canada geese are present in the state during those periods.

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

SNOW, ROSS'S, AND WHITE-FRONTED GOOSE POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Snow geese, Ross's geese, and white-fronted geese are present in Texas during the winter and during migration periods. Of those three species, the snow goose is the most common species found in Texas. The snow goose is a medium to large-sized goose and one of the most abundant species of waterfowl in the world (Mowbray et al. 2020*c*). In North America, snow geese nest in the extreme northern artic region and migrate southward to winter in parts of the United States and Mexico. There are two recognized subspecies of snow geese: lesser snow goose and greater snow goose. The lesser snow goose is the smaller of the two subspecies and dimorphic, with two color phases. The light phase goose has a white plumage and the dark phase goose looks almost blue. Until recently, the two color morphs were once thought to be two separate species (Mowbray et al. 2020*c*). The greater snow goose is very similar to the white phase lesser snow goose, only slightly larger in size.

The two subspecies are similar in many ways but vary in geographical range. Both subspecies nest in large colonies in the subarctic and arctic tundra (Mowbray et al. 2020*c*). The greater snow goose makes up the Eastern Population while the lesser snow goose makes up the Midcontinental and Western Populations (Mowbray et al. 2020*c*). There is also a variation among color morphs of the lesser snow goose. While it is not uncommon for lesser snow goose populations to be mixed, the highest proportion of blue morph snow geese breed on the southwest coast of Baffin Island, Nanavut, Canada (Mowbray et al. 2020*c*). There is also some geographical variation throughout the wintering grounds as migration patterns roughly parallel longitudes from the breeding colonies (Mowbray et al. 2020*c*).

The Midcontinental Population of lesser snow geese are the most often observed in Texas, although lesser snow geese from the Western Population may also occur in the state. During the 2020 midwinter survey, the Midcontinental Population of lesser snow geese was estimated at around 9.9 million geese, a 14% decrease from the 2019 estimate (USFWS 2020*c*). Since 2010, the survey has indicated 4% annual decline in the Midcontinental Population of lesser snow geese. From 1970 through 2019, the number of snow geese observed in areas of the state surveyed during the CBC has shown a declining trend estimated at -0.7% per year; however, from 2009 through 2019, the number observed has shown an increasing trend estimated at 1.5% per year (National Audubon Society 2020). The number of snow geese that winter or migrate through Texas annually is unknown.

Ross's goose has a similar appearance to the snow goose but is generally smaller than snow geese. Ross's geese nest in the central artic region of North America and migrate southward to winter in southern United States and northern Mexico. Ross's geese are often found with snow geese during the migration periods and in wintering areas. Ross's geese occur throughout most of Texas during the migration periods and during the winter (Jonsson et al. 2020). From 1970 through 2019, the number of Ross's geese observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 9.6% per year. From 2009 through 2019, the number observed has shown an increasing trend estimated at 8.8% per year (National Audubon Society 2020). The number of Ross's geese that winter or migrate through Texas annually is unknown. During the 2020 midwinter survey, the population was estimated at 233,000 Ross's geese, a 37% decrease from the 2019 estimate (USFWS 2020*c*). Since 2010, the survey has indicated 11% annual decline in the population of Ross's geese.

In North America, the white-fronted goose nest in the northern article regions of Canada and throughout most of Alaska. They winter along the western and southcentral United States and parts of Mexico. In Texas, white-fronted geese winter in the southeastern portion of the state and can be present in other parts of the state during the migration periods (Ely et al. 2020). From 1970 through 2019, the number of white-fronted geese observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 3.5% per year; however, from 2009 through 2019, the number observed has shown a decreasing trend estimated at -4.8% per year (National Audubon Society 2020). The number of white-fronted geese that winter or migrate through Texas annually is unknown. During the 2020 midwinter survey, the Midcontinent population was estimated at nearly 1.3 million white-fronted geese, a 64% increase from the 2019 estimate (USFWS 2020*c*). Since 2010, the survey has indicated 4% annual increase in the Midcontinent population of white-fronted geese.

From FY 2017 through FY 2019, the TWSP lethally removed one snow goose in FY 2018 to alleviate damage or the threat of damage. No take of snow geese occurred by the TWSP in FY 2017 and FY 2019. In addition, no take of Ross's geese or white-fronted geese occurred by the TWSP from FY 2017 through FY 2019. No take of snow geese, Ross's geese, and white-fronted geese were reported by other entities in Texas from 2017 through 2019. Like Canada geese, people can harvest snow geese, Ross's geese, and white-fronted geese in Texas during annually hunting seasons. In 2018, the Raftovich et al. (2020) estimates that hunters harvested nearly 33,700 snow geese in Texas and over 65,600 snow geese during 2019. Hunters harvested nearly 10,900 Ross's geese and nearly 33,700 white-fronted geese in Texas during 2018. In 2019, hunters harvested 12,000 Ross's geese and 38,400 white-fronted geese in Texas (Raftovich et al. 2020).

The TWSP anticipates lethally removing up to 1,000 snow geese, 100 Ross's geese, and 10 white-fronted geese annually to alleviate damage and threats of damage in the state. Based on the population estimates for those species and the number of geese that people harvest annually, the take of up to 1,000 snow geese, 100 Ross's geese, and 10 white-fronted geese annually by the TWSP would be of low magnitude and would not adversely affect those species' populations. The take of snow geese, Ross's geese, and white-fronted geese can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of great those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species.

DUCK AND MERGANSER POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The TWSP could address ducks and mergansers when providing assistance. As shown in Table 3.1, the TWSP addressed black-bellied whistling-ducks, mallards, mottled ducks, ring-necked ducks, blue-winged ducks, and green-winged ducks from FY 2017 through FY 2019. Table 3.20 shows the estimated breeding populations for each species addressed by the TWSP from FY 2017 through FY 2019 using current BBS data along with current trend data from the BBS and CBC conducted in Texas. The TWSP could address additional species of ducks when they are associated with requests for assistance. In addition, the TWSP could address common mergansers, hooded mergansers, and red-breasted mergansers to alleviate damage or threats of damage. Table 3.20 also shows the estimated breeding populations for additional duck and merganser species that the TWSP could address using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

As shown in Table 3.20, many of the duck and merganser species that the TWSP could address do not nest in the state but are present in the state during the migration periods and during the winter. In addition, juveniles and non-breeding adults of some duck and merganser species are present in the state during the nesting season and are observed during the BBS but those species are not generally considered as nesting in the state, which is often indicated by their small estimated breeding population in the state. For example, gadwall generally do not nest in the state but, as indicated in Table 3.20, observers have counted gadwall in the state during the BBS, which are likely juveniles or non-breeding adults.

Table 3.21 indicates the annual take anticipated by the TWSP to alleviate damage and threats of damage associated with duck and merganser species in Texas. As shown in Table 3.21, the anticipate annual take of ducks and mergansers by the TWSP would be of low magnitude when compared to the species' population. In addition, many of the population estimates in 3.21 represent the breeding population; therefore, the fall post-breeding population would likely be higher and the anticipated annual take by the

TWSP would represent a lower percentage of the population. The number of ducks and mergansers that migrate through and/or winter in Texas is unknown.

Table 3.20 - Texas breeding population estimates and trend data for several duck and merganser species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Wood Duck	7,967	1.5%	-0.03%	2.0%	0.2%
Gadwall	1,795	1.2%	0.02%	2.0%	1.9%
American Wigeon	-	-	-	-1.5%	-0.8%
Mallard	44,998	1.2%	-2.7%	-2.2%	-1.4%
American Black Duck	-	-	-	-17.9%	-17.7%
Mottled Duck	25,473	-4.0%	-3.7%	0.9%	0.4%
Blue-winged Teal	27,380	1.7%	-1.8%	1.5%	2.2%
Cinnamon Teal	3,030	0.7%	-0.3%	-3.8%	-3.6%
Northern Shoveler	2,244	0.2%	-2.2%	1.7%	0.6%
Northern Pintail	5,835	-1.7%	6.6%	-5.4%	-5.3%
Green-winged Teal	3,591	-0.4%	1.6%	-5.0%	-16.4%
Canvasback	-	-	-	-0.6%	1.5%
Redhead	6,621	3.0%	3.3%	1.9%	2.6%
Ring-necked Duck	175,069	-	-	4.0%	3.6%
Greater Scaup	-	-	-	1.2%	1.9%
Lesser Scaup	-	-	-	0.2%	-0.4%
Bufflehead	-	-	-	0.9%	-0.7%
Common Goldeneye	-	-	-	-1.0%	-2.2%
Common Merganser	-	-	-	-2.2%	-3.0%
Hooded Merganser	224	-	-	5.6%	3.8%
Red-breasted Merganser	-	-	-	-0.2%	1.5%
Ruddy Duck	2,132	-0.2	-2.7%	0.8%	-1.3%
Black-bellied Whistling-Duck	207,261	5.7%	-7.1%	16.7%	17.4%

The USFWS has and could authorized other entities to take duck and mergansers in the state. As indicated in Table 3.2, other entities have taken a small number of ducks previously to alleviate damage. Based on the number of ducks that other entities have lethally removed previously, the cumulative take of duck and merganser species would be of low magnitude. The TWSP anticipates take by other entities to alleviate damage or threats of damage in the state to be similar to previous take levels and to be of low magnitude when compared to those species' populations.

Like geese, people can harvest ducks and mergansers in Texas during annually hunting seasons. In 2018, the Raftovich et al. (2020) estimates that hunters harvested 103,378 mallards, 1,921 mottled ducks, 132,017 green-winged teal, 298,958 blue-winged/cinnamon teal, and 58,325 ring-necked ducks in Texas. In 2019, hunters harvested 47,491 mallards, 4,215 mottled ducks, 125,190 green-winged teal, 153,713 blue-winged/cinnamon teal, and 36,531 ring-necked ducks in Texas (Raftovich et al. 2020). Annual anticipated take by the TWSP would be of low magnitude compared to the number of those species harvested annually during the waterfowl season.

Table 3.21 - Estimated breeding waterfowl populations, anticipated annual take by the TWSP, and the impacts of TWSP anticipated take on a species population

Species	Nesting Population*	TWSP Annual Take	TWSP Take % Population
Wood Duck[2]**	665,000†	10	0.002%
Gadwall	3,566,682	100	0.003%
American Wigeon	1,973,572	100	0.005%
Mallard	10,093,512	1,000	0.010%
American Black Duck	550,000†	1	0.000%
Mottled Duck[2]**	40,000†	100	0.250%
Blue-winged Teal	8,601,953	100	0.001%
Cinnamon Teal[**]	10,000†	10	0.100%
Northern Shoveler	4,477,141	100	0.002%
Northern Pintail	2,642,912	100	0.004%
Green-winged Teal	2,821,398	100	0.004%
Canvasback	705,473	10	0.001%
Redhead	1,260,187	10	0.001%
Ring-necked Duck	1,249,458	10	0.001%
Greater Scaup	3,864,044	10	0.0003%
Lesser Scaup		100	0.003%
Bufflehead	1,310,237	10	0.001%
Goldeneye spp.	669,280	10	0.001%
Common Merganser	1,300,000†	10	0.001%
Hooded Merganser	1,100,000†	10	0.001%
Red-breasted Merganser	240,000†	10	0.004%
Ruddy Duck	747,504	10	0.001%
Black-bellied Whistling-Duck	200,000†	100	0.050%

*Nesting population estimates derived from the Waterfowl Breeding Population and Habitat Survey (USFWS 2021*b*) and include estimates for the traditional survey of central and western Canada and parts of Montana, North/South Dakota, and extreme western Minnesota (Survey Areas 13-50, 75-77, but not including Survey Units 1-12) (USFWS 2021*b*) for most species unless otherwise noted in the table
†Population estimate from Wetlands International (2021)

The take of ducks and mergansers can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species.

COOT AND GALLINULE POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

The TWSP could receive requests for assistance to manage damage or threats of damage associated with American coots, purple gallinules, and common gallinules. American coots occur statewide and throughout the year in Texas (Brisbin and Mowbray 2020). Purple gallinules nest in eastern Texas near the coastal areas and along the border with Louisiana and generally winter further south but they do occur in areas of Texas during the winter (West and Hess 2020). Common gallinules have a similar distribution in Texas as the purple gallinule but generally occur further inland during the nesting season. Common gallinules occur throughout the year along the coastal areas of the state (Bannor and Kiviat 2020). Table 3.22 also shows the estimated breeding populations for the American coot, common gallinule, and purple gallinule using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.22 - Texas breeding population estimates and trend data for gallinules and American coot

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
American Coot	73,936	-0.8%	0.6%	0.7%	0.4%
Common Gallinule	36,231	-1.0%	1.1%	0.6%	5.5%
Purple Gallinule	5,008	-0.7%	1.3%	-	-

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed four American coots during FY 2019. No lethal take of American coots occurred by the TWSP during FY 2017 and FY 2018. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, the TWSP could lethally remove up to 1,000 American coots to alleviate damage or threats of damage when permitted by the USFWS. As shown in Table 3.22, the breeding population of American coots in Texas is estimated to be 73,936 American coots using current BBS data. The lethal take of up to 1,000 American coots by the TWSP would represent 1.4% of the breeding population in Texas. However, most activities to alleviate damage are likely to occur in during the migration periods and during the winter when the population of American coots in the Texas increases. Other entities reported to the USFWS the lethal take of 278 American coots in 2018. If other entities lethally removed 278 American coots and take by the TWSP reached 1,000 American coots, the cumulative take would represent 1.7% of the breeding population estimated at 73,936 American coots. People can also hunt American coots during annual hunting seasons in Texas. Raftovich et al. (2020) estimates that people in Texas harvested 400 American coots in 2018 and 2,700 American coots in 2019. During the Mid-winter Waterfowl Survey, observers counted 333,438 American coots in Texas (USFWS 2021*b*). The cumulative take of up to 1,000 American coots by the TWSP, the take of 278 coots by other entities, and the harvest of 2,700 American coots would represent 1.2% of the 333,438 American coots observed in Texas during the Mid-winter Waterfowl Survey.

No take of purples gallinules or common gallinules occurred by the TWSP from FY 2017 through FY 2019. No take of gallinules was reported to the USFWS from 2017 through 2019. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, the TWSP could lethally remove up to 20 common gallinules and up to 20 purple gallinules annually to alleviate damage or threats of damage when permitted by the USFWS. Using current BBS data, the breeding population of common gallinules in Texas is estimated to be 36,231 common gallinules and the purple gallinule breeding population is estimated at 5,008 purple gallinules. The lethal take of up to 20 common gallinules by the TWSP would represent 0.06% of the breeding population in Texas. The lethal take of up to 20 purple gallinules by the TWSP would represent 0.4% of the breeding population in Texas. However, most activities to alleviate damage are likely to occur in during the migration periods and during the winter when the population of gallinules in the Texas increases. People can harvest gallinules during annual hunting season in the state; however, Raftovich et al. (2020) estimates that no harvest of gallinules occurring in Texas during the 2018 and 2019 hunting seasons.

The take of coots and gallinules can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species.

CRANE POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

Sandhill cranes and whooping cranes are present in Texas during the migration periods and during the winter. Sandhill cranes nest across much of Canada and Alaska and winter in areas of the southern United States and northern Mexico (Gerber et al. 2020). In Texas, sandhill cranes are present statewide during the migration periods and winter throughout most of the state. From 1970 through 2019, the number of sandhill cranes observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 1.4% per year. From 2009 through 2019, the number of sandhill cranes observed in areas of the state surveyed during the CBC has shown an increasing trend estimated at 0.2% per year (National Audubon Society 2020).

Whooping cranes are listed as an endangered species by the USFWS pursuant to the ESA and is likely one of the rarest birds in North America. In Texas, whooping cranes migrate through the state to winter in or near the Aransas National Wildlife Refuge. Those whooping cranes that winter in Texas nest in or near the Wood Buffalo National Park in the Northwest Territories of Canada (Urbanek and Lewis 2020).

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed one sandhill crane during FY 2019. No lethal take of sandhill cranes occurred by the TWSP during FY 2017 and FY 2018. Based on previous requests for assistance and in anticipation of receiving additional requests for assistance, the TWSP could lethally remove up to 100 sandhill cranes to alleviate damage or threats of damage when permitted by the USFWS. As shown in Table 3.1, the breeding population of sandhill cranes is North America estimated to be 750,000 sandhill cranes using current BBS data. The lethal take of up to 100 sandhill cranes by the TWSP would represent 0.01% of the breeding population in North America. However, activities to alleviate damage are likely to occur in during the migration periods and during the winter when the population of sandhill cranes is higher. Other entities did not report any take occurring from 2017 through 2019. People can also hunt sandhill cranes during annual hunting seasons in Texas. Dubovsky (2020) estimates that people in Texas harvested 22,526 sandhill cranes in 2018 and 29,607 sandhill cranes in 2019. The take of up to 100 sandhill cranes by the TWSP would represent 0.4% of the 22,526 sandhill cranes harvested in Texas during 2018 and 0.3% of the 29,607 sandhill cranes harvest during 2019.

The take of sandhill cranes can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of sandhill cranes by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for sandhill cranes.

In rare circumstances, the TWSP could receive a request to disperse a whooping crane using non-lethal hazing methods. As discussed previously, the USFWS considers the whooping crane to be an endangered species pursuant to the ESA. Using non-lethal hazing methods to disperse a whooping crane could constitute take as defined by the ESA. Therefore, the TWSP would only haze whooping cranes after receiving the appropriate permits from the USFWS. The most likely reasons for take would be to haze them from an airport or contaminated site, such as an oil spill. Dispersing whooping cranes would serve to protect individuals from potentially being killed and, thus, beneficial in the long term (they may be temporarily impacted from being harassed). Therefore, activities to haze whooping cranes would require a Section 10 permit from the USFWS, which the TWSP would obtain prior to conducting any activities associated with whooping cranes. The TWSP would only conduct activities involving whooping cranes after receiving the appropriate permits (*e.g.*, Section 10 permit) and consulting with the USFWS on those activities. Activities to disperse whooping cranes would not occur at an intensity or magnitude that would result in mortality. Therefore, TWSP believes that it would not impact this species, but potentially provide a benefit if it is successfully hazed from a harmful situation.

SWALLOW, NIGHTHAWK, MARTIN, NIGHTJAR, AND SWIFT POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

There are seven species of swallows, two swift species, two nighthawk species, and five nightjar species that occur in Texas (see Table 3.23). In addition, the purple martin occurs in Texas. Table 3.23 also shows the estimated breeding populations for those swallow, nighthawks, martin, nightjar, and swift species that occur in Texas using current BBS data along with current trend data from the BBS and CBC conducted in Texas.

Table 3.23 - Texas breeding population estimates and trend data for several swallow, nighthawk, martin, nightjar, and swift species

Species	Texas Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Tree Swallow	1,692	2.3%	-1.3%	6.2%	5.0%
Violet-green Swallow	256	-0.3%	-1.8%	-	-
Northern Rough-winged Swallow	524,685	0.0%	-1.9%	4.2%	5.4%
Bank Swallow	2,405	-0.7%	-0.4%	-	-
Cliff Swallow	8,126,361	2.7%	0.9%	-	-
Cave Swallow	1,560,688	13.9%	-3.0%	5.5%	-2.2%
Barn Swallow	2,217,009	3.4%	-3.3%	2.7%	1.0%
Lesser Nighthawk	680,754	0.1%	-0.9%	-7.3%	-0.1%
Common Nighthawk	4,050,289	-1.3%	-2.0%	-	-
Purple Martin	1,002,979	0.3%	-3.6%	-	-
Common Pauraque	44,886	3.8%	-1.8%	-2.1%	-2.0
Common Poorwill	125,939	-0.5%	-1.0%	-	-
Chuck-will's-widow	671,965	-1.3%	-0.4%	-	-
Eastern Whip-poor-will	-	-3.7%	-1.1%	-	-
Mexican Whip-poor-will	4,621	-	-	-	-
Chimney Swift	306,558	-3.0%	-4.9%	-	-
White-throated Swift	11,199	-3.0%	-6.3%	2.8%	4.3%

As shown in Table 3.1, from FY 2017 through FY 2019, the TWSP lethally removed an average of 59 cliff swallows, 37 barn swallows, and 15 common nighthawks per year to alleviate damage or threats of damage. The take of other species of swallows, swifts, nighthawks, nightjars, and purple martins did not occur by the TWSP from FY 2017 through FY 2019. As shown in Table 3.2, other entities reported to the USFWS the take of nighthawks, cliff swallows, and barns swallows from 2017 through 2019.

Table 3.24 indicates the annual take anticipated by the TWSP to alleviate damage and threats of damage associated with swallows, swifts, nighthawks, nightjars, and purple martins in Texas. As shown in Table 3.24, the anticipate annual take of swallows, swifts, nighthawks, nightjars, and purple martins by the TWSP would be of low magnitude when compared to the species' population. In addition, many of the population estimates in Table 3.24 represent the breeding population; therefore, the fall post-breeding population would likely be higher and the anticipated annual take by the TWSP would represent a lower percentage of the population. The number of swallows, swifts, nighthawks, nightjars, and purple martins that migrate through and/or winter in Texas is unknown.

As discussed previously, the USFWS has and could authorized other entities to take swallows, swifts, nighthawks, nightjars, and purple martins in the state. As indicated in Table 3.2, other entities have taken a small number of nighthawks and swallows previously to alleviate damage. Based on the number of those species that other entities have lethally removed previously, the cumulative take of swallows, swifts, nighthawks, nightjars, and purple martins would be of low magnitude. The TWSP anticipates take by other entities to alleviate damage or threats of damage in the state to be similar to previous take levels and to be of low magnitude when compared to those species' populations.

Table 3.24 - Estimated Texas breeding populations, anticipated annual take by the TWSP, and the impacts of TWSP anticipated take on a species population

Species	Texas Nesting Population	TWSP Annual Take	TWSP Take % Population
Tree Swallow	1,692	20	**1.18%**
Violet-green Swallow	256	20	**7.81%**
Northern Rough-winged Swallow	524,685	200	**0.04%**
Bank Swallow	2,405	50	**2.08%**
Cliff Swallow	8,126,361	500	**0.01%**
Cave Swallow	1,560,688	200	**0.01%**
Barn Swallow	2,217,009	500	**0.02%**
Lesser Nighthawk	680,754	100	**0.01%**
Common Nighthawk	4,050,289	100	**0.003%**
Purple Martin	1,002,979	500	**0.05%**
Common Pauraque	44,886	50	**0.11%**
Common Poorwill	125,939	50	**0.04%**
Chuck-will's-widow	671,965	50	**0.01%**
Eastern Whip-poor-will	-	50	**-**
Mexican Whip-poor-will	4,621	20	**0.43%**
Chimney Swift	306,558	100	**0.03%**
White-throated Swift	11,199	100	**0.89%**

The take of swallows, swifts, nighthawks, nightjars, and purple martins can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species.

WOODPECKER POPULATIONS - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

There are several species of woodpeckers that occur in Texas or parts of Texas at least part of the year (see Table C-1 and Table C-2 in Appendix C). Table 3.25 shows the estimated breeding populations, BBS trend data, and CBC trend data for those woodpecker species that occur in Texas that reside for some part of the year in Texas and could be addressed by the TWSP. In addition, the Lewis's woodpecker, Williamson's sapsucker, red-breasted sapsucker, and red-cockaded woodpecker may also occur in Texas but are infrequently observed or accidental in the state.

No take of woodpeckers occurred by the TWSP from FY 2017 through FY 2019. Similarly, no take of woodpeckers was reported to the USFWS from 2017 through 2019. Table 3.26 indicates the annual take anticipated by the TWSP to alleviate damage and threats of damage associated with woodpeckers in Texas. As shown in Table 3.26, the anticipate annual take of woodpeckers by the TWSP would be of low magnitude when compared to the species' breeding population. The population estimates in Table 3.26 represent the breeding population; therefore, the fall post-breeding population would likely be higher and the anticipated annual take by the TWSP would represent a lower percentage of the population. The number of woodpeckers that migrate through and/or winter in Texas is unknown.

Table 3.25 - Texas breeding population estimates and trend data for several woodpecker species

Species	Breeding Population	Texas BBS Trend		Texas CBC Trend	
		1966-2019	2009-2019	1970-2019	2009-2019
Red-headed Woodpecker	43,577	-1.2%	-1.8%	-1.9%	0.4%
Acorn Woodpecker	5,431	-	-	1.3%	2.1%
Golden-fronted Woodpecker	549,241	-0.3%	-0.2%	1.1%	2.3%
Red-bellied Woodpecker	924,614	0.3%	-0.5%	1.8%	1.3%
Yellow-bellied Sapsucker	-	-	-	-0.4%	-2.6%
Red-naped Sapsucker	-	-	-	-0.2%	0.0%
Ladder-backed Woodpecker	1,284,190	-0.2%	-0.8%	0.6%	0.4%
Downy Woodpecker	533,482	-	-	1.1%	-1.4%
Hairy Woodpecker	9,205	0.2%	-0.8%	-1.9%	-1.3%
Northern Flicker	9,831	-1.6%	-2.0%	-2.0%	-2.2%
Pileated Woodpecker	63,435	0.3%	-1.3%	1.6%	1.6%

The Lewis's woodpecker, Williamson's sapsucker, and red-breasted sapsucker occasionally occur in Texas, primarily in west Texas. The TWSP anticipates receiving requests for assistance involving those species to be infrequent. In addition, the TWSP anticipates requests for assistance would primarily involve one or two individuals that are causing dame or posing a threat of damage. The TWSP anticipates using primarily non-lethal methods to address those species but could take up to five individuals of each species annually if non-lethal methods were unable to alleviate damage or the threat of damage. The take of up to five individuals of each of those species would not reach a magnitude that would cause adverse effects to a species' population. Take of those species by the TWSP would only occur when authorized by the USFWS and the TPWD and only at levels authorized.

Table 3.26 - Estimated breeding woodpecker populations, anticipated annual take by the TWSP, and the impacts of TWSP anticipated take on a species population

Species	Nesting Population*	TWSP Annual Take	TWSP Take % Population
Red-headed Woodpecker	43,577	20	**0.05%**
Acorn Woodpecker	5,431	10	**0.18%**
Golden-fronted Woodpecker	549,241	20	**0.004%**
Red-bellied Woodpecker	924,614	20	**0.002%**
Yellow-bellied Sapsucker	84,158†	10	**0.01%**
Red-naped Sapsucker	111,806†	10	**0.01%**
Ladder-backed Woodpecker	1,284,190	20	**0.002%**
Downy Woodpecker	533,482	20	**0.004%**
Hairy Woodpecker	9,205	10	**0.11%**
Northern Flicker	9,831	10	**0.1%**
Pileated Woodpecker	63,435	20	**0.03%**

*Breeding population in Texas unless otherwise noted

†Breeding population in the Central Plains States because yellow-bellied sapsuckers and red-naped sapsuckers do not nest in Texas but do winter and migrate through Texas

As discussed previously, the USFWS could authorized other entities to take woodpeckers in the state. Based on the number of those species that other entities have lethally removed previously, the cumulative take of woodpeckers would be of low magnitude. The TWSP anticipates take by other entities to alleviate damage or threats of damage in the state to be similar to previous take levels and to be of low magnitude when compared to those species' populations.

The take of woodpeckers can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of those species by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for those species.

AMERICAN ROBIN POPULATION - DIRECT, INDIRECT, AND CUMULATIVE EFFECTS

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

In Texas, the number of American robins observed during the BBS has shown an increasing trend estimated at 0.6% annually since 1966 with a 0.1% annual increase occurring from 2009 through 2019 (Sauer et al. 2020). As shown in Table 3.1, the nesting population in Texas is estimated at 230,400 American robins. The number of American robins observed in areas of the state surveyed during the CBC has shown a declining trend from 1970 through 2019 estimated at -2.5% per year (National Audubon Society 2020). However, from 2009 through 2019, the number of American robins observed in areas of the state surveyed during the CBC has shown a stable trend (National Audubon Society 2020).

From FY 2017 through FY 2019, the TWSP has lethally removed an average of 16 American robins per year in the state to alleviate damage or threats of damage. The highest annual take occurred in FY 2018 when the TWSP lethally removed 29 American robins. Based on requests for assistance previously received, the TWSP could lethally remove up to 200 American robins annually to alleviate damage or reduce threats in the state. The take of 200 American robins by the TWSP would represent 0.09% of the estimated breeding population within Texas. As stated previously, large flocks of American robins are present in the state during the winter, as well as, during the migration periods and most requests for assistance are associated with large groups of robins at airports. Although the TWSP could address robins during the breeding season, most activities would occur during the migration periods when robins occur in large flocks. No take of American robins was reported by other entities in the state from 2017 through 2019.

The take of American robins can only occur when authorized through the issuance of depredation permits by the USFWS and when authorized by the TPWD. All take of American robins by the TWSP would occur within the levels permitted by the USFWS pursuant to the MBTA and authorizations issued by the TPWD. The permitting of take by the USFWS pursuant to the MBTA and the authorization of take by the TPWD would ensure take by the TWSP and other entities occurred within allowable levels to achieve desired population objectives for American robins.

ADDITIONAL TARGET BIRD SPECIES

In addition to those bird species discussed previously, the TWSP has addressed limited numbers of additional target bird species previously or the TWSP anticipates addressing a limited number of additional bird species if the TWSP implements Alternative 1, including gallinaceous birds (turkeys, grouse, quail), cuckoos (roadrunners and anis), frugivorous birds (robins, waxwings, finches), and miscellaneous birds (mockingbirds, cardinals, and grosbeaks). Table C-1 in Appendix C lists those bird species that occur in Texas that reside for some part of the year in Texas and could be addressed by the TWSP. In addition, Section 1.2 discusses the bird species that the TWSP has addressed previously to alleviate damage or threats of damage. The TWSP would primarily address additional bird species to alleviate aircraft strike risks at airports in the state. Requests for assistance associated with those species would often occur infrequently or would involve only a few individuals. The TWSP anticipates addressing those requests for assistance using primarily non-lethal dispersal methods. If the TWSP implements Alternative 1, the TWSP could receive requests for assistance to use lethal methods to remove those bird species when non-lethal methods were ineffective or were determined to be inappropriate using the WS Decision model.

Based on previous requests for assistance and the take levels necessary to alleviate those requests for assistance, the TWSP would not lethally remove more than 25 individuals annually of those species identified in Table C-1 of Appendix C that were not specifically addressed previously. The TWSP would only conduct activities associated with those migratory bird species identified in Table C-1 of Appendix C when authorized and only at levels authorized by the USFWS and/or the TPWD. Some of the bird species in Table C-1 of Appendix C are classified as species of conservation concern by the USFWS. The TWSP does not anticipate addressing those species unless they pose an aircraft strike risk or to disperse those species from contamination sites, such as oil spills. Similarly, the TWSP does not anticipate addressing those species in Table C-2 and Table C-3 in Appendix C unless those species pose an aircraft strike risk or to disperse those species from contaminated sites. If take is determined to be necessary through the use of the WS Decision Model, the TWSP anticipates the take would not exceed one individual per year of those species identified in Table C-1 of Appendix C as species of conservation concern and those species identified in Table C-2 and Table C-3.

The TWSP does not expect the annual take of those species identified in Table C-1, Table C-2, and Table C-3 of Appendix C to occur at any level that would adversely affect populations of those species. Take would be limited to those individuals deemed causing damage or posing a threat. The MBTA protects most of those bird species from take unless the USFWS permits the take pursuant to the MBTA. If the USFWS and/or the TPWD did not issue a permit, no take would occur by the TWSP. In addition, take could only occur at those levels stipulated in a permit. Therefore, the take of those bird species would occur in accordance with applicable state and federal laws and regulations authorizing take of migratory birds and their nests and eggs, including the USFWS and/or the TPWD permitting processes. The USFWS and/or the TPWD, as the agencies with management responsibility for migratory birds, could impose restrictions on depredation take as needed to assure cumulative take does not adversely affect the continued viability of populations. This would assure that cumulative effects on those bird populations would not have a significant adverse effect on the quality of the human environment. In addition, the TWSP would report annually to the USFWS and/or the TPWD any take of the bird species listed in Table C-1 of Appendix C in accordance with a permit or other authorization when required.

The USFWS has designated some species identified in Table C-1, Table C-2, and Table C-3 of Appendix C as endangered or threatened pursuant to the ESA. In rare circumstances, the TWSP could receive a request to disperse a threatened or endangered species using non-lethal hazing methods. Using non-lethal hazing methods to disperse a threatened or endangered species could constitute take as defined by the ESA. Therefore, the TWSP would only haze a threatened or endangered species after receiving the appropriate permits from the USFWS. The most likely reasons for take would be to haze them from an airport or to disperse them from a contaminated area, such as an oil spill. Dispersing those threatened or endangered species would serve to protect individuals from potentially being killed and, thus, beneficial in the long term (they may be temporarily impacted from being harassed). Therefore, activities to haze threatened or endangered species would require a Section 10 permit from the USFWS, which the TWSP would obtain prior to conducting any activities associated threatened or endangered species. The TWSP would only conduct activities involving threatened or endangered species after receiving the appropriate permits (*e.g.*, Section 10 permit) and consulting with the USFWS on those activities. Activities to disperse threatened or endangered species would not occur at an intensity or magnitude that would result in mortality. Therefore, TWSP believes that it would not impact those species, but potentially provide a benefit if they were successfully hazed from a harmful situation.

AVIAN DISEASE SURVEILLANCE AND MONITORING

As part of disease monitoring and surveillance, WS could collect samples from birds. Examples of strategies for collecting samples in birds that WS could implement include investigating sick/dead birds, conducting surveillance in live wild birds, conducting surveillance of hunter-harvested birds, and/or conducting environmental sampling. Implementation of those sampling strategies to detect or monitor avian diseases would not adversely affect avian populations in the state. For example, the sampling (*e.g.*, drawing blood, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse effects because WS personnel would release those birds unharmed on site. In addition, collecting samples from birds that were sick, dying, or harvested by hunters would not result in the additive lethal take of birds that would not have already occurred in the absence of sampling. Therefore, sampling birds for pathogens would not adversely affect the populations of any of the birds addressed in this EA nor would sampling result in any take of birds that would not have already occurred in the absence of sampling (*e.g.*, hunter harvest).

EFFECTS ON THE PUBLIC'S ESTHETIC ENJOYMENT OF BIRDS

Public opinion about the best ways to reduce conflicts between people and animals is highly variable, making the implementation and conduct of damage management programs extremely complex. Some people express concerns that proposed activities could interfere with their enjoyment of recreational activities and their esthetic enjoyment of birds. Another concern is WS' activities would result in the loss of esthetic benefits of birds to the public.

People generally regard animals as providing economic, recreational, and esthetic benefits (Decker and Goff 1987), and the mere knowledge that animals exists is a positive benefit to many people. Esthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, esthetics is truly subjective in nature, dependent on what an observer regards as beautiful. The human attraction to animals likely started when people began domesticating animals. The public today share a similar bond with animals and/or wildlife in general and in modern societies, a large percentage of households have indoor or outdoor pets. However, some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing animals. Therefore, the public reaction can be variable and mixed to animal damage management because there are numerous philosophical, esthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between people and animals.

Animal populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those benefits include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing animals exist and contribute to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals and may take the form of direct consumptive use (*e.g.,* using parts of or the entire animal) or non-consumptive use (*e.g.*, viewing the animal in nature or in a zoo, photographing) (Decker and Goff 1987). Birds may provide similar benefits to people that enjoy viewing certain bird species and knowing they are part of natural ecosystems.

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

In 2011, the USFWS and the United States Department of Commerce (2011) found over 6.3 million people participated in wildlife-associated recreation in Texas, including people that participated in hunting, fishing, and wildlife watching. In total, people spent over $6.2 billion on wildlife recreation in Texas during 2011 (USFWS and the United States Department of Commerce 2011).

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

In some cases, the presence of overabundant bird species offends people, such as starlings, pigeons, or feral species, such as domestic waterfowl. To such people, those species represent pests that are nuisances, which upset the natural order in ecosystems, and are carriers of diseases transmissible to people or other animals. In those situations, the presence of overabundant species can diminish their overall enjoyment of other animals by what they view as a destructive presence of such species. They are offended because they feel that those species proliferate in such numbers and appear to remain unbalanced.

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

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

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

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

If WS implements Alternative 2, WS personnel would only use non-lethal methods to resolve damage or threats of damage associated with target bird species in Texas. No intentional lethal removal of target bird species would occur by WS personnel. Non-lethal methods generally disperse, exclude, or live-capture birds. Methods intended to disperse birds from areas where they are causing damage or posing a threat of damage are generally visual or auditory deterrents, such as lights, lasers, pyrotechnics, propane cannons, or air horns. Exclusion methods would prevent target bird species from accessing a resource and could disperse those birds to other areas where resources are unprotected. Exclusion methods could include overhead wires, fencing, and netting. WS could also live-capture target bird species and then translocate those birds to appropriate habitat for release. WS could continue to use aircraft and UAVs to survey, monitor, and track birds in Texas. Table 3.27 shows the bird species and number of each species addressed by the TWSP using non-lethal methods from FY 2017 through FY 2019.

Table 3.27 - Birds hazed (scared with frightening devices or other non-lethal method) from damage situations from or captured (in parentheses) and released (disease monitoring) or relocated from FY 2017 to FY 2019 by TWSP.

Species	FY 2017	FY 2018	FY 2019	Ave
Great-tailed Grackle*	6,855	14,300	13,291	**11,482**
Brown-headed Cowbird*	135	151	11,965	**4,084**
Red-winged Blackbird*	425	110	2,141	**892**
Common Grackle	10,775	18,537	3,895	**11,069**
Boat-tailed Grackle	851	2,200	0	**1,017**

Species	FY 2017	FY 2018	FY 2019	Ave
European Starling*	15,772	19,620	10,097	**15,163**
Feral (Rock) Pigeon*	7,607	940	1,449	**3,332**
House Sparrow*	204	211	1,549	**655**
Eurasian Collared-Dove	46	714	724	**495**
Feral Domestic Duck	4	(92)	(5)	**34**
Feral Geese	4	3	0	**2**
American Crow*	282	369	342	**331**
Common Raven	1	59	42	**34**
Turkey Vulture	1,840	3,074	2,123	**2,346**
Black Vulture	3,067	3,379	6,440	**4,295**
Swainson's Hawk	1,010 (1)	1,143	1,256	**1,137**
American Kestrel	239	594	606	**480**
Peregrine Falcon	1	0	1	**<1**
Prairie Falcon	0	0	1	**<1**
Merlin	0	0	1	**<1**
Broad-winged Hawk	0	0	275	**92**
Crested Caracara	19	156	649	**275**
Harris Hawk	0	25	5	**10**
Red-tailed Hawk	202 (12)	603 (6)	414 (1)	**413**
Osprey	12	7	21	**13**
Northern Harrier	25	212	356	**198**
Mississippi Kite	32	15	79	**42**
Sharp-shined Hawk	(9)	8	10	**9**
Cooper's Hawk	2 (10)	2 (4)	69 (4)	**30**
White-tailed Hawk	1	0	7	**3**
Great Horned Owl	(4)	(3)	2 (2)	**4**
Shrot-eared Owl	0	0	3	**1**
Red-shouldered Hawk	(2)	(4)	4	**3**
Common Barn Owl	29	0	(1)	**10**
Pied-billed Grebe	0	0	20	**7**
Laughing Gull	4,240	2,056	8,151	**4,816**
Ring-billed Gull	605	820	2,260	**1,228**
Franklin's Gull	103	367	335	**268**
Black Skimmer	0	0	65	**22**
Common Tern	0	0	100	**33**
Herring Gull	537	0	547	**361**
Forster's Tern	0	0	20	**7**
Caspian Tern,	0	56	343	**133**
Anhinga	0	10	210	**73**
Double-crested Cormorant	4,971	950	11,217	**5,713**
American White Pelican	115	245	435	**265**
Brown Pelican	0	34	31	**22**
Belted Kingfisher	0	0	1	**<1**
Upland Sandpiper	1,039	1,088	1,100	**1,076**
Killdeer	902	1,380	2,313	**1,532**
Long-billed Curlew	35	26	430	**164**
Wilson's Snipe	0	2	0	**<1**
Least Sandpiper[D]	0	0	79	**26**

Species	FY 2017	FY 2018	FY 2019	Ave
Black-necked Stilt	0	0	305	**102**
Willets	0	0	85	**28**
Semipalmated Sandpiper[D]	124	25	0	**50**
Greater Yellowlegs	0	0	6	**2**
Lesser Yellowlegs[D]	0	91	240	**110**
Cattle Egret	2,601	3,984	7,726	**4,770**
Great Blue Heron	451	162	1,593	**735**
Great Egret	722	41	372	**378**
Snowy Egret	79	62	723	**288**
Roseate Spoonbill	2	0	0	**1**
White Ibis	40	93	2,410	**848**
Little Blue Heron	0	0	92	**31**
Green Heron	0	2	1	**1**
Black-crowned Night-Heron	0	27	3	**10**
Yellow-crowned Night-Heron	20	61	111	**64**
Sandhill Crane	61	616	302	**326**
Black-bellied Whistling-Duck	108	0	1,077	**395**
Northern Shoveler	75	0	0	**25**
Blue-winged Teal	40	0	1,216	**419**
Lesser Scaup	9	0	0	**3**
Ring-necked Duck	0	0	603	**201**
Mallard	21	190	678	**296**
Mottled Duck	96	4	683	**261**
Canada Goose	0	60	58	**39**
Redhead	40	0	0	**13**
Green-winged Teal	0	0	330	**110**
American Coot	0	0	400	**133**
Western Meadowlark	503	5,595	10,234	**5,444**
Eastern Meadowlark	6,251	15,175	23,365	**14,930**
Horned Lark	80	266	0	**115**
Scissor-tailed Flycatcher	326	2,006	1,590	**1,307**
Chipping Sparrow	200	0	0	**67**
Savannah Sparrow	1,400	800	10	**737**
Dickcissels	0	0	97	**32**
Western Kingbird	0	148	195	**114**
White-winged Dove	4,025	9,069	15,535	**9,543**
Mourning Dove	10,327	14,218	33,962	**19,502**
Barn Swallow	11,376	19,983	29,327	**20,229**
Cliff Swallow	10,676	24,660	19,043	**18,126**
Common/Lesser Nighthawks	37	10 (2)	5 (2)	**19**
Purple Martin	0	0	200	**67**
Wild Turkey	0	22	10	**11**
Loggerhead Shrike	0	9	4	**4**
Roadrunner	14 (3)	1	1	**6**
American Robin	240	800	2,100	**1,047**
Northern Cardinal	0	0	2	**<1**
Northern Mockingbird	0	32	0	**11**

DIRECT EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

As discussed for Alternative 1, the TWSP has used non-lethal methods to disperse target bird species. For example, from FY 2017 through FY 2019, the TWSP used non-lethal methods to disperse an average of 20,229 barn swallows per year in the state to alleviate damage or threats of damage (see Table 3.27). The intent associated with the use of auditory and visual deterrents is to elicit a flight response by scaring birds from an area where damage is occurring or where damage could occur. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of individual birds or the ability of a bird to survive, especially if the exposure to the stressor was chronic. If stress occurs to a bird from the scaring associated with hazing, the negative effects associated with causing a flight response could be exacerbated by other deleterious stressors already occurring (*e.g.*, disease, food availability). The stress from hazing could negatively affect the health of a bird, interfere with the raising of young, and/or increase energy needs. A similar concern would occur when using exclusion methods, which could prevent birds from accessing a resource (*e.g.*, food source, nesting locations). When using methods to live-capture a bird or birds, injuries or death could occur during the process of capturing a bird. Constantly monitoring and addressing captured birds immediately after capture can reduce the likelihood of injuries and death. In addition, making appropriate modification to live-capture methods can reduce injuries.

If WS implements Alternative 2, the federal WS program would continue to participate as part of the TWSP with the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association; however, WS would only recommend and use non-lethal methods when responding to requests for assistance. Therefore, WS' use of non-lethal methods would be occurring along with any non-lethal methods being used by the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association. The TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association) and other entities could continue to use lethal methods under this alternative.

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

The TWSP could also live-capture a limited number of birds and translocate them to appropriate habitat for release. Translocation often occurs during the migration periods when birds are moving between nesting areas and wintering areas. Translocating birds for release into appropriate habitat would generally have no impacts on a species population. The TWSP could also attach leg bands or other identifying markers (*e.g.*, patagial tags) for identification purposes to birds after live-capture. Live-capturing and attaching identifying markers would only occur after the TWSP or another entity received the appropriate permits from the USFWS and the United States Geological Survey to attach those identifying markers on birds. When using leg bands, the TWSP would use those band sizes indicated in the North American Bird Banding Manual developed by the United States Geological Survey. Because the intent of using identifying markers is to monitor natural movement patterns and to identify individual birds, researchers have designed those methods to allow for natural movements and limit adverse effects on the bird species. Fair et al. (2010) stated "[w]*hen appropriate* [leg] *band sizes are used, the occurrence and rate of adverse effects on the subjects is ordinarily very low*".

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

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

Impacts on Bird Populations from the Use of Non-lethal Methods

The TWSP hazed, captured and released, or relocated 101 species that had the potential to cause or were causing damage, or were involved in disease monitoring from FY 2017 to FY 2019 (see Table 3.27). The TWSP could potentially conduct activities using non-lethal methods for many more species (see Appendix C). Operationally, the TWSP conducts most all hazing activities for projects on airports or in urban areas where birds are an aviation strike hazard or a threat to human health and safety and property. The bird species that caused damage in Texas are listed in Section 1.2 with general information about them in Section 2.1.1 and the agency, USFWS, TPWD, or TWSP, with primary responsibility to assist with damage complaints from these species.

The TWSP annually averaged hazing about 170,000 birds of at least 68 species from FY 2017 through FY 2019 (see Table 3.27). In some cases, many individual birds may be hazed several times before they are successfully moved. For the three fiscal years, the number of species hazed (n= 68-90 species) and the total number of birds hazed (n= 111,972-240,183) increased over the three year period. the TWSP conducted most hazing in conjunction with projects on airports. Additional hazing efforts were concentrated on reducing property damage and human health concerns for roosting vultures, wading birds rookeries, starlings and great-tailed grackles. The primary target species hazed by TWSP annually were swallows (22%), doves (14%), grackles (13%), meadowlarks (12%), and European starlings (9%), almost exclusively at airports. The remaining 81 species combined accounted for 29.3% of the non-lethal hazing conducted by the TWSP. Hazing birds by TWSP employees may negatively impact birds in the short term, especially if weather is particularly cold, because the birds are expending energy that they would otherwise not normally expend to search for food elsewhere. However, it is likely that the energy spent is minimal and not enough to cause impacts. For example, birds hazed from an area such as a crop field or an airport typically find alternate feeding, roosting, or loafing areas close by and actually benefit from being hazed. Birds hazed from an air operating area benefit from being less likely to be killed by aircraft and birds hazed to protect crops or other resources likely benefit because removing them from damage situations probably increases the tolerance of agricultural producers and other resource owners to their presence elsewhere (International Association of Fish and Wildlife Agencies 2005, Treves and Naughton-Treves 2005). This means that they should be less inclined to seek political help in reducing populations through increased sport hunting or direct population management.

Capture with relocation or release is done for some birds and mostly involved raptors and domestic waterfowl (combined average 43/year) from FY 2017 through FY 2019. Some waterfowl are relocated from damage situations. Domestic waterfowl are almost always given to an organization or individual that will take them. Barn owls, Cooper's hawks, and sharp-shinned hawks trapped inside a warehouse, often by chasing prey through an open doorway, were captured and relocated back outdoors. Several raptors were trapped at airports and relocated at least 50 miles away. Species that would most likely be involved in relocation would be rarer species and any species at the request of the TPWD and the USFWS.

INDIRECT EFFECTS ON BIRD POPULATIONS ASSOCIATED WITH IMPLEMENTING ALTERNATIVE 2

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

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

CUMULATIVE EFFECTS ON BIRD POPULATIONS FROM IMPLEMENTING ALTERNATIVE 2

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

Although implementation of this alternative would limit the federal WS program to using only non-lethal methods, other entities, including the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association as part of the TWSP, could continue to use lethal methods. Implementation of Alternative 2 by WS would not prevent the USFWS and/or the TPWD from continuing to issue depredation permits or other authorizations for the take of birds in Texas and would not limit the ability to take non-native bird species. The continued use of many non-lethal methods can often lead to the habituation of birds to those methods (*i.e*., showing no response or limited movements), which can decrease the effectiveness of those methods (Conover 2002, Seamans and Gosser 2016).

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

WS anticipates the lethal take of birds would continue to occur by other entities if WS implements Alternative 2 and would likely occur at levels similar to the take that would occur if WS implemented Alternative 1. Therefore, the WS anticipates the cumulative effects associated with implementing Alternative 2 would be similar to those cumulative effects discussed for Alternative 1 because the lethal take of birds in the state could continue to occur by other entities, including take by the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association as part of the TWSP.

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

Under a technical assistance only alternative, WS would recommend an integrated methods approach similar to Alternative 1 and Alternative 2; however, WS would not provide direct operational assistance under this alternative. WS would continue to be part of the TWSP but WS would only provide technical assistance when receiving a request for assistance. Using information that a requester provides or from a site visit by an employee, WS personnel would recommend methods and techniques based on their use of the WS Decision Model. In some instances, information provided to the requester by WS could result in tolerance/acceptance of the situation. In other instances, WS would discuss and recommend damage management options. In addition, WS personnel could assist people with the process for applying for their own depredation permit from the USFWS and authorizations from the TPWD. In accordance with WS Directive 2.301, WS personnel could assist people with applying for a depredation permit from the USFWS by completing a USFWS Migratory Bird Permit Application or Review form (WS Form 37). Personnel with the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association as part of the TWSP would also provide technical assistance and could also provide direct operational assistance.

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

When discussing damage management options with the person requesting assistance, WS personnel could recommend and demonstrate the use of both non-lethal and lethal methods that were legally available for use to alleviate damage. Those people receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from the other entities within the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association), could seek assistance from other entities, or take no further action. If WS implements Alternative 3, WS would have no direct effect on bird populations because WS personnel would not provide direct operational assistance.

Despite WS not providing direct operational assistance to resolve damage and threats associated with birds, those people experiencing damage caused by birds could alleviate damage by employing those methods legally available or by seeking assistance from other entities, including assistance from the other entities within the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association). Implementation of Alternative 3 by WS would not prevent other entities from using lethal and non-lethal methods and would not prevent the USFWS and/or the TPWD from authorizing the lethal take of birds in the state. The take of blackbirds, grackles, cowbirds, crows, and magpies could occur pursuant to the blackbird depredation order without the need for a depredation permit. The take of Muscovy ducks could occur under the control order and the take of non-native bird species could occur without the need for a depredation permit or authorization from the USFWS or the TPWD. Take of certain harvestable bird species would continue to occur during the hunting season for those species (*e.g*., doves, crows, waterfowl, turkeys). People could continue to address certain non-native species, such as house sparrows, European starlings, and rock pigeons, without the need for a depredation permit or other authorization.

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

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

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

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

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

If WS implemented Alternative 4, WS would not have direct effects on target bird populations because WS would not provide any assistance involving those bird species addressed in this EA. However, like the other alternatives, other entities could continue to use non-lethal and lethal methods to address damage caused by birds. Implementation of Alternative 4 by WS would not prevent the USFWS and/or the TPWD from continuing to authorize the take of birds in Texas. The take of blackbirds, grackles, cowbirds, crows, and magpies could occur under the blackbird depredation order without the need for a depredation permit. The take of Muscovy ducks could occur under the control order and the take of non-native bird species could occur without the need for a depredation permit or authorization from the USFWS or the TPWD. Take of certain harvestable bird species would continue to occur during the hunting season for those species. People could continue to address certain non-native species, such as house sparrows, European starlings, and rock pigeons, without the need for a depredation permit or other authorization. Therefore, WS anticipates the indirect and cumulative effects associated with implementing Alternative 4 would be similar to those indirect and cumulative effects discussed for the other alternatives because other entities would continue to use non-lethal and lethal methods to alleviate bird damage.

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

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

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

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

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

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

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

Risks to non-target animals associated with available methods

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

In regards to risks to non-target animals, the primary risk would be associated with lethal methods because the use of lethal methods could result in the death of a non-target animal. Lethal methods that

TWSP employees could use and/or recommend would include the use of a firearm, egg destruction (*i.e.*, puncturing, breaking, oiling, or shaking an egg), euthanasia after live-capture, Avitrol, and the avicide DRC-1339.

- *Firearms*

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

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

- *Egg Destruction*

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

- *Euthanasia after Live Capture*

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

- *Snap Traps*

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

➢ *4-Aminopyridine (Avitrol)*

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

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

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

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

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

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

The TWSP would only use those formulations of 4-Aminopyridine that the EPA has approved for use in accordance with the FIFRA and that the Texas Department of Agriculture has approved for use in Texas. The TWSP will reduce risks to non-target species by following the label requirements of the products TWSP personnel use in Texas. From FY 2016 through FY 2020, the TWSP did not use 4-Aminopyridine in Texas. The TWSP anticipates using 4-Aminopyridine infrequently.

➢ *DRC-1339 Avicide*

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

WS has registered two formulations of DRC-1339 with the EPA that could be available for WS to use, including use by the TWSP. Those formulations restrict the use of DRC-1339 to certain areas where target bird species are causing damage or posing a threat of damage. The Livestock, Nest, and Fodder Depredations label (EPA Reg. #56228-29) would be available to manage crows and ravens causing damage to livestock, causing damage to silage/fodder bags, or feeding on the eggs or young of federally designated threatened or endangered species. The TWSP can only use DRC-1339 formulated under the Livestock, Nest, and Fodder Depredations label in rangeland and pastureland areas where corvids prey upon newborn livestock; refuges or other areas where they prey upon the eggs and/or young of federally designated threatened or endangered species or other species of designated to be in need of special protection, and within 25 feet of silage/fodder bags that have been damaged or are likely to be damaged by crows or ravens.

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

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

As discussed previously, some bird species that cause damage to agricultural and other resources, such as blackbirds, crows, starlings, and pigeons, are highly sensitive to the avicide DRC-1339 (*i.e.*, toxic effects occur at very small doses). However, some bird and mammal species are less sensitive to the avicide DRC-1339 (*i.e.*, toxic effects occur at very high doses). For example, the median acute lethal dose (LD_{50})[21] values for starlings, blackbirds, and magpies (Corvidae) range from one to five mg/kg (Eisemann et al. 2003). For American crows, the median acute lethal dose is approximately 1.33 mg/kg (DeCino et al. 1966). In comparison, the median lethal dose (LD_{50}) of DRC-1339 for horned larks is 232 mg/kg and more than 320 mg/kg for white-crowned sparrows (*Zonotrichia leucophrys*) (Eisemann et al. 2003).

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

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

There have been concerns expressed about the study designs used to derive acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine acute toxicity to pesticides has many views (Lipnick et al. 1995). The use of small sample sizes was the preferred method of screening for toxicity beginning as early as 1948 to minimize the number of animals

[21] An LD_{50} is the dosage in milligrams of material per kilogram of body weight required to cause death in 50% of a test population of a species.

involved (Dixon and Mood 1948). In 1982, the EPA established standardized methods for testing for acute toxicity that favored larger sample sizes (EPA 1982). More recently, regulatory agencies have again begun to debate the appropriate level of sample sizes in determining acute toxicity based on a growing public concern for the number of animals used for scientific purposes.

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment was established by the EPA to provide guidance on ecological risk assessment methods (EPA 1999). The committee report recommended to the EPA that only one definitive LD_{50} be used in toxicity screening either on the mallard or northern bobwhite and recommended further testing be conducted using the up-and-down method (EPA 1999). Many of the screening methods used for DRC-1339 prior to the establishment of EPA guidelines in 1982 used the up-and-down method of screening (Eisemann et al. 2003). A review of the literature shows that LD_{50} research using smaller sample sizes conducted prior to EPA established guidelines are good indicators of LD_{50} derived from study designs that were more rigorous (Bruce 1985, Bruce 1987, Lipnick et al. 1995). Therefore, acute and chronic toxicity data gathered prior to EPA guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

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

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

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

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

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

Most residue tests to detect DRC-1339 in tissues of birds that have died after ingesting DRC-1339 used dosages that far exceeded the known acute lethal oral dose for those species tested and the dosages far exceeded the level of DRC-1339 dosage that a target bird could ingest from treated bait. For example, Johnston et al. (1999) found DRC-1339 residues in the breast tissue of boat-tailed grackles using acute DRC-1339 doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for boat-tailed grackles is ≤ 1 mg/kg (Eisemann et al. 2003). In those boat-tailed grackles consuming a trace of DRC-1339 up to 22 mg/kg, no DRC-1339 residues were found in the gastrointestinal track nor found in breast tissue (Johnston et al. 1999). Cunningham et al. (1979) fed carcasses of birds that died from DRC-1339 to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed. Cunningham et al. (1979) concluded that cats, owls, and magpies would be at risk only after exclusively eating starlings killed with DRC-1339 for 30 continuous days. Similarly, the risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999). The TWSP would retrieve all dead birds to the extent possible following treatment with DRC-1339 to minimize secondary hazards associated with scavengers feeding on bird carcasses.

The risks associated with non-target animal exposure to DRC-1339 baits have been evaluated in rice fields in Louisiana (Glahn et al. 1990, Cummings et al. 1992, Glahn and Wilson 1992), poultry and cattle feedlots in several western states (Besser 1964, Ford 1967, Royall et al. 1967), ripening sunflower fields in North Dakota (Linz et al. 2000), and around blackbird staging areas in east-central South Dakota (Knutsen 1998, Linz et al. 1999, Smith 1999). Smith (1999) used field personnel and dogs to search for dead non-target animals but did not find any non-target animal carcasses that exhibited histological signs consistent with DRC-1339 poisoning. However, DRC-1339 is a slow-acting avicide and thus, some birds could have moved to areas not searched by the study participants before dying.

DRC-1339 is highly toxic to aquatic invertebrates. Therefore, the DRC-1339 label prohibits applying bait treated with DRC-1339 within 50 feet of permanent manmade or natural bodies of water. In addition, the TWSP would not use bait treated with DRC-1339 when water runoff is likely to occur. The TWSP would not apply treated bait directly to water, to areas where surface water was present, or to intertidal areas below the mean high-water mark. The TWSP would not contaminate water by the cleaning of equipment or disposal of waste.

DRC-1339 Environmental Degradation: DRC-1339 is typically very unstable in the environment and degrades quickly when exposed to sunlight, heat, and ultraviolet radiation. The half-life of DRC-1339 in biologically active soil is approximately 25 hours with the identified metabolites having a low toxicity (EPA 1995). DRC-1339 is also highly soluble in water, does not hydrolyze, and photodegrades quickly in water with a half-life estimated at 6.3 hours in summer, 9.2 hours in spring sunlight, and 41 hours during winter (EPA 1995). DRC-1339 binds tightly with soil and has low mobility (EPA 1995).

***Risks of Crows Caching Bait Treated with DRC-1339*:** Additional concerns occur regarding the risks to non-target wildlife associated with crows caching bait treated with DRC-1339. Crows may cache surplus food. Crows generally cache surplus food by making a small hole in the soil using their bill, by pushing the food item under the substrate, or by covering food items with debris (Verbeek and Caffrey 2020). Distances traveled from where crows gather a food item to where they cache the item varies. Kilham (1989) found that crows could travel up to 100 meters to cache food while Cristol (2001, 2005) found that crows could travel up to 2 kilometers to cache food. Caching activities appear to occur throughout the year but may increase when food supplies are low. Therefore, the potential for crows to carry treated baits from a bait site to surrounding areas exists as part of their food caching behavior.

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

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

Effects on non-target animal populations from unintentional take

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

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

TWSP impact on biodiversity

The TWSP does not attempt to eradicate any species of native wildlife in the state. The TWSP operates in accordance with applicable federal and state laws and regulations enacted to ensure species viability. TWSP personnel would use or recommend the use of methods that target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population is frequently temporary because immigration from adjacent areas or natural reproduction replaces those birds that an entity removes. The TWSP operates on a small percentage of the land area in Texas (less than 8%) and would only target those birds identified as causing damage or posing a threat. Therefore, bird damage management activities conducted pursuant to any of the alternatives would not adversely affect biodiversity in the state.

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

Analysis of risks to threatened and endangered species

The TWSP would make special efforts to avoid jeopardizing threatened or endangered species through biological evaluations of potential effects and the establishment of special restrictions or minimization measures through consultation with the USFWS and/or the National Marine Fisheries Service. The ESA states that all federal agencies *"...shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the Act"* [Sec. 7(a)(1)]. The TWSP conducts consultations with the USFWS and/or the National Marine Fisheries Service pursuant to Section 7 of the ESA to ensure compliance. The TWSP also conducts consultations to ensure that *"any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency shall use the best scientific and commercial data available"* [Sec. 7(a)(2)].

No take of threatened or endangered species by the TWSP has occurred previously in the state during the implementation of activities and the use of methods to manage the damage that birds cause. During the development of this EA, the TWSP reviewed the current list of species designated as threatened or endangered in Texas as determined by the USFWS and the National Marine Fisheries Service. The TWSP conducted a review of potential impacts of implementing Alternative 1 on each of those species designated as threatened or endangered in the state by the USFWS and the National Marine Fisheries Service. The evaluation took into consideration the direct and indirect effects of implementing Alternative 1 to alleviate damage caused by birds. The TWSP reviewed the status, critical habitats designations, and current known locations of those species. The TWSP has made a "*no effect*" determination for bird damage management activities under Alternative 1 for all federally listed threatened or endangered plants, amphibians, invertebrates, fish, reptiles and mammals based on the use patterns of the available methods and the locations where the TWSP uses those methods. In addition, the TWSP has also determined that the proposed activities would have no effect on any threatened or endangered species designated by the National Marine Fisheries Service, including any designated critical habitat.

Among the federally listed bird species, bird damage management activities under Alternative 1 would have no effect on the black rail, rufa red knot, Mexican spotted owl, golden cheek warbler, southwestern willow flycatcher, eskimo curlew, red-cockaded woodpecker, or Attwater's greater prairie chicken based on the use patterns of the available methods and the locations where the TWSP uses those methods. There is a remote possibility that unrestricted bird damage management activities could reduce the forage base of nesting northern aplomado falcons by reducing the number of blackbirds in an area. However, northern aplomado falcons feed on a variety of other prey. As indicated in Section 2.3, the TWSP would not use avicides within 2.5 miles of known northern aplomado falcon nests during the nesting season (March-September). Therefore, the TWSP has determined the implementation of this alternative would have no effect on the status of the northern aplomado falcon in Texas.

Based on the use patterns of the available methods and the locations the TWSP uses those methods, WS has determined the implementation of this alternative would have "*no effect*" on whooping cranes. Until 2021, whooping cranes in Texas were part of the migratory flock that wintered along the mid-Texas coast. However, in 2021, several individuals from the non-migratory, reintroduced population in Louisiana began living in Texas during breeding season. These birds, covered by a non-essential, experimental population rule when in Louisiana are considered fully endangered when they leave the state, thus they are fully protected by the ESA when in Texas. The TWSP considered all impacts, including the use of avicides and predacides on these birds in August 2021. Because avicides are not used in areas occupied by whooping cranes (see Section 2.3), the TWSP has made a no effect determination for bird damage management activities for whooping cranes. The TWSP has consulted with the USFWS regarding the use of predacides in areas occupied by non-migratory whooping cranes.

The use of mist nets for live bird capture (trap and relocate or disease surveillance) would have a remote possibility of capturing interior least terns or piping plovers. This method is extremely limited in use in Texas and would not be implemented in shorebird habitat during winter months (November-March) without further consultation with the USFWS (see Section 2.3). Because of this self-imposed restriction, the TWSP has made a "*no effect*" determination for interior least terns and piping plovers.

The USFWS has also designated critical habitat in Texas for some of the species listed as threatened or endangered. The TWSP has determined implementation of Alternative 1 would have no effect on any critical habitat designated in Texas. The TWSP based the effects determinations on a review of the activities that the TWSP could conduct if the TWSP implemented Alternative 1. The TWSP would continue to review the species listed as threatened or endangered by the USFWS and the National Marine Fisheries Service and would continue to consult with the USFWS and/or the National Marine Fisheries Service as appropriate.

The TWSP has also reviewed the list of species the TPWD has designated as threatened or endangered. Based on the review of species listed in the state, the TWSP has determined that the proposed activities would have no effect on those species currently listed as threatened or endangered by the TPWD. Unlike the MBTA, State regulations includes "*harassment*" of listed species in the definition of "*take*". As a result, some state-listed species may be taken, under MBTA permit, at airports, with preference given to non-lethal harassment. The limited level of take would not jeopardize these species. The TWSP would continue to review the species listed as threatened or endangered by the TPWD. As appropriate, the TWSP would consult with the TPWD when the TWSP determines activities may affect a threatened or endangered species designated by the TPWD.

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

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

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

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

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

Risks to non-target animals associated with available methods

Section I in Appendix B describes the non-lethal methods that would be available for WS personnel to use if WS implemented Alternative 2. The methods in Appendix B would continue to be available for use by other entities within the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association). The potential effects associated with specific methods or a category of methods occurs below.

- *Human Presence*

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

➢ *Modifying Cultural Practices*

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

➢ *Limited Habitat Modification*

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

➢ *Supplemental Feeding and Lure Crops*

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

➢ *Exclusion Devices*

Exclusionary devices can be effective in preventing access to resources in certain circumstances. The primary exclusionary methods are netting and overhead lines but could include fencing and surface coverings. The use of exclusionary methods may include floating plastic balls or wire grids across water retention ponds to prevent birds from using the ponds because they pose a threat to aircraft from a bird strike. Exclusion methods could include using overhead wires in outdoor eating areas at a restaurant to discourage birds from attempting to take food from customers. The use of exclusionary methods is primarily associated with areas modified by people because birds are posing a threat the human health and safety or causing damage to a resource valued by people, such as buildings, infrastructure, turf, and agricultural commodities. Given the expense of excluding birds from large areas, exclusion methods are often restricted to small areas around high value resources (*e.g.*, netting over a small grain research plot). Therefore, purchase and installation of exclusion devices would primarily occur by the entity experiencing damage or threats of damage.

In addition, exclusion methods may also have limited application because their use could restrict people's access to the resource. For example, netting erected to prevent swallows from nesting under bridges could prevent access to people that inspect the safety of the bridge or require repeated daily removal to feed aquaculture stock in a pond. Any exclusionary device erected to prevent access of target species also potentially excludes other non-target species. However, TWSP personnel and other entities would not employ exclusionary devices over large geographical areas or use those devices at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

- *Visual Scaring Techniques*

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

- *Trained Dogs*

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

- *Electronic Hazing Devices, Pyrotechnics, Propane Cannons*

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

- *Paintballs*

As described on product labeling and Safety Data Sheets, paintballs are non-toxic to people and do not pose an environmental hazard. However, consumption may cause toxicosis in dogs, which is potentially fatal without supportive veterinary treatment (Donaldson 2003). Although unknown, Donaldson (2003) speculated the there is an osmotic diuretic effect resulting in an abnormal electrolyte and fluid balance in dogs that consume paintballs. Most affected dogs recovered within 24 hours (Donaldson 2003).

- *High-pressure Water Spray*

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

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

- *Live traps*

Live traps (*e.g*., cage traps, pigeon traps, decoy traps) generally allow a target bird species to enter inside the trap but prevent the bird from exiting the trap. When using live-traps, TWSP personnel generally use bait and/or a lure to attract target bird species and to encourage a target bird or birds to enter the trap. Live traps have the potential to capture non-target species if they enter inside the trap. The placement of live-traps in areas where target species are active and the use of target-specific attractants would likely minimize the capture of non-target animals. TWSP personnel would attend live-traps appropriately, which would allow them to release any non-target animals captured unharmed. For example, under the blackbird depredation order, when using a live-trap to capture blackbirds, TWSP personnel would check live-traps at least once every day (see 50 CFR 21.43(f)). Therefore, TWSP personnel could release any non-target animals captured in live-traps.

- *Nets*

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

Nets could include the use of net guns, net launchers, cannon/rocket nets, drop nets, hand nets, bow nets, and mist nets. Nets are virtually selective for target individuals because application would occur by attending personnel or TWSP personnel would check nets frequently to address any live-captured animals. Therefore, TWSP personnel could release any non-target animals captured using nets on site. TWSP personnel would handle any non-target animals captured using in such a manner as to ensure the survivability of the animal if released. Even though live capture does occur from those methods, the potential for death of a target or non-target animal while being restrained or released does exist, primarily from being struck by cannon or rocket assemblies during deployment. The likelihood of cannon or rocket assemblies striking a non-target animal is extremely low. The risk is likely extremely low because a non-target animal must be present when TWSP personnel activate the net and the non-target animal must be in a position where the assemblies strike the animal. TWSP personnel would position nets so the net envelops target birds upon deployment, which would minimize the risk of assemblies striking a non-target animal. When using nets, TWSP personnel would often use a bait to attract target species and to concentrate target species in a specific area to ensure the net completely envelopes target birds. Therefore, TWSP personnel could abandon sites if non-target use of the area was high or could refrain from firing the net at a time when non-target animals were present.

- *Modified Padded Foothold Trap*

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

- *Nest Destruction*

TWSP personnel would remove nests by hand, hand tools, or by high-power water spray, which would allow TWSP personnel to identify the nest to bird species prior to removal. TWSP personnel have experience and receive training in wildlife identification, which allows them to identify individual species. TWSP personnel would be familiar with the nests of a target species before destroying a nest; therefore, it is highly unlikely TWSP personnel would inadvertently destroy the nest of a non-target species.

➢ *Translocation*

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

➢ *Aircraft*

Low-level flights, including the use of UAVs, have the potential to disturb wildlife. Aerial operations could be an important method for surveying, monitoring, and tracking birds in Texas. In addition, the TWSP could use UAVs (*e.g*., drones) to locate and haze target bird species. Aircraft play an important role in the management of various wildlife species for many agencies. Resource management agencies rely on low flying aircraft to monitor the status of many animal populations, including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (USFWS 2019), and colonial waterbirds (Speich 1986). Low-level flights also occur when entities use aircraft to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1996).

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

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

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

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

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

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

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

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

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

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

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

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

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

- *Anthraquinone and Methyl Anthranilate*

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

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

- *Nicarbazin*

Commercial products are available that contain the active ingredient nicarbazin that, when ingested by target bird species, can reduce the hatchability of eggs laid. Nicarbazin is the only reproductive inhibitor currently registered with the EPA for certain bird species and the only reproductive inhibitor approved for use in Texas by the Texas Department of Agriculture. In Texas, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons, European starlings, red-winged blackbirds, common grackles, and brown-headed cowbirds, which is available as a general use commercial product available to the general public under the trade name OvoControl® P. Use restrictions of OvoControl® P limit its use to rooftops or other flat paved or concrete surfaces and limited to use in secured areas with limited public access. Nicarbazin is available for use on rooftops or other flat paved or concrete surfaces in non-food areas of manufacturing facilities, power utilities, hospitals, food processing plants, distribution centers, oil refineries and processing centers, chemical plants, rail yards, schools, campuses, military bases, seaports, hotels, apartments, condominiums, maintenance yards, shopping malls, feed mills, airports and other commercial or industrial locations. In addition, applicators must ensure that children and pets do not come in contact with the bait and applicators cannot apply the product within 20 feet of any body of water, including lakes, ponds, or rivers. Commercial products containing the active ingredient nicarbazin were also available for Canada geese and domestic waterfowl in the past; however, those products are no longer available and the manufacturer has not registered those products with the Texas Department of Agriculture for use in Texas.

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

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

Secondary hazards also exist from wildlife consuming target birds that have ingested nicarbazin. As mentioned previously, once consumed, nicarbazin is rapidly broken down into the two base components of DNC and HDP. DNC is the component of nicarbazin that limits egg hatchability while HDP only aids in absorption of DNC into the bloodstream. DNC is not readily absorbed into the bloodstream and requires the presence of HDP to aid in absorption of appropriate levels of DNC. Therefore, to pose a secondary hazard to wildlife, ingestion of both DNC and HDP from the carcass would have to occur and a non-target animal would have to consume HDP at a level to allow for absorption of DNC into the bloodstream. In addition, a non-target animal would have to consume an appropriate level of DNC and HDP from a carcass daily to produce any negative reproductive effects because current evidence indicates a single dose does not limit reproduction. To be effective, a target bird must consume nicarbazin (both DNC and HDP) daily during the duration of the reproductive season to limit the hatchability of eggs. Therefore, to experience the reproductive effects of nicarbazin, a non-target animal would need to consume the carcass of a target bird species daily and a high enough level of DNC and HDP would have to be available in the carcass and consumed for nicarbazin to affect the reproduction of a non-target animal. Based on the risks and likelihood of non-target wildlife consuming a treated carcass daily and receiving the appropriate levels of DNC and HDP daily to negatively impact reproduction, secondary hazards to wildlife from the use of nicarbazin would be extremely low (EPA 2005).

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

- *Unmanned Aerial Vehicles*

The TWSP could use UAVs to locate and haze target bird species. The TWSP could use UAVs to elicit a flight response by scaring target birds from an area where damage was occurring or where damage could occur. The TWSP could also use UAVs with the intent of locating or monitoring individuals or groups of birds and their associated nests or eggs. Of concern are the possible negative physiological and/or behavioral effects that negative stimuli could cause, which could reduce the fitness of non-target animals, or the ability of non-target animals to survive, especially if the exposure to the stressor was chronic. The stress from dispersal methods could negatively affect the health of an animal, interfere with the raising of young, and/or increase energy needs. However, for effects to occur non-target animals would have to visually encounter UAVs and/or be within hearing distance at the time TWSP personnel used UAVs and the resulting visual and/or auditory stimuli would have to elicit a negative response. Like other non-lethal methods, TWSP personnel would not employ UAVs over large geographical areas or use UAVs at such an intensity level that essential resources (*e.g.*, food sources, habitat) would be unavailable for extended durations or over such a wide geographical scope that long-term adverse effects would occur to a species' population.

Potential effects of implementing alternative 2 on eagles

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

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

Under a technical assistance alternative, WS would have no direct impact on non-target species, including threatened or endangered species. Those people receiving technical assistance from WS could implement those methods recommended by WS, could employ other methods not recommended by WS, could seek assistance from the other entities within the TWSP (*i.e*., the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association), could seek assistance from other entities, or take no further action. If WS implements Alternative 3, WS would have no direct effect on bird populations because WS personnel would not provide direct operational assistance.

Those persons requesting assistance from WS could employ methods that WS personnel recommend or provide through loaning of equipment. Using the WS Decision Model, WS personnel would base recommendations from information provided by the person requesting assistance or through site visits. Recommendations would include methods or techniques to minimize impacts on non-target animals associated with the methods that personnel recommend or loan. Methods recommended could include non-lethal and lethal methods as deemed appropriate by the WS Decision Model and as permitted by laws and regulations. The only methods that would not be available to other entities under a technical assistance only alternative would include some formulations of DRC-1339, which is only available for use by WS employees and persons under their direct supervision.

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

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

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

If WS provided technical assistance to people but those people did not implement any of the recommended actions and conducted no further action, the potential to remove non-target animals would be lower when compared to Alternative 1. If those persons requesting assistance implemented recommended methods appropriately and as instructed or demonstrated, the potential impacts to non-target animals would be similar to Alternative 1. If WS made recommendations on the use of methods to alleviate damage but people did not implement those methods as recommended by WS or if people used those methods recommended by WS inappropriately, the potential for lethal removal of non-target animals would likely increase under a technical assistance only alternative. Therefore, the potential impacts to non-target animals, including threatened or endangered species, would be variable under a technical assistance only alternative. It is possible that frustration caused by the inability to reduce damage and associated losses could lead to illegal killing of birds, which could lead to unknown effects on local non-target species populations, including some threatened or endangered species.

When the damage caused by wildlife reaches a level where assistance does not adequately reduce damage or where no assistance is available, people sometimes resort to using chemical toxicants that are illegal for use on the intended target species that often results in loss of both target and non-target wildlife (*e.g.*, see White et al. 1989, USFWS 2001, United States Food and Drug Administration 2003). The use of illegal toxicants by people frustrated with the lack of assistance or assistance that inadequately reduces damage to an acceptable level can often result in the indiscriminate take of wildlife species.

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

WS' recommendation that birds be harvested during the regulated season by private entities to alleviate damage would not increase risks to non-target animals. Shooting would essentially be selective for target species and the unintentional lethal removal of non-target animals would not likely increase based on WS recommendation of the method. The ability to reduce negative effects caused by birds to wildlife species and their habitats, including threatened or endangered species, would be variable under this alternative. The skills and abilities of the person implementing damage management actions would determine the risks to non-target animals.

Potential impacts to non-target animals would be similar to the other alternatives because other entities would continue to conduct activities to alleviate bird damage even if WS only provides technical assistance. The TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage

Management Association) and other entities could continue to provide direct operational assistance under this alternative. Those methods discussed in Appendix B would continue to be available to manage bird damage in Texas. The only methods that would not be available to other entities under a technical assistance only alternative would include some formulations of DRC-1339, which is only available for use by WS employees and persons under their direct supervision. Therefore, the risks to non-target animals from the use of methods would be similar to those discussed for Alternative 1 and Alternative 2.

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

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

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

Potential impacts to non-target animals would be similar to the other alternatives because other entities would continue to conduct activities to alleviate bird damage even if WS did not provide assistance. The TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association) and other entities could continue to provide direct operational assistance under this alternative. Those methods discussed in Appendix B would continue to be available to manage bird damage in Texas. The only methods that would not be available to other entities under a technical assistance only alternative would include some formulations of DRC-1339, which is only available for use by WS employees and persons under their direct supervision. Therefore, the risks to non-target animals from the use of methods would be similar to those discussed for Alternative 1 and Alternative 2.

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

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

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

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

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

TWSP personnel receive training in the safe use of methods and would follow the safety and health guidelines required by WS' directives (*e.g*., see WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635, WS Directive 2.640). For example, TWSP employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.601. In addition, TWSP personnel would also follow WS Directive 2.635 that establishes guidelines and standard training requirement for health, safety, and personal protection from zoonotic diseases. When responding to oil spills and other hazardous materials operations, TWSP personnel would follow WS Directive 2.640. When using watercraft, TWSP employees would follow the guidelines in WS Directive 2.630. In addition, TWSP use of methods would comply with applicable federal, state, and local laws and regulations (see WS Directive 2.210).

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

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

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

Section I and Section II in Appendix B discuss several non-chemical methods that would be available for use by the TWSP. When using non-chemical lethal methods, TWSP personnel would dispose of carcasses in accordance with WS Directive 2.515 and would comply with requirements in depredation orders, control orders, depredation permits, and/or authorizations issued by the USFWS and/or the TPWD for activities associated with birds. TWSP personnel would also notify the cooperator requesting assistance of threats to human safety associated with the use of methods. Risks to human safety from activities and methods would be similar to the other alternatives because the same methods would be available. If people misuse or apply those methods inappropriately, any of the methods available to alleviate bird damage could threaten human safety. However, when used appropriately, methods available to alleviate damage would not threaten human safety.

No adverse effects to human safety have occurred from TWSP use of non-chemical methods to alleviate bird damage in the state from FY 2017 through FY 2019. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by birds, the use of non-chemical would comply with Executive Order 12898 and Executive Order 13045.

- *Human presence*

As discussed previously, human presence may consist of physical actions of people or the presence of people and/or a vehicle. If the TWSP implements Alternative 1, TWSP activities would comply with relevant laws, regulations, policies, orders, and procedures. TWSP personnel would follow the safety and health guidelines required by WS' directives (*e.g*., see WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, WS Directive 2.627, WS Directive 2.630, WS Directive 2.635). Therefore, the physical actions of TWSP employees, including the presence of employees and vehicles would not pose threat to human health and safety.

- *Changes in cultural practices and exclusion methods*

Based on their use profile for alleviating damage associated with wildlife, the TWSP considers risks to human safety associated with changes in cultural practices and exclusion methods to be low. The use of fencing, surface coverings, overhead lines/wires, and netting to exclude birds would not pose risks to human health and safety. The TWSP would not use electrified fencing in areas where risks to human safety would occur. For example, restricting the use of electrified fencing to agricultural areas where waterfowl are feeding on crops. Altering cultural practices would not pose a threat to human health and safety.

➢ *Auditory deterrents*

Auditory deterrents that the TWSP could use and/or recommend would include electronic hazing devices, pyrotechnics, and propane cannons. The TWSP used 3,564 pyrotechnics in FY 2017, 2,149 pyrotechnics in FY 2018, and 2,846 pyrotechnics in FY 2019 to disperse birds. On average, the TWSP used 2,853 pyrotechnics per year from FY 2017 through FY 2019 to alleviate bird damage. Risks to human health and safety would primarily occur from the noise produced by those methods, such as hearing loss from repeated and/or prolonged exposure to the noise produced by those methods. Other risks could include fire risks and bodily harm associated with the use of pyrotechnics and propane cannons. Although hazards to human safety from the use of auditory deterrents do occur, those methods are generally safe when used by trained individuals who have experience in their use. For example, although some risk of fire and bodily harm exists from the use of pyrotechnics, when used appropriately and in consideration of those risks, TWSP personnel can use those methods with a high degree of safety. TWSP employees would adhere to safety requirements and use appropriate personal protective equipment pursuant to WS Directive 2.601. TWSP personnel who use pyrotechnics would follow the guidelines for using pyrotechnics in accordance with WS Directive 2.627.

➢ *Visual deterrents*

Visual deterrents that TWSP personnel could use and/or recommend would include Mylar tape, eyespot balloons, flags, effigies, lasers, and lights. Lasers and lights would pose minimal risks to the public because application occurs directly to target species by trained personnel, which limits the exposure of the public to misuse of the method. Similarly, the use of mylar tape, eyespot balloons, flags and effigies would not pose risks to human safety.

➢ *Trained dogs*

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

➢ *Live-capture methods and translocation*

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

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

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

- *Nest destruction*

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

- *Unmanned Aerial Vehicles*

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

- *High-pressure water spray*

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

- *Snap traps*

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

- *Sport hunting*

The recommendation by the TWSP that people harvest birds or allow other people to harvest birds during the annual hunting seasons would not increase risks to human safety above those risks already inherent with hunting birds. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce a localized bird population that could then reduce bird damage or threats would not increase risks to human safety. Safety requirements established by the TPWD for annual hunting seasons would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized bird populations would not increase those risks.

- *Aircraft*

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

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

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

- *Firearms*

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

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

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

- *Egg destruction*

Egg destruction would involve puncturing, breaking, shaking, or oiling an egg. Risks to human health and safety associated with egg destruction would be minimal. Egg oiling involves the use of corn oil to coat bird eggs in the nest, which renders the egg unviable. TWSP personnel generally apply the corn oil by hand (rubbing oil over eggs), dipping eggs in corn oil, or spraying corn oil from a pump-type (non-aerosol) container. TWSP personnel use commercially available, food-grade corn oil when oiling eggs. Egg oiling is generally a method used to treat the eggs of bird species that nest on the ground, such as waterfowl. TWSP personnel coat each egg with a light to moderate amount of corn oil. The TWSP only uses food-grade corn oil that people use every day when preparing food and uses a small amount of corn oil to treat each egg; therefore, risks to human safety associated with the use of corn oil to coat eggs would be extremely low.

- *Cervical Dislocation for Euthanasia*

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

SAFETY OF CHEMICAL METHODS EMPLOYED

In addition to non-chemical methods, chemical methods could also be available for TWSP personnel to use (see Appendix B). Many of the chemical methods would only be available to target certain bird species and/or to manage damage or threats of damage in specific situations. Those chemical methods that the TWSP could use as part of an integrated methods approach include nicarbazin (pigeons, starlings, blackbirds, grackles, cowbirds only), carbon dioxide for euthanasia, egg oiling, Avitrol (pigeons, crows, blackbirds, grackles, cowbirds, starlings, house sparrows only), the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, gulls only), sodium lauryl sulfate (starlings and blackbirds), commercially available chemical repellents, and paintballs.

TWSP personnel would use the WS' Decision Model to determine when chemical methods were appropriate to alleviate damage. TWSP personnel would adhere to WS' directives when using chemical methods, including WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, and WS Directive 2.465. All TWSP personnel who handle and administered chemical methods would receive appropriate training to use those methods. The TWSP would dispose of carcasses in accordance with WS Directive 2.515.

No adverse effects to human safety have occurred from TWSP use of chemical methods to alleviate bird damage in the state from FY 2016 through FY 2020. The risks to human safety from the use of chemical methods, when used appropriately and by trained personnel, would be low. Therefore, the TWSP does not expect any direct, indirect, or cumulative effects to occur from TWSP use of those chemical methods discussed below and described further in Appendix B. Based on the use patterns of methods available to address damage caused by birds, the use of chemical methods would comply with Executive Order 12898 and Executive Order 13045.

- *Nicarbazin*

In Texas, nicarbazin is currently only available to inhibit egg hatching in localized populations of rock pigeons European starlings, red-winged blackbirds, yellow-headed blackbirds, Brewer's blackbirds, common grackles, and brown-headed cowbirds, which is available as a general use commercial product available to the public. A general use pesticide is a pesticide that, when applied in accordance with its directions for use, would not generally cause unreasonable adverse effects on people or the environment. Use restrictions of nicarbazin for pigeons limit its use to rooftops or other flat paved or concrete surfaces and limited to use in secured areas with limited public access. In addition, applicators must ensure that children and pets do not come in contact with the bait and applicators cannot apply the product within 20 feet of any body of water, including lakes, ponds, or rivers. Commercial products containing the active ingredient nicarbazin were also available for Canada geese and domestic waterfowl in the past; however, those products are no longer available and the manufacturer has not registered those products with the Texas Department of Agriculture for use in Texas.

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

➢ *Carbon Dioxide for Euthanasia*

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

➢ *Egg Oiling*

Egg oiling involves the use of corn oil to coat the eggs in the nest of a target bird species, which renders the egg unviable. TWSP personnel generally apply the corn oil by hand (rubbing oil over eggs), dipping eggs in corn oil, or spraying corn oil from a pump-type (non-aerosol) container. TWSP personnel use commercially available, food-grade corn oil when oiling eggs. Egg oiling is generally a method used to treat the eggs of bird species that nest on the ground, such as Canada geese. TWSP personnel coat each egg with a light to moderate amount of corn oil. The TWSP only uses food-grade corn oil that people use every day when preparing food and uses a small amount of corn oil to treat each egg; therefore, risks to human safety associated with the use of corn oil to coat eggs would be extremely low. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under the FIFRA.

➢ *4-Aminopyridine (Avitrol)*

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

When re-evaluating the registration of 4-Aminopyridine (*i.e.*, Avitrol) for use, the EPA (2007) stated, "…*long-term environmental exposure of* [4-Aminopyridine] *is expected to* [be] *minimal, and no drinking water exposure is expected.*" Further, the EPA (2007) stated, "*Because* [4-Aminopyridine] *is no longer registered on any food commodities, nor is exposure expected from drinking water sources, the* [EPA] *only assessed potential exposures in occupational and residential settings*". When handling and applying Avitrol, TWSP personnel would follow label requirements for personnel protective equipment to minimize their exposure to treated bait. The EPA (2007) further stated, "*Since all* [4-Aminopyridine] *products are restricted use products, no residential handler exposure scenario is expected*." However, the EPA (2007) further stated, "*Post-application residential exposures to* [4-Aminopyridine] *may result from application in residential settings*" but "*It is unlikely that adults will be exposed to the bait through dermal exposure, inhalation exposure, or through incidental oral exposure*." The primary concern of the EPA (2007) from the use of Avitrol in residential areas and public areas was the potential for children to encounter and accidentally ingest treated bait. Although children could accidentally ingest treated bait, the EPA (2007) "…*does not believe that children will be routinely exposed to* [4-Aminopyridine]". To minimize risks from children encountering and accidently ingesting treated bait, the EPA (2007) required several minimization measures as part of label requirements for products containing 4-Aminopyridine. Those requirements include:

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

From FY 2017 through FY 2019, the TWSP only used 8 ounces of Avitrol on grain baits during FY 2018. The TWSP did not use Avitrol during FY 2017 and FY 2019. The EPA (2007) has required the applicator implement several minimization measures when handling and applying Avitrol to reduce risks to applicators and the public, including children. By following label requirements of Avitrol, risks to human health and safety associated with the use of Avitrol should be minimal.

➢ *DRC-1339*

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

For all uses, the TWSP must mix technical DRC-1339 (powder) with water and in some cases, a binding agent (required by the label for specific bait types). Once the technical DRC-1339, water, and binding agent, if required, are mixed, the liquid is poured over the bait and mixed until the liquid is absorbed and evenly distributed. After mixing, the handler allows the treated bait to air dry. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Therefore, risks to public safety from the preparation of DRC-1339 are minimal. Some risks do occur to the handlers during the mixing process from inhalation and direct exposure on the skin and eyes. TWSP personnel that prepare, mix, and handle technical DRC-1339 and treated bait would adhere to label requirements, including the use of personal protective equipment to ensure the safety of TWSP personnel. Therefore, risks to handlers and mixers that adhere to the personal protective equipment requirements of the label are low. Before application at bait locations, applicators would mix treated bait with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

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

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

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

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

Current information indicates that target bird species metabolize or excrete the majority of the chemical within a few hours of ingestion. The highest concentration of chemical residue occurs in the gastrointestinal tract of the bird, which people are likely to discard and not consume. Although residues have been detected in the tissues that people might consume (*e.g.*, breast meat) in some bird species that have consumed DRC-1339, residues appear to only be detectable when the bird has consumed a high dose of the chemical that far exceeds the LD_{50} for that species, which would not be achievable under normal baiting procedures.

To alleviate damage, the TWSP used 48.8 grams of DRC-1339 in FY 2017, 193.5 grams in FY 2018, and 124.9 grams in FY 2019 of DRC-1339. On average, the TWSP used 122.4 grams of DRC-1339 per year from FY 2017 through FY 2019 in Texas. Under the proposed action, the controlled and limited circumstances in which the TWSP could use DRC-1339 would prevent any exposure of the public to

DRC-1339. Based on current information, the human health risks from the use of DRC-1339 would be virtually nonexistent if the TWSP implemented this alternative.

➢ *Sodium Lauryl Sulfate*

Sodium lauryl sulfate (Stepanol WA-Extra PCK, Stepan Co., Northfield IL) is considered a minimum-risk pesticide because it actually has about little toxic properties as a chemical with the exception that it is moderately toxic to aquatic organisms and possibly harmful to some plants. Sodium lauryl sulfate is a surfactant commonly used in soap products. When applied to birds, sodium lauryl sulfate allows water to penetrate and saturate the feathers so that with low temperatures (<41 °F) and sufficient water, birds die of hypothermia. It works by washing oils off the bird feathers. It must be used in upland situations, basically to keep sodium lauryl sulfate from entering wetland ecosystems with permanent water bodies. It was exempt from FIFRA requirements because the pesticide satisfied certain conditions. In general, conditions claiming that a pesticide should be exempt from registration under FIFRA Section 25(b) are that claims cannot be made regarding control of public-health pests, and the product cannot be used on food or feed crops. Sodium lauryl sulfate (Chemical Abstract Service No. 151-21-3) was included on the list of 31 exempt compounds. Sodium lauryl sulfate can be used to control starlings, most blackbird species, crows, magpies, and ravens. In FY 2009, the TWSP used 40 gallons to alleviate damage associated with an urban blackbird roost. The TWSP has not used sodium lauryl sulfate since FY 2009. TWSP anticipates using this method in the future, especially to control starling and blackbird roosts in urban areas. Because sodium lauryl sulfate is used in roost situations, where only target animals are present, the TWSP does not anticipate any impacts to non-target animals.

➢ *Commercially Available Repellents*

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

Methyl anthranilate, which has been classified by the United States Food and Drug Administration as a product that is "*generally recognized as safe*", is a naturally occurring chemical found in grapes, and is synthetically produced for use as a grape food flavoring and for perfume (see 21 CFR 182.60). The EPA exempts methyl anthranilate from the requirement of establishing a tolerance for agricultural applications (see 40 CFR 180.1143). The final ruling published by the EPA on the exemption from the requirement of a tolerance for methyl anthranilate concludes with reasonable certainty that no harm would occur from cumulative exposure to the chemical by the public, including infants and children, when applied according to the label and according to good agricultural practices (see 67 FR 51083-51088). Based on the use patterns of methyl anthranilate and the conclusions of the United States Food and Drug Administration and the EPA on the toxicity of the chemical, TWSP use of methyl anthranilate and the recommendation of the use of the chemical would not have adverse effects on human safety. The EPA (2015) stated, "*No harmful effects to humans are expected from using products containing* [methyl anthranilate] *as specified on the label*".

Additional repellents could contain the active ingredient anthraquinone. Overall, the EPA considers the toxicological risk from exposure to anthraquinone to be negligible (EPA 1998). The EPA also considers the primary cumulative exposure is most likely to occur to handlers and/or applicators from dermal, oral, and inhalation exposure but consider the exposure risks, when applicators use the required personal protective equipment, to be negligible (EPA 1998). Therefore, the EPA concluded that cumulative effects would not likely occur from any common routes of toxicity (EPA 1998). Based on the known use patterns and the conclusions of the EPA, WS does not expect any adverse effects on human safety to occur from WS' use of anthraquinone or the recommendation of the use of anthraquinone. When used according to label requirements, the EPA (2015) determined the use of anthraquinone would have no harmful effects on people.

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

- *Paintballs*

The TWSP could also use paintball guns to disperse target bird species. Paintballs do not actually contain paint but are marking capsules that consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. Although the ingredients may vary slightly depending on the manufacturer, paintball ingredients may include polyethylene glycol, gelatin, glycerine (glycerol), sorbitol, water, ground pigskin, dipropylene glycol, mineral oil, and dye as the colorant (Donaldson 2003). Paintballs are considered non-toxic to people and do not pose an environmental hazard, as described on product labeling and Safety Data Sheets.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

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

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

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

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

Implementation of this alternative would require the federal WS program, as part of the TWSP, to only recommend and use non-lethal methods to manage and prevent damage caused by target bird species. The Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association could continue to conduct activities using lethal and non-lethal methods. WS would provide technical assistance and direct operational assistance under this alternative recommending and using only non-lethal methods. If implements Alternative 2, the non-lethal methods that would be available for the WS to recommend and/or use would have the potential to threaten human safety.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

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

No adverse effects to human safety have occurred from TWSP use of non-chemical methods to alleviate bird damage in the state from FY 2017 through FY 2019. The risks to human safety from the use of non-chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Other entities, including the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association, could and would likely continue to use non-chemical methods if WS implements this alternative, including the use of non-chemical lethal methods, such as the use of a firearm. Many of the lethal methods available to manage bird damage would be available for use by other entities. This could result in less experienced persons implementing lethal methods, which could lead to greater risks to human safety. Other entities could use lethal methods where WS personnel may not because WS personnel would consider threats to human safety when formulating strategies to alleviating bird damage.

SAFETY OF CHEMICAL METHODS EMPLOYED

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

No adverse effects to human safety have occurred from TWSP use of chemical methods to alleviate bird damage in the state from FY 2017 through FY 2019. The risks to human safety from the use of chemical methods, when used appropriately and by trained personnel, would be low. Based on the use patterns of methods available to address damage caused by birds, this alternative would comply with Executive Order 12898 and Executive Order 13045.

Other entities, including the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association, could and would likely continue to use chemical methods if WS implements this alternative, including the use of lethal chemical methods, such as the use of Avitrol. Many of the lethal methods available to manage bird damage would be available for use by other entities. This could result in less experienced persons implementing lethal methods, which could lead to greater risks to human safety. Other entities could use lethal methods where WS personnel may not because WS personnel would consider threats to human safety when formulating strategies to alleviating bird damage.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

As discussed previously, using non-lethal methods can be effective at alleviating damage associated with birds. The use of non-lethal methods in an integrated approach can be effective at dispersing birds (*e.g.*, see Avery et al. 2008*a*, Chipman et al. 2008, Seamans and Gosser 2016). Section 1.2.2 discusses the need to resolve threats to human safety associated with the target bird species. Threats to human safety associated with birds are primarily associated with the risks of aircraft striking birds at airports in the state but can include threats of pathogen transmission where fecal droppings accumulate. Limiting the methods available could lead to higher risks to human health and safety. For example, vultures have the potential to cause severe damage to aircraft, which can threaten the safety of flight crews and passengers. Risks of aircraft strikes could increase if birds near airports and/or military facilities habituate to the use of non-lethal methods and no longer respond to the use of those methods.

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

If WS implements this alternative, WS personnel would only provide recommendations on methods the requester could use to alleviate bird damage themselves with no direct involvement by WS; however, as part of the TWSP, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association could continue to provide direct operational assistance. On occasion, WS personnel could demonstrate the use of methods but WS personnel would not conduct any direct operational activities to manage damage caused by birds. WS personnel would only recommend for use those methods that were legally available to the requester for use. If WS implements this alternative, the only method described in Appendix B that would not be available for use by other entities would be DRC-1339. The avicide DRC-1339 is only available for use by WS personnel and those persons under their direct supervision. WS would only provide technical assistance to those persons requesting assistance with bird damage and threats.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people that request assistance from WS could conduct activities and use methods recommended by WS personnel, they could implement other methods, they could seek assistance from the other entities within the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association), they could seek further assistance from other entities, or they could take no further action. Therefore, the requester and/or other entities would be responsible for using those methods available, including methods recommended by WS. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance use non-chemical methods according to recommendations and as demonstrated by WS, the potential risks to human safety would be similar to those risks if WS personnel were using those methods. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use methods not recommended by WS, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. The extent of the increased risk would be unknown and variable. However, non-chemical methods inherently pose minimal risks to human safety given the design and the extent of the use of those methods.

SAFETY OF CHEMICAL METHODS EMPLOYED

Several chemical methods would continue to be available for use by the public if WS implements Alternative 3, which the WS could recommend to people when providing technical assistance. Nicarbazin, carbon dioxide for euthanasia, egg oiling, paintballs, Avitrol, sodium lauryl sulfate, and commercially available repellents are chemical methods that would continue to be available to the public for use. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people receiving technical assistance from WS implement chemical methods appropriately and in consideration of human safety, including following label requirements, then the effects of implementing this alternative on human health and safety would be similar to those effects if WS, as part of the TWSP, implemented Alternative 1. If people implement chemical methods inappropriately, without regard for human safety, and/or use methods not recommended by the WS, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

If WS implemented this alternative, the avicide DRC-1339 would not be a method that WS could recommend to the general public because the avicide is currently only available for use by WS and persons under their direct supervision. A product with the same active ingredient as DRC-1339 has been commercially available to the public in the past and it is possible that other entities could seek to register the active ingredient of DRC-1339 as a restricted use pesticide in the state if WS implements this alternative. DRC-1339 can effectively reduce local populations of target bird species, which can reduce threats to human health and safety. For example, Boyd and Hall (1987) showed that a 25% reduction in a local crow roost using DRC-1339 resulted in reduced hazards to a nearby airport. However, DRC-1339 is only available to target certain bird species. The avicide DRC-1339 is only available to target pigeons, crows, ravens, blackbirds, grackles, cowbirds, magpies, starlings, Eurasian collared-doves, and gulls.

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If people implement methods as intended at a similar level that would occur if WS personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If people attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the ability of those people to reduce threats to human health and safety would be lower than Alternative 1. This would likely occur on a case-by-case basis because one person may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be more effective at reducing threats to human health and safety than the implementation of Alternative 4 because WS would be available to provide technical assistance and demonstration to those persons seeking assistance.

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

If WS implements Alternative 4, WS would not provide assistance in Texas with any aspect of managing damage caused by those target bird species addressed in this EA, including providing technical assistance. People could contact WS for assistance but WS would refer those people to other entities, such as the USFWS, Texas A&M AgriLife Extension Service, TPWD, and/or private entities. Due to the lack of involvement in managing damage caused by those target bird species addressed in this EA, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities from conducting damage management activities in the absence of WS' assistance. Many of the methods discussed in Appendix B would be available to those persons experiencing damage or threats and, when required, people could continue to take birds lethally when authorized by the USFWS and/or the TPWD.

SAFETY OF NON-CHEMICAL METHODS EMPLOYED

If WS implements this alternative, those people experiencing bird damage could conduct activities themselves, they could seek assistance from the other entities within the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association), they could seek assistance from other entities, or they could take no action. The requester and/or other entities would be responsible for using those methods available. Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Most non-chemical methods available to alleviate bird damage involve the live-capture or hazing of birds. The skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people implement non-chemical methods appropriately and in consideration of human safety, then the effects of using non-chemical methods would be similar to those effects if WS implemented Alternative 1. If people implement non-chemical methods inappropriately, without regard for human safety, and/or use illegal methods, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1. Although some risks to human safety are likely to occur with the use of pyrotechnics, propane cannons, exclusion devices, and firearms, those risks would likely be minimal when people use those methods appropriately and in consideration of human safety.

SAFETY OF CHEMICAL METHODS EMPLOYED

Similar to Alternative 3, several chemical methods would continue to be available for use by the public if WS implements Alternative 4. Nicarbazin, carbon dioxide for euthanasia, egg oiling, Avitrol, commercially available repellents, sodium lauryl sulfate, and paintballs are chemical methods that would continue to be available to the public for use. If WS implements this alternative, the only method described in Appendix B that would not be available for use by other entities would be DRC-1339. The avicide DRC-1339 is only available for use by WS personnel and those persons under their direct supervision. Similar to the use of non-chemical methods, the skill and knowledge of the person applying methods would determine the safety and efficacy of the methods the person was using. If people use chemical methods appropriately and in consideration of human safety, including follow label requirements, then the effects of implementing this alternative on human health and safety would be similar to those effects if WS implemented Alternative 1. If people implement chemical methods inappropriately, without regard for human safety, and/or use illegal methods, risks to human health and safety could be higher than those risks associated with the implementation of Alternative 1.

EFFECTS OF NOT EMPLOYING METHODS TO REDUCE THREATS TO HUMAN SAFETY

Similar to Alternative 3, the avicide DRC-1339 would not be available for the public to use if the TWSP implements this alternative because those methods are currently only available for use by WS or persons under their direct supervision. A product with the same active ingredient as DRC-1339 has been commercially available to the public in the past and it is possible that other entities could seek to register the active ingredient of DRC-1339 as a restricted use pesticide in the state if WS implements this alternative.

As discussed previously, if WS implements this alternative, the skill and knowledge of the person using methods would determine how effective those methods were at reducing threats to human health and safety. If people implement methods as intended at a similar level that would occur if WS personnel were conducting those activities, the ability to reduce threats to human health and safety would be similar. If people attempting to reduce threats to human health and safety applied methods incorrectly or were not as diligent at employing methods, then the ability of those people to reduce threats to human health and safety would be lower than Alternative 1. This would likely occur on a case-by-case basis because one person may apply methods as intended at a similar intensity level as would occur if WS were conducting the activities while another person may not apply methods as intended or may not apply those methods at a similar intensity level. Therefore, implementing this alternative would likely be effective at reducing threats to human health and safety similar to Alternative 1 in some cases but would not be as effective in other cases. However, implementing this alternative would likely be less effective at reducing threats to human health and safety than the implementation of Alternative 3 because WS would not be available to provide technical assistance and demonstration to those persons seeking assistance. However, other entities within the TWSP could continue to provide assistance.

3.1.4 Issue 4 - Humaneness and Animal Welfare Concerns of Methods

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

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

The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife is an important but very complex concept that people interpret in a variety of ways. Schmidt (1989) indicated that vertebrate damage management for societal benefits could be compatible with animal welfare concerns, if *"...the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process."* The AVMA has previously described suffering as a *"...highly unpleasant emotional response usually associated with pain and distress"* (AVMA 1987). However, suffering *"...can occur without pain...,"* and *"...pain can occur without suffering..."* (AVMA 1987). Because suffering carries with it the implication of occurring over time, a case could be made for *"...little or no suffering where death comes immediately..."* (California Department of Fish and Game 1991). Pain and physical restraint can cause stress in animals and the inability of animals to effectively deal with those stressors can lead to distress. Suffering occurs when people do not take action to alleviate conditions that cause pain or distress in animals.

Defining pain as a component in humaneness appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain. However, pain experienced by individual animals probably ranges from little or no pain to considerable pain (California Department of Fish and Game 1991). Research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness (Bateson 1991, Sharp and Saunders 2008, Sharp and Saunders 2011). Therefore, the challenge in coping with this issue is how to achieve the least amount of animal suffering.

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

Humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. Some individuals believe any use of lethal methods to resolve damage associated with wildlife is inhumane because the resulting fate is the death of the animal. Others believe that certain lethal methods can lead to a humane death. Others believe most non-lethal methods of capturing wildlife to be humane because the animal is generally unharmed and alive. Still others believe that any disruption in the behavior of wildlife is inhumane. Given the multitude of attitudes on the meaning of humaneness and the varying perspectives on the most effective way to address damage and threats in a humane manner, the challenge for agencies is to conduct activities and employing methods that people perceive to be humane while assisting those persons requesting assistance to manage damage and threats associated with wildlife. The goal of the TWSP would be to use methods as humanely as possible to resolve requests for assistance to reduce damage and threats to human safety. The TWSP would continue to evaluate methods and activities to minimize the pain and suffering of methods addressed when attempting to resolve requests for assistance.

Some people and groups of people have stereotyped methods as "*humane*" or "*inhumane*". However, many "*humane*" methods can be inhumane if not used appropriately. Therefore, the goal would be to address requests for assistance effectively using methods in the most humane way possible that minimizes the stress and pain to the animal. When formulating a management strategy using the WS Decision Model, TWSP personnel would give preference to the use of non-lethal methods, when practical and effective, pursuant to WS Directive 2.101.

Although some issues of humaneness could occur from the use of non-lethal methods, when used appropriately and by trained personnel, those methods would not result in the inhumane treatment of birds. The non-lethal methods of primary concern would be the use of live-capture methods, such as nets and cage traps. Concerns from the use of those non-lethal methods would be from injuries to birds while those methods restrain birds and from the stress of the bird while being restrained or during the application of the method. However, TWSP personnel would be present on-site during capture events or personnel would check methods frequently to ensure the TWSP addresses birds captured in a timely manner to prevent injury. Although stress could occur from being restrained, timely attention to live-captured wildlife would alleviate suffering. Stress would likely be temporary.

Under the proposed action, the TWSP could also use lethal methods to resolve requests for assistance to resolve or prevent bird damage and threats. Lethal methods would include firearms, DRC-1339, sodium lauryl sulfate, the recommendation that people harvest birds during regulated hunting seasons, egg destruction, and euthanasia after birds are live-captured. TWSP use of euthanasia methods under the proposed action would follow those required by WS Directive 2.505.

The euthanasia methods being considered for use under the proposed action for live-captured birds are cervical dislocation and carbon dioxide. The AVMA guideline on euthanasia lists cervical dislocation and carbon dioxide as conditionally acceptable methods of euthanasia for free-ranging birds, which can lead to a humane death (AVMA 2020). The use of cervical dislocation or carbon dioxide for euthanasia would occur after the animal has been live-captured and away from public view. Although the AVMA guideline also lists gunshot as a conditionally acceptable method of euthanasia for free-ranging wildlife, there is greater potential the method may not consistently produce a humane death (AVMA 2020). TWSP personnel that employ firearms to address bird damage or threats to human safety would be trained in the proper placement of shots to ensure a timely and quick death.

Although the mode of action of DRC-1339 is not well understood, it appears to cause death primarily by nephrotoxicity in susceptible species and by central nervous system depression in non-susceptible species (DeCino et al. 1966, Westberg 1969, Schafer 1984). DRC-1339 causes irreversible necrosis of the kidney and the affected bird is subsequently unable to excrete uric acid with death occurring from uremic poisoning and congestion of major organs (Decino et al. 1966, Knittle et al. 1990). The external appearances and behavior of starlings that ingested DRC-1339 slightly above the LD_{50} for starlings appeared normal for 20 to 30 hours, but water consumption doubled after 4 to 8 hours and decreased thereafter. Food consumption remained fairly constant until about 4 hours before death, at which time starlings refused food and water and became listless and inactive. The birds perched with feathers fluffed as in cold weather and appeared to doze, but were responsive to external stimuli. As death nears, breathing increased slightly in rate and became more difficult; the birds no longer responded to external stimuli and became comatose. Death followed shortly thereafter without convulsions or spasms (DeCino et al. 1966).

Birds ingesting a lethal dose of DRC-1339 become listless and lethargic, and a quiet death normally occurs in 24 to 72 hours following ingestion. This method appears to result in a less stressful death than which probably occurs by most natural causes, which are primarily disease, starvation, and predation. In non-sensitive birds and mammals, central nervous system depression and the attendant cardiac or pulmonary arrest is the cause of death (Felsenstein et al. 1974). DRC-1339 is the only lethal method that would not be available to other entities under the other alternatives. Certain formulations of DRC-1339 to manage damage caused by certain species of birds are only available to TWSP personnel for use.

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

When TWSP personnel deem firearms to be an appropriate method to alleviate damage or threats of damage using the WS Decision Model, TWSP personnel would strive to minimize the distress and pain of target birds and to induce death as rapidly as possible. The use of carbon dioxide for euthanasia would occur after TWSP personnel live-capture a bird. TWSP personnel that use firearms and carbon dioxide would receive training in the proper use of the methods to ensure a timely and quick death. Egg destruction would involve puncturing, breaking, shaking, or oiling an egg. In general, egg destruction would represent a humane method of making an egg unviable. In accordance with WS Directive 2.505, when taking an animal's life, TWSP personnel would exhibit a high level of respect and professionalism toward the animal, regardless of method.

TWSP personnel would be experienced and professional in their use of management methods (see WS Directive 1.301). TWSP personnel would receive training in the latest and most humane devices/methods to manage damage associated with birds. Consequently, TWSP personnel would implement methods in the most humane manner possible. People experiencing damage or threats of damage associated with birds could use many of those methods discussed in Appendix B regardless of the alternative implemented by the TWSP. The only method that would not be available for the public to use if the TWSP implemented the other alternatives would be DRC-1339. Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives because people could use those methods in the absence of TWSP involvement. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives.

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

If WS implemented this alternative, the federal WS program would continue to be a part of the TWSP but WS would only use non-lethal methods, which most people would generally regard as humane. WS would use non-lethal methods to live-capture, exclude, or disperse birds. The humaneness and animal welfare concerns of non-lethal methods would be identical to those described for Alternative 1 because those same non-lethal methods would be available for use if WS implemented this alternative. Although some issues of humaneness and animal welfare concerns could occur from the use of non-lethal methods, those methods, when used appropriately and by trained personnel, would not result in the inhumane treatment of birds.

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

If WS implemented this alternative, the issue of method humaneness and animal welfare concerns would be similar to the humaneness and animal welfare concerns discussed for Alternative 1 because many of the same methods would be available for people to use. WS would not directly be involved with damage management activities if WS implemented Alternative 3. However, the entity receiving technical assistance from WS could employ those methods that the TWSP recommends. Therefore, by recommending methods and, thus, a requester employing those methods, the issue of humaneness and animal welfare concerns would be similar to Alternative 1.

WS would instruct and demonstrate the proper use of methodologies to increase their effectiveness and to ensure people have the opportunity to use methods to minimize pain and suffering. However, the skill and knowledge of the person applying methods would determine the humane use of the methods the person was using despite WS instruction and demonstration. Therefore, a lack of understanding of the behavior of birds or improperly identifying the damage caused by birds along with inadequate knowledge and skill in using methodologies to resolve the damage or threat could lead to incidents with a greater probability of people perceiving those activities as inhumane. In those situations, people are likely to regard the pain and suffering to be greater than discussed for Alternative 1.

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

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

WS would not provide any assistance with managing bird damage in Texas if WS implemented Alternative 4. Those people experiencing damage or threats associated with birds could continue to use those methods legally available. Those persons who consider methods inhumane would likely consider those methods inhumane under any alternative because people often label methods inhumane no matter the entity employing those methods. A lack of understanding regarding the behavior of birds or methods used could lead to an increase in situations perceived as being inhumane to wildlife despite the method used. Despite the lack of involvement by WS under this alternative, those methods perceived as inhumane by certain individuals and groups would still be available to the public and other entities to use to resolve damage and threats caused by birds.

3.2 ISSUES NOT CONSIDERED FOR COMPARATIVE ANALYSIS

The TWSP identified additional issues during the scoping process of this EA. The TWSP considered those additional issues but a detailed analysis does not occur in Chapter 3. Discussion of those additional issues and the reasons for not analyzing those issues in detail occur below.

3.2.1 Effects of Activities on Soils, Water, and Air Quality

The implementation of those alternative approaches discussed in Section 2.4.1 by WS as part of the TWSP would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the environment, including the Clean Air Act. The actions described in Section 2.4.1 do not involve major ground disturbance, construction, or habitat alteration. Activities that WS could conduct during implementation of those alternative approaches discussed in Section 2.4.1 as part of the TWSP would not cause changes in the flow, quantity, or storage of water resources. The use and storage of methods by TWSP personnel would also follow WS' directives, including WS Directive 2.210, WS Directive 2.401, WS Directive 2.405, WS Directive 2.430, WS Directive 2.465, WS Directive 2.601, WS Directive 2.605, WS Directive 2.615, WS Directive 2.620, WS Directive 2.625, and WS Directive 2.627. Through programmatic risk assessments, WS has determined the use of cage traps (USDA 2019*c*), foothold traps (USDA 2019*d*), nets (USDA 2020), aircraft (USDA 2019*e*), and firearms (USDA 2019*f*) to manage wildlife damage pose minimal risks to the environment.

Most methods available for use to manage damage caused by birds are mechanical methods. Mechanical methods would not cause contaminants to enter water bodies or result in bioaccumulation. For example, firearms are mechanical methods that the TWSP could use to remove a target bird lethally and to reinforce the noise associated with non-lethal methods, such as pyrotechnics. Firearms would not enter bodies of water and would be securely stored off-site after each use; therefore, the firearm itself would not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials. Depredation permits issued by the USFWS require the use of non-toxic shot when using shotguns to target birds listed on the permit. Therefore, when conducting activities pursuant to a depredation permit issued by the USFWS and when using shotguns, TWSP personnel would only use non-toxic shot. The TWSP would also use non-toxic ammunition when required by depredation/control orders. Occasionally, TWSP personnel could use lead ammunition in rifles, handguns, air rifles, and shotguns[22].

[22]Occasionally, the TWSP could use shotguns using lead shot when targeting bird species that do not require a depredation permit from the USFWS to take those species, such as pigeons, house sparrows, and starlings.

There is often concern about the deposition of lead into the environment from ammunition used in firearms to remove birds lethally. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996). To address lead exposure from the use of shotguns, the USFWS Migratory Bird Permit Program has implemented the requirement to use non-toxic shot (see 50 CFR 20.21(j)) as part of the standard conditions of depredation permits issued pursuant to the MBTA for the lethal take of birds under 50 CFR 21.41. The depredation order for blackbirds (see 50 CFR 21.43(b)) includes the requirement for use of non-toxic shot, as defined under 50 CFR 20.21(j), as well as, non-toxic bullets. However, this prohibition on the use of lead bullets does not apply if an entity uses an air rifle or an air pistol to remove depredating blackbirds under the depredation order.

The take of target bird species by the TWSP in the state would occur primarily from the use of shotguns. However, TWSP personnel could use rifles, air rifles, and handguns to disperse or remove target bird species in some situations when TWSP personnel determine their use to be safe. To reduce risks to human safety and property damage from bullets passing through a target bird, the use of rifles and air rifles would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to reduce the likelihood of the bullet passing through the target bird species. Birds that were removed using a firearm would often occur within areas where retrieval of all carcasses for proper disposal would be highly likely (*e.g.*, at roost sites). TWSP personnel would retrieve the carcasses of birds to the extent possible and would dispose of the carcasses in accordance with WS Directive 2.515. With risks of lead exposure occurring primarily from ingestion of bullet fragments and lead shot, the retrieval and proper disposal of bird carcasses would greatly reduce the risk of scavengers ingesting lead contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a firearm, the projectile passed through a bird, if misses occurred, or if TWSP personnel were not able to retrieve the carcass. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil generally stays within the top 20 cm (about eight inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could lead to contamination of ground water or surface water. Stansley et al. (1992) studied lead levels in water that had high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "*transport*" readily in surface water when soils were neutral or slightly alkaline in pH (*i.e.*, not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley et al. 1992).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e.*, requiring action to treat the water to remove lead). The study found that the dissolution (*i.e.*, capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments, which reduces the transport of lead across the landscape and naturally serves to reduce the potential for ground or surface water contamination (Craig et al. 1999). Those studies suggest that, given the very low amount of lead deposited and the concentrations that would occur from TWSP activities to reduce bird damage using firearms, as well as most other forms of hunting in general, lead contamination from such sources would be minimal to nonexistent.

Because the take of birds could occur by other entities when authorized by the USFWS and/or the TPWD, when required, TWSP assistance with removing target bird species would not be additive to the environmental status quo. TWSP assistance would not be additive to the environmental status quo because those birds removed by the TWSP using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of TWSP involvement. TWSP involvement in activities may result in lower amounts of lead being deposited into the environment due to efforts by the TWSP to ensure projectiles do not pass through, but are contained within the bird carcass, which would limit the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by TWSP employees in firearm use and accuracy increases the likelihood that TWSP personnel lethally remove a target bird humanely in situations that ensure accuracy and that misses occur infrequently, which would further reduce the potential for TWSP activities to deposit lead in the soil.

In addition, TWSP involvement in activities would ensure TWSP personnel made efforts to retrieve bird carcasses lethally removed using firearms to prevent the ingestion of lead in carcasses by scavengers. TWSP involvement would also ensure carcasses were disposed of properly to limit the availability of lead. Based on current information, the risks associated with lead ammunition that TWSP activities could deposit into the environment due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination. The TWSP would not use lead ammunition at a magnitude that activities would deposit a large amount of spent bullets or shot in such a limited area that would result in large accumulations of lead in the soil. As stated previously, when using shotguns to target those migratory bird species addressed in a depredation permit issued by the USFWS only non-toxic shot would be used by the TWSP pursuant to 50 CFR 20.21(j). The TWSP may utilize non-toxic ammunition in rifles, air rifles, and handguns as the technology improves and ammunition becomes more effective and available. In addition, when targeting birds pursuant to a depredation or control order, the TWSP would use non-toxic ammunition if required by the order (*e.g.*, the blackbird depredation order (50 CFR 21.43)).

The TWSP could also use aircraft to survey, locate, and monitor birds. The use of a fixed-winged aircraft or helicopter for surveillance and monitoring activities, like any other flying, may result in an accident. The TWSP would primarily use aircraft to conduct surveys of waterbirds in the state, such as American white pelicans. TWSP pilots and crewmembers receive training and have experience to recognize the circumstances that lead to accidents. The national WS Aviation Program has a strong emphasis on safety, including funding for training, the establishment of a WS Flight Training Center, and annual recurring training for all pilots. In addition, WS has developed a comprehensive Aviation Operations and Safety Manual that provides guidance to TWSP personnel when conducting aerial operations. However, accidents may still occur. Nationwide, the WS program has been using aircraft during aerial operations for many years. During this time, no incidents of major ground fires associated with WS' aircraft accidents have occurred; thus, the risk of catastrophic ground fires caused by an aircraft accident is exceedingly low.

Aviation fuel is extremely volatile and it will normally evaporate within a few hours or less to the point that even detecting its odor is difficult. The fuel capacity for aircraft used by WS varies. For fixed-winged aircraft, a 52-gallon capacity would generally be the maximum, while 91 gallons would generally be the maximum fuel capacity for helicopters. In some cases, little or none of the fuel would spill if an accident occurs. Thus, there should be little environmental hazard from unignited fuel spills.

With the size of aircraft used by the TWSP, the quantities of oil (*e.g*., 6 to 8 quarts maximum for reciprocating (piston) engines and 3 to 5 quarts for turbine engines) capable of spilling in any accident would be small with minimal chance of causing environmental damage. Aircraft used by the TWSP would be single engine models, so the greatest amount of oil that could spill in one accident would be about eight quarts.

Petroleum products degrade through volatilization and bacterial action, particularly when exposed to oxygen (EPA 2000). Thus, small quantity oil spills on surface soils can biodegrade readily. Even in subsurface contamination situations involving underground storage facilities that generally involve larger quantities than would ever be involved in a small aircraft accident, the EPA guidelines provide for *"natural attenuation"* or volatilization and biodegradation in some situations to mitigate environmental hazards (EPA 2000). Thus, even where the owner of the aircraft did not clean up oil spills in small aircraft accidents, the oil does not persist in the environment or persists in such small quantities that no adverse effects would likely occur. In addition, TWSP accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low to nonexistent.

For those reasons, the risk of ground fires or fuel/oil pollution from aviation accidents would be low. In addition, based on the history and experience of the program in aircraft accidents, it appears the risk of environmental damage from such accidents is exceedingly low.

Currently, the two principal types of fuel used in aviation today are aviation gasoline (commonly referred to as avgas) and jet fuel. According to the Federal Aviation Administration, aviation gasoline is the only transportation fuel that still contains a lead additive (Federal Aviation Administration 2018). Jet fuel does not contain a lead additive. The helicopters that the TWSP could use to conduct monitoring and surveillance activities would use jet fuel, which does not contain lead. However, the airplanes that the TWSP could use would use aviation gasoline, which does contain a lead additive. The Federal Aviation Administration (2018) stated, "[Aviation gasoline] *emissions have become the largest contributor to the relatively low levels of lead emissions produced in* [the United States]."

In consultation with the Federal Aviation Administration, the EPA has the authority to regulate aircraft emissions under the Clean Air Act, including lead emissions from the use of aviation gasoline. When the EPA sets standards for aircraft emissions, the Clean Air Act specifies that the EPA and the Federal Aviation Administration must consider the time needed to develop required technology, consider cost, and must not adversely affect aircraft safety or noise (Federal Aviation Administration 2018).

In 2006, an environmental advocacy organization petitioned the EPA to find that lead emissions from airplanes using aviation gasoline containing lead additives contribute to lead air pollution that may endanger public health or welfare. The same environmental advocacy organization petitioned the EPA again in 2014 and urged the EPA to make an endangerment finding regarding lead emissions from aviation gasoline. Despite the petitions, the EPA continues to indicate a need for more data and findings to make a judgment on whether lead emissions from aviation gasoline are a danger to public health. Pursuant to Section 231 of the Clean Air Act, the EPA is currently conducting proceedings regarding whether lead emissions from piston-engine general aviation aircraft that use aviation gasoline cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare. In addition, the Federal Aviation Administration is supporting research of alternative fuels to replace aviation gasoline that contain lead additives. The Federal Aviation Administration anticipates issuing final test reports on alternative fuels to replace aviation gasoline that contain lead additives by mid-2020 (Federal Aviation Administration 2018). The Federal Aviation Administration is committed to developing an alternative fuel or fuels for use in airplanes and the EPA continues to proceed with investigations regarding whether lead emissions from airplanes using aviation gasoline cause or contribute to air pollution that may endanger the public. When the EPA and the Federal Aviation Administration approve the general use of an alternative fuel or fuels and the fuel or fuels become readily available for use, the TWSP would use the alternative fuel or fuels.

The use of chemical immobilization and euthanizing agents by TWSP employees would occur pursuant to WS Directive 2.430. TWSP employees would follow WS Directive 2.401, which provides for the safe and effective storage, disposal, recordkeeping, and use of pesticides. When using pesticides, TWSP employees would follow product labels to minimize risks of environmental hazards. For example, label requirements of the avicide DRC-1339 may include not placing treated bait directly in water, not using treated bait within 50 feet of permanent manmade or natural bodies of water, not applying treated bait when runoff is likely to occur, and not contaminating water when cleaning equipment or disposing of waste. Similarly, label requirements for 4-Aminopyridine (Avitrol) may include not placing treated bait directly in water, not using treated bait within 25 feet of permanent bodies of water, and not contaminating water when cleaning of equipment or disposing of waste.

When conducting activities using lethal methods, TWSP personnel would retrieve carcasses to the extent possible for disposal. TWSP personnel would dispose of retrieved carcasses in accordance with WS Directive 2.510 and WS Directive 2.515. When applicable, TWSP personnel would also dispose of carcasses pursuant to requirements in authorizations issued by the USFWS and/or authorizations provided by the TPWD. In addition, TWSP personnel would follow the requirements of labels and use guidelines when using pesticides and when using chemical immobilization and euthanizing agents.

Consequently, the TWSP does not expect that implementing any of the alternative approaches discussed in Section 2.4.1 would significantly change the environmental status quo with respect to soils, geology, minerals, water quality, water quantity, floodplains, wetlands, other aquatic resources, air quality, prime and unique farmlands, timber, and range. The TWSP has received no reports or documented any effects associated with soil, water, or air quality from previous activities associated with managing damage caused by birds in the state that the TWSP conducted. Therefore, the EA will not analyze those elements further.

3.2.2 Greenhouse Gas Emissions by the TWSP

The TWSP could potentially produce criteria pollutants (*i.e.*, pollutants for which maximum allowable emission levels and concentrations are enforced by state agencies). Those activities could include working in the office, travel from office to field locations, travel at field locations (vehicles or all-terrain vehicles), and from other work-related travel (*e.g.*, attending meetings). During evaluations of the national program to manage feral swine (*Sus scrofa*), the WS program reviewed greenhouse gas emissions for the entire national WS program (see pages 266 and 267 in USDA 2015*b*). The analysis estimated effects of vehicle, aircraft, office, and all-terrain vehicle use by WS for FY 2013 and included the potential new vehicle purchases that could be associated with a national program to manage damaged caused by feral swine. The review concluded that the range of Carbon Dioxide Equivalents (includes CO_2, NO_x CO, and SO_x) for the entire national WS program would be below the reference point of 25,000 metric tons per year recommended at that time by the Council on Environmental Quality for actions requiring detailed review of impacts on greenhouse gas emissions. The cumulative activities that the TWSP could conduct under the alternative approaches discussed in Section 2.4.1 would have negligible cumulative effects on atmospheric conditions, including the global climate.

3.2.3 TWSP Actions Would Result in Irreversible and Irretrievable Commitments of Resources

Other than relatively minor uses of fuels for vehicles/aircraft, electricity for office operations and UAVs, carbon dioxide for euthanasia, and some components associated with ammunition (*e.g.*, black powder, shot) and pyrotechnics (*e.g*., black powder, cardboard), no irreversible or irretrievable commitments of resources result from TWSP activities.

3.2.4 Impacts on Cultural, Archaeological, Historic, and Tribal Resources and Unique Characteristics of Geographic Areas

A number of different types of federal and state lands occur within the analysis area, such as national wildlife refuges, national forests, and wildlife management areas. The TWSP recognizes that some persons interested in those areas may feel that any activities that could occur in those areas would adversely affect the esthetic value and natural qualities of the area. Similarly, TWSP activities could occur within areas with cultural, archaeological, historic, and/or tribal resources. WS would only provide direct operational assistance in the state as part of the TWSP if WS implements Alternative 1 or Alternative 2 (see Section 2.4.1). WS would provide no assistance with managing damage caused by birds if WS implements Alternative 4 and WS would only provide technical assistance if WS implements Alternative 3. However, WS would continue to be a part of the TWSP and the other entities within the TWSP (*i.e*., the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association) could continue to conduct activities to alleviate bird damage in the state.

If WS implements Alternative 1 or Alternative 2, the methods that the TWSP could employ would not cause major ground disturbance and would not cause any physical destruction or damage to property. In addition, the methods available would not cause any alterations of property, wildlife habitat, or landscapes, and would not involve the sale, lease, or transfer of ownership of any property. In general, implementation of Alternative 1 or Alternative 2 would not have the potential to introduce visual, atmospheric, or audible elements to areas that could result in effects on the character or use of properties. Therefore, if WS implemented Alternative 1 or Alternative 2, the methods would not have the potential to affect the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources. If WS implements Alternative 1 or Alternative 2 and the TWSP planned an individual activity with the potential to affect historic resources, the TWSP and/or the entity requesting assistance would conduct the site-specific consultation, as required by Section 106 of the National Historic Preservation Act, as necessary.

Conducting activities at or in close proximity to historic or cultural sites for the purposes of alleviating damage caused by birds would have the potential for audible effects on the use and enjoyment of the historic property. For example, the TWSP could use pyrotechnics to disperse birds. However, the TWSP would only use such methods at a historic site after the property owner or manager signed a work initiation document allowing the TWSP to conduct activities on their property. A built-in minimization factor for this issue is that nearly all the methods involved would only have temporary effects on the audible nature of a site and could be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects.

In addition, the TWSP would only conduct activities on tribal lands at the request of the Tribe and only after signing appropriate authorizing documents. Therefore, the Tribe would determine what activities they would allow and when TWSP assistance was required. Because Tribal officials would be responsible for requesting assistance and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would likely occur. The TWSP would also adhere to the Native American Graves Protection and Repatriation Act. If TWSP personnel located Native American cultural items while conducting activities on federal or tribal lands, the TWSP would notify the land manager and would discontinue work at the site until authorized by the managing entity.

The TWSP would abide by federal and state laws, regulations, work plans, Memorandum of Understandings, and policies to minimize any effects and would abide by any restrictions imposed by the land management agency on activities conducted by the TWSP. The implementation of those alternative approaches discussed in Section 2.4.1 would meet the requirements of applicable federal laws, regulations, and Executive Orders for the protection of the unique characteristics of geographic areas or any cultural, archeological, historic, and tribal resources.

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

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

In urban areas, the TWSP would often work with the community or municipal leaders to address bird damage involving large bird roosts that would likely be affecting several people; therefore, the TWSP often consults not only with the property owner where roosts are located but also with community leaders to allow for community-based decision-making on the best management approach. In addition, funding would often be provided by the municipality where the roost was located, which would allow activities to occur within city limits where bird roosts occurred. This would allow the TWSP and/or other entities to address roosts that relocated to other areas effectively and often times, before roosts become well established. Section 2.2.1 further discusses a community-based decision-making approach to bird damage management in urban areas. Therefore, the TWSP did not consider this issue further.

3.3 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Based on the best available information, the analyses in Section 3.1.1 indicate the direct, indirect, and cumulative effects on target bird populations associated with implementing Alternative 1 would be of low magnitude. The cumulative lethal removal of target bird species from all known sources of mortality would not reach a threshold that would cause a decline in their respective populations. The implementation of Alternative 2, Alternative 3, or Alternative 4 would likely have similar effects on target bird populations to implementing Alternative 1 because the same or similar activities would likely occur by other entities, including other entities of the TWSP (*i.e.*, the Texas A&M AgriLife Extension Service and the Texas Wildlife Damage Management Association). The USFWS has issued depredation permits for other entities to take many of the bird species addressed in this EA and the lethal take of birds in Texas has occurred by entities other than WS and the TWSP. The USFWS could continue to issue depredation permits to entities experiencing damage or threats of damage caused by birds in the state despite WS only providing technical assistance if WS implemented Alternative 3 or provided no assistance if WS implemented Alternative 4.

If WS implemented Alternative 1, those methods that the TWSP could use to alleviate damage would essentially be selective for target bird species because TWSP personnel would consider the methods available and their potential to disperse, capture, or kill non-target animals based on the use pattern of the method. TWSP personnel would have experience with managing animal damage and would receive training in the use of methods, which would allow TWSP employees to use the WS Decision Model to select the most appropriate methods to address damage caused by birds and to reduce the risks to non-target animals. If WS implemented Alternative 3, the knowledge and skill of those persons implementing recommended methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from providing only technical assistance could be greater than Alternative 1. The incorrect implementation of methods or techniques recommended by WS could lead to an increase in non-target animal removal when compared to the non-target animal removal that could occur by the TWSP under Alternative 1. Similarly, if WS implemented Alternative 4, the knowledge and skill of those persons implementing methods would determine the potential for impacts to occur. If those persons experiencing damage do not implement methods or techniques correctly, the potential impacts from implementing Alternative 4 could be greater than Alternative 1. However, if WS implemented Alternative 2, Alternative, 3, or Alternative 4, people experiencing damage caused by birds could continue to seek assistance from the other entities of the TWSP. If the other entities of the TWSP continued to implement activities similar to Alternative 1, those activities to manage bird damage in the state would likely result in similar effects to Alternative 1.

The risks to human health and safety from the use of available methods, when used appropriately and by trained personnel, would be low. No adverse effects to human safety have occurred from TWSP use of methods to alleviate bird damage in the state from FY 2017 through FY 2019. Based on the use patterns of methods available to address damage caused by birds, implementation of Alternative 1 would comply with Executive Order 12898 and Executive Order 13045. Other entities have and could continue to conduct activities to manage bird damage in the state. If people implemented methods appropriately and in consideration of human safety, threats to human health and safety would be minimal. If people implemented methods inappropriately, without regard for human safety, and/or used illegal methods, risks to human health and safety would increase.

People experiencing damage or threats of damage associated with birds could use many of those methods discussed in Appendix B regardless of the alternative implemented by WS. The only method that would not be available for use by the public would be the avicide DRC-1339 (pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, gulls only). Therefore, the issue of humaneness associated with methods would be similar across any of the alternatives because people could use those methods in the absence of WS' involvement. Those persons who view a particular method as humane or inhumane would likely continue to view those methods as humane or inhumane under any of the alternatives. In addition, many "*humane*" methods can be inhumane if not used appropriately. For example, people may view a live trap as a humane method because the trap captures an animal alive. Yet, without proper care, people can treat a bird captured in a live trap inhumanely if they do not attend to the bird appropriately.

In conclusion, implementation of Alternative 1 would not result in cumulatively significant environmental impacts on any of the issues analyzed in this EA based on past, present, and/or reasonably foreseeable future actions. If WS implements Alternative 1, all activities would comply with relevant laws, regulations, policies, orders, procedures, and WS' directives. In addition, WS would review this EA periodically to ensure activities and their impacts remain consistent with the activities and impacts analyzed in this EA. Monitoring activities would ensure that WS' activities and the effects of those activities occurred within the limits of evaluated/anticipated activities. Monitoring involves review of the EA for all of the issues evaluated in Chapter 3 to ensure that the activities and associated impacts have not changed substantially over time.

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

4.1 LIST OF PREPARERS

Michael Bodenchuk, USDA-APHIS-TWSP, State Director, San Antonio, TX

Cory W Wilson, USDA-APHIS-TWSP, Wildlife Biologist, San Antonio, TX

Aithne Loeblich, USDA-APHIS-TWSP, Biological Technician, San Antonio, TX

4.2 LIST OF PERSONS CONSULTED AND REVIEWERS

Kristin Madden, US Fish and Wildlife Service, Interior Regions 6 (OK, TX), 7 (NM), and 8 (AZ)

Shaun Oldenburger, Texas Parks and Wildlife Department, Small Game Program Director

APPENDIX A
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APPENDIX B
BIRD DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE

The TWSP is evaluating the use of an adaptive approach to managing damage associated with birds, when requested, through the implementation and integration of safe and practical methods based on local problem analyses and the informed decisions of trained TWSP personnel. TWSP personnel would formulate integrated method approaches using the WS Decision Model (Slate et al. 1992; see WS Directive 2.201). An integrated approach to resolving requests for assistance using the Decision Model would allow TWSP personnel greater flexibility and more opportunity to develop an effective damage management strategy for each request for assistance, such as considerations for threatened, endangered, or candidate species, that could be present in an area.

When selecting damage management techniques for specific damage situations, TWSP personnel would consider the species involved along with the magnitude, geographic extent, duration, frequency, and likelihood of further damage. TWSP personnel would also consider the status of target and potential non-target species, local environmental conditions and impacts, social and legal aspects, humaneness of methods, animal welfare concerns, and relative costs of damage reduction options. The cost of damage reduction may sometimes be a secondary concern because of the overriding environmental, legal, and animal welfare considerations. TWSP personnel would evaluate those factors when formulating damage management strategies that incorporate the application of one or more techniques.

A variety of methods would potentially be available to the TWSP relative to the management or reduction of damage from birds. Various federal, state, and local statutes and regulations and WS' directives would govern TWSP use of damage management methods. The TWSP would develop and recommend or implement strategies based on resource management, physical exclusion, and wildlife management approaches. Within each approach there may be available a number of specific methods or techniques. The TWSP could recommend or use the following methods in Texas. Many of the methods described would also be available to other entities in the absence of any involvement by the TWSP.

I. NON-LETHAL METHODS

Non-lethal methods consist primarily of tools or devices used to disperse, exclude, or capture a particular bird or a local population of birds to alleviate damage and conflicts. When evaluating management methods and formulating a management strategy, TWSP personnel would give preference to non-lethal methods when they determine those methods to be practical and effective (see WS Directive 2.101). Most of the non-lethal methods available to the TWSP would also be available to other entities within the state and other entities could employ those methods to alleviate bird damage.

Human presence: Human presence may consist of physical actions of people, such as clapping, waving, or shouting, or the presence of people and/or a vehicle at a location where damage or threats of damage are occurring. For example, birds may associate a vehicle with previous hazing activities and approaching an area in that vehicle or a similar vehicle may disperse target bird species from an area. Similarly, making a person's presence known to target bird species by clapping, waving, or shouting can often disperse birds from an area. When birds begin to associate people with hazing and/or shooting activities, the presence of people can disperse those birds when they see people approach. Human activities can also enhance the effectiveness of effigies, such as human effigies, because they associate people with hazing or shooting activities.

Modifying cultural practices: TWSP personnel could make recommendations to people on where to locate facilities, the design of facilities, modifications of existing facilities, and fisheries management to reduce the threat of bird damage. TWSP personnel could make recommendations on facility design or modifications to existing facilities to minimize the attractiveness of the facilities to birds, such as removing or altering areas where birds can perch and loaf. TWSP personnel could also make recommendations on operations management, such as areas to locate vulnerable fish stock, stocking rates, and the timing of releasing vulnerable fish stock.

Recommendations could include modifying the behavior of people that may be attracting or contributing to the damage caused by birds. For example, artificial feeding of waterfowl by people can attract and sustain more birds in an area than could normally be supported by natural food supplies. Recommendations may include altering planting dates so that crops are less vulnerable to damage when birds may be present. Modifying human behavior could include recommending people plant crops that are less attractive or less vulnerable to damage. At feedlots or dairies, cultural methods generally involve modifications to the level of care or attention given to livestock, which may vary depending on the age and size of the livestock. For example, Carlson et al. (2018*a*) found that red-winged blackbirds preferred flaked corn over ground corn in livestock feed. Similarly, Carlson et al. (2018*b*) found that pelleted feed of 0.95 centimeters diameter or larger inhibited starling consumption by more than 79%. The TWSP could make recommendations on changes to animal husbandry practices, such as feeding animals at night, feeding animals indoors, removing spilled grain or standing water, and use of bird proof feeders.

In situations where the presence of birds at or near airports results in threats to human safety and cannot be resolved by other means, TWSP personnel could recommend airports or military facilities alter aircraft flight patterns or schedules to avoid risks of striking birds. However, altering operations at airports to decrease the potential for strike hazards involving birds would generally not be feasible unless an emergency exists. Otherwise, the expense of interrupted flights and the limitations of existing facilities generally make this practice prohibitive.

Removal of domestic waterfowl could be recommended or implemented by the TWSP and other entities to alleviate damage. Flocks of urban/suburban domestic waterfowl can act as decoys and attract other migrating waterfowl (Crisley et al. 1968, Woronecki 1992). Avery (1994) reported that birds learn to locate food sources by watching the behavior of other birds. The removal of domestic waterfowl from water bodies removes birds that act as decoys that attract other waterfowl. Domestic waterfowl could also carry diseases, which can threaten wild populations.

Limited habitat modification: In most cases, the resource or property owner would be responsible for implementing habitat modifications, and the TWSP would only provide recommendations on the type of modifications that would provide the best chance of achieving the desired effect. Habitat management would most often be a primary component of damage management strategies at or near airports to reduce bird aircraft strike problems by eliminating bird nesting, roosting, loafing, or feeding sites. Management of vegetation and water from areas adjacent to aircraft runways can minimize many bird problems on airport properties. The TWSP could also recommend limited habitat modification in urban areas. For example, habitat management would often be necessary to minimize damage caused by egret rookeries, or by crows, blackbirds, and starlings that form large roosts during late autumn and winter in urban areas. Selectively thinning trees or pruning trees can greatly reduce bird activity at a roost location.

Supplemental feeding and lure crops: Supplemental feeding and lure crops are food resources planted or provided to attract wildlife away from more valuable resources (*e.g.*, crops). The intent is to provide a more attractive food source so that the animals causing damage would consume it rather than a more valuable resource. In feeding programs, an alternative food source with a higher appeal is offered to target birds with the intention of luring them from feeding on affected resources. This method can be ineffective if other food sources are available. For example, lure crops would largely be ineffective for geese because food resources (*e.g.*, turf) are readily available. For lure crops to be effective, the ability to keep birds from surrounding fields would be necessary, and the number of alternative feeding sites must be minimal (Fairaizl and Pfeifer 1988). Additionally, lure crops reduce damage for only a short time (Fairaizl and Pfeifer 1988) and damage by birds is often continuous. The resource owner would be limited in implementing this method contingent upon ownership of or ability to manage the property.

Fencing: The TWSP could recommend and implement fencing to alleviate bird damage; however, fencing has limited application for birds. TWSP personnel would primarily use and recommend fencing when addressing requests for assistance associated with waterfowl. Similar to other exclusion methods, the intent of fencing is to prevent waterfowl from accessing an area. For example, the TWSP could place fencing between a crop and a pond that waterfowl use. The fencing would act as a barrier to prevent waterfowl from leaving the pond and walking to feed on the crop. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993). In addition, limits to the use of fencing arise where there are multiple landowners, the size of the area, and its proximity to bodies of water used by waterfowl. Unfortunately, there have been situations where barrier fencing designed to inhibit goose nesting has entrapped young and resulted in starvation (Cooper 1998). The preference for geese to walk or swim, rather than fly, during this time period contributes to the success of barrier fences. Birds that are capable of full or partial flight render this method useless, except for enclosed areas small enough to prevent landing.

Fencing could include the use and recommendation of electrified fencing. Cooper and Keefe (1997) found people viewed the use of electric fencing as highly effective. The application of electrified fencing would be limited to rural settings, due to the possibility/likelihood of interaction with people and pets in populated areas. Problems that typically reduce the effectiveness of electric fences include vegetation on fence, flight capable birds, fencing knocked down by other animals (*e.g*., white-tailed deer and dogs), and poor power.

Surface coverings: The TWSP could recommend or use surface coverings to discourage birds from using areas. For example, covering the surface of a pond with plastic balls that float on the surface of the water can prevent access by waterfowl and gulls. However, a "*ball blanket*" would render a pond unusable for boating, swimming, fishing, and other recreational activities. It would also make it difficult to harvest fish from the pond. In addition, this method can be very expensive depending on the area covered, which often restricts its applicability to small water retention ponds.

Overhead wire grids: Overhead lines and wires consist of a line (*e.g*., fishing line) or wire (*e.g*., high-tensile galvanized or stainless steel wire) grid that is stretched over a resource to prevent access by birds. The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. Johnson (1994) found that wire grids could deter crow use of specific areas where they are causing a nuisance. Waterfowl may be excluded from ponds using overhead wire grids (Fairaizl 1992, Lowney 1993) and are most applicable on ponds of two acres or less. Exclusion may be impractical in most settings (*e.g*., commercial agriculture); however, wire grids could be practical in small areas (*e.g*., personal gardens) or for high-value crops (*e.g*., grapes) (Johnson 1994). A few people would find exclusionary devices such as wire grids unsightly and a lowering of the esthetic value of the neighborhood when used in residential areas or public areas. Wire grids can render an area unusable by people.

Netting: In some limited situations, the TWSP could recommend or use netting to exclude birds. Similar to overhead wire grids, netting is not likely practical in most situations because the size of the area requiring netting would be too large, such as fields used for commercial agriculture. In addition, as they attempt to access resources, birds may entangle themselves in nets causing injuries or death.

Visual scaring techniques: Visual scaring techniques that the TWSP may use and/or recommend include Mylar tape, eyespot balloons, flags, effigies, lasers, and lights. Visual scaring techniques can act as novel stimuli that birds act to avoid. TWSP personnel would place those methods in areas to scare and disperse target bird species, such as at roosting locations or areas where target birds nest.

Mylar tape has a highly reflective surface that produces flashes of light as sunlight reflects off the surface, which can startle birds. In addition, the metallic rattle and quick movement of Mylar tape as it moves in the wind can startle birds. TWSP personnel would attach Mylar tape to a stake and then insert the stake into the ground so the Mylar tape was visible and could move in the wind. In addition, TWSP personnel could tie Mylar tape to structures in a similar manner to using a stake. Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988). Reflective tape has been used successfully to repel some birds from crops when spaced at three to five meter intervals (Bruggers et al. 1986, Dolbeer et al. 1986). Mylar flagging has been reported effective at reducing migrant Canada goose damage to crops (Heinrich and Craven 1990). Other studies have shown reflective tape ineffective (Bruggers et al. 1986, Tobin et al. 1988, Conover and Dolbeer 1989). Flagging often works similar to Mylar tape, which often creates quick movements when they blow in the wind.

Eyespot balloons are large balloons that people can hang inside buildings to disperse birds. When inflated, the balloons appear to have a large eye or eyes that apparently give birds a visual cue that a large predator is present.

Scarecrows and effigies are models or silhouettes that often depict predator animals (*e.g*., alligators, owls), people (*e.g*., scarecrows), or mimic distressed target species (*e.g*., dead geese, dead vultures) that applicators can place in areas where birds cause damage or pose a threat of damage. Scarecrows and effigies may elicit a flight response from target birds, which disperses those birds from the area. Avery et al. (2002) and Seamans (2004) found that the use of vulture effigies were an effective non-lethal method to disperse roosting vultures. Avery et al. (2008*a*) found that effigies could be effective at dispersing crows. Effigies and scarecrows that pop-up into the air and/or have moving parts are often more effective at dispersing birds. Scarecrows and effigies would be most effective when they were moved frequently, alternated with other methods, and were well maintained. However, scarecrows and effigies tend to lose effectiveness over time and become less effective as populations increase (Smith et al. 1999).

TWSP personnel could use lasers and lights to disperse birds when low-light conditions exist (Glahn et al. 2000, Blackwell et al. 2002). Lasers and lights may be novel stimuli that birds act to avoid. Lasers and lights have advantages over other dispersal methods because they are silent and TWSP personnel can use those methods directly at birds. Therefore, TWSP personnel can use those methods is areas where disturbing other wildlife is a concern.

For best results and to disperse numerous birds from a roost, a laser is most effectively used in periods of low light, such as after sunset and before sunrise. In the daytime, the laser can be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser may be diminished. Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing pigeons and mallards with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002). Similarly, lasers were ineffective at dispersing starlings and cowbirds (Blackwell et al. 2002). Lasers were found to be only moderately effective for hazing geese, with a reduction in night roosting, but little to no reduction in diurnal activity at the site pre- and post-use (Sherman and Barras 2004).

Lights would primarily consist of high-powered spotlights. Similar to the use of lasers, application of spotlights to haze birds from night roosts has proven to be a moderately effective method. It is a method that can be incorporated with other methods in integrated management plans (VerCauteren et al. 2003).

Birds quickly learn to ignore visual and other scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics. Visual scaring techniques can be impractical in many locations and has met with some concerns due to the negative esthetic appearance presented on the properties where those methods are used.

Trained Dogs: The use of trained dogs can be effective at hazing waterfowl to keep them off turf and beaches (Conover and Chasko 1985, Castelli and Sleggs 2000). Around water, this technique appears most effective when the body of water is less than two acres in size (Swift and Felegy 2009). The TWSP would recommend and encourage the use of dogs where appropriate. Swift and Felegy (2009) have reported that when hazing with dogs ceases, the number of geese returns to pre-treatment numbers.

Electronic Hazing Devices: The TWSP could recommend and/or use electronic devices that mimic the sounds exhibited when target species are in distress, which is intended to cause a flight response and disperse target animals from the area. Alarm calls are given by birds when they detect predators while distress calls are given by birds when they are captured by a predator (Conover 2002). When other birds hear these calls, they know a predator is present or a bird has been captured (Conover 2002). Recordings of both calls have been broadcast in an attempt to scare birds from areas where they are unwanted. Recordings have been effective in scaring starlings from airports and vineyards, gulls from airports and landfills, finches from grain fields, and herons from aquaculture facilities and American crows from roosts (Conover 2002). However, the effectiveness of alarm or distress calls can be reduced as birds become accustomed to the sounds and learn to ignore them (Seamans and Gosser 2016).

Because alarm or distress calls are given when a bird is being held by a predator or when a predator is present, birds should expect to see a predator when they hear these calls. If they do not, they may become accustomed to alarm or distress calls more quickly. Birds can habituate to hazing techniques (Zucchi and Bergman 1975, Summers 1985, Aubin 1990, Seamans and Gosser 2016). For this reason, scarecrows or effigies should be paired with alarm or distress calls (Conover 2002), pyrotechnics (Mott and Timbrook 1988), or other methods to achieve maximum effectiveness. Although, Mott and Timbrook (1988) reported distress calls were effective at repelling resident geese 100 meters from the distress unit, the birds would return shortly after the calls stopped. The repellency effect was enhanced when pyrotechnics were used with the distress calls. Whitford (2003) used a combination of noise harassment, dogs, nest displacement, and visual harassment to chase geese from an urban park during the nesting season. Birds responded by dispersing and continued harassment with alarm calls prevented recolonization of the site during the nesting season.

The use of electronic hazing devices can have some drawbacks. For example, birds hazed from one area where they were causing damage frequently move to another area where they continue to cause damage (Brough 1969, Conover 1984, Summers 1985, Swift and Felegy 2009). Smith et al. (1999) noted that others have reported similar results, stating "*biologists are finding that some techniques (e.g., habitat modifications or scare devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and geese become more accustomed to human activity*". In some situations, the level of volume required for this method to be effective may disturb local residents or be prohibited by local noise ordinances.

Paintballs: TWSP personnel may use paintballs and recreational paintball equipment to supplement other hazing methods. Paintballs consist of a gelatin shell filled with a non-toxic glycol and water-based coloring that rapidly dissipates and is not harmful to the environment. A paintball marker (or gun) uses compressed CO_2 to propel paintballs an average of 280 feet per second but they are not very accurate. The discharge of the paintball marker combined with the sound of paintballs hitting the ground or splashing in water may be effective in dispersing birds, especially when combined with other hazing techniques. Although paintballs break easily and velocity rapidly decreases with distance, firing at close range is discouraged to avoid harming birds. The use of paintballs may be restricted in some areas by local ordinances.

Pyrotechnics: The term "*pyrotechnic*" encompasses a number of commercially available devices that produce a loud noise after firing the device. People may refer to some of the common individual devices as "*bird bombs*", "*screamers*", "*bangers*", "*shell crackers*", or "*CAPA*". The most common pyrotechnics are pyrotechnics that people fire from a pyrotechnic launcher or from a shotgun. Those pyrotechnics fired from a launcher or from a shotgun travel approximately 200 to 300 feet downrange. Some types of pyrotechnics emit a loud whistle as they travel while some travel downrange and then explode with a bang. Pyrotechnics that whistle as they travel and those that explode with a bang after travelling downrange generally emit a 100-decibel report that can startle target animals. A long-range pyrotechnic that is commercially available can travel approximately 1,000 feet downrange and produce a 150-decibel report. Pyrotechnics are one of the primary methods that TWSP personnel use to disperse birds.

Williams (1983) reported an approximate 50% reduction in blackbirds at two south Texas feedlots because of pyrotechnics and propane cannon use. These devices are sometimes effective but usually only for a short period before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Shirota et al. 1983, Schmidt and Johnson 1984, Mott 1985, Bomford 1990). There are also safety and legal implications regarding their use. Discharge of pyrotechnics is inappropriate and prohibited in some urban/suburban areas. Pyrotechnic projectiles can start fires, ricochet off buildings, pose traffic hazards, trigger dogs to bark incessantly, and annoy and possibly injure people. Use of pyrotechnics in certain municipalities would be constrained by local firearm discharge and noise ordinances.

Propane cannons: These small cannons operate using propane gas and when fired, produce a noise similar to a firearm. The user attaches the cannon to a propane tank using a hose. Opening the valve on the propane tank releases propane gas into a bladder system on the propane cannon, which begins to fill with propane gas. Once the bladder system fills, it releases the propane gas into the chamber of the cannon and simultaneously, a striking mechanism produces a spark that ignites the gas causing a loud explosion similar to the sound of a firearm firing. Propane cannons use a timing mechanism that people can adjust to vary how often the cannon fires. For example, propane cannons may be set to fire every five minutes. Some models are capable of being set to produce multiple blasts. For example, the user can set the propane cannon to produce a random series of single, double, or triple blasts. In addition, attachments to propane cannons can allow the user to control when the cannon operates during a 24-hour period. For example, the user may set the cannon to begin firing in the morning and then shut off in the evening. The user can also fit cannons with mechanisms that allow the cannon to rotate so that each firing occurs from a different direction.

High-pressure water spray: The TWSP could use high-pressure water to scare birds from a location (*e.g.*, areas where birds loaf or roost) and/or to clean surfaces (*e.g.*, remove fecal droppings, remove inactive nests). Spray from a high-pressure sprayer would be persistent enough to irritate birds and cause them to leave an area but would not be strong enough to cause physical damage. For example, the TWSP could use this method when rousing crows or other gregarious bird species from a roost. Using high-pressure water may be more acceptable than using loud noises or chemicals in some areas, such as urban areas. The TWSP could also use high-pressure water to remove inactive nests to discourage nesting. Logistical issues with using this method arise due to the size of the equipment needed and access to water.

Bow nets: Bow nets are suitcase or basket-type traps that people use to primarily live-capture raptors. Bow nets consist of two semi-circular bows as a frame with loose netting strung between the bows that the user places on the ground. Hinges and springs connect the two semi-circular bows at their bases with one bow fixed to the ground. The other semi-circular frame is folded and held together with the staked portion of the bow net that are held together by a trigger or release mechanism (Bloom et al. 2007). The user typically places an attractant near the center of the circle. For example, the TWSP could use a mouse inside a small cage or a tethered rock pigeon in the center of the bow net to attract raptors. For other bird species, the TWSP could place the bow net to envelope a nest on the ground. Therefore, the nest would act as the attractant. When a target bird approaches the nest, the user activates the bow net by a line or electronic mechanism that the user pulls or that personnel trigger while monitoring the trap. When activated, the net envelopes the bird. TWSP personnel would be present on site during the use of bow nets to address birds live-captured in the net.

Cage traps: Cage traps often consist of wire mesh or netting and are available in a variety of styles to live-capture birds. Cage traps allow target bird species to enter inside the trap through a one-way door or opening but prevent the target bird from exiting the trap. When using cage traps, TWSP personnel would place a visual attractant or bait inside the trap to attract target bird species. Visual attractants usually consist of a decoy bird or birds of the same species as the target birds. The feeding behavior and calls of the decoy birds attract other birds to the trap. The TWSP could also place cage traps over nests where the nest acts as the attractant. Target bird species enter the trap through one-way doors or openings to access the bait or attractant but are then unable to exit. People often refer to cage traps that use a visual attractant as decoy traps. TWSP personnel could use decoy traps for a variety of species, such as European starlings (Homan et al. 2017), blackbirds (Dolbeer and Linz 2016), crows (Johnson 1994), and rock pigeons (Williams and Corrigan 1994). When using live decoy birds in traps, TWSP personnel would ensure the birds have sufficient food, water, and shelter to assure their survival. TWSP personnel may also configure perches within the trap to allow birds to roost and perch above the ground. TWSP personnel would monitor decoy traps appropriately (*e.g.*, daily) to remove target bird species and to replenish food and water.

Nest box traps: Nest box traps are similar to cage traps; however, nest box traps resemble a nest box used by cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976). When birds enter inside the box trap, they trigger a mechanism that closes the opening to the box. The TWSP would place nest box traps on the side of a building or on a tree in an area where the target birds are active.

Raptor traps: There are a variety of traps available designed to capture raptors. The TWSP would primarily use raptor traps at airports to live-capture raptors that pose a risk of an aircraft strike. The bal-chatri trap, dho-gaza trap, the phai hoop trap, and the Swedish goshawk traps are some of the more common raptor traps. The designs of several raptor traps are similar to the use of nets (*e.g.*, dho-gaza trap) and the use of cage traps (*e.g.*, Swedish goshawk trap). Raptor traps use a prey animal (*e.g.*, mouse, pigeon) to attract raptors to the traps.

Bal-chatri traps consist of a small cage made from mesh wire. The small cage is often in a conical, half cylinder, or rectangle shape and holds the prey animal. To capture raptors, the user attaches one end of short pieces of monofilament line to the exposed areas of the cage trap and creates a noose with the other end of the monofilament line. As a raptor attempts to grab the prey item in the cage with their foot or feet, the noose tightens around the raptor's foot or feet, which holds the raptor at the location. TWSP personnel place weights on or anchor Bal-chatri traps to prevent the raptor from flying off with the trap attached to their foot or feet. Phai hoop traps function in a similar way to the bal-chatri trap. Phai hoop traps consist of a circular hoop with upright nooses placed along the length of the hoop with the lure animal placed inside the hoop. As a raptor attempts to grab the prey animal, the nooses close on their feet and/or legs. Similar to bal-chatri traps, personnel would place weights on the trap or anchor the hoop to the ground to prevent raptors from flying off with the trap.

Dho-gaza traps function similar to mist nets. Personnel attach the four corners of a small net to a pole frame. TWSP personnel attach the net to the pole frame is such a way as to allow the net to easily detach from the pole frame, such as attaching the net to the pole frame using paper clips. A cinch-line string runs through the mesh along all four sides of the net with the ends of the cinch-line string securely attached to the pole frame. TWSP personnel place the net in front of a lure animal that acts to attract the target raptor. Personnel place the net and frame perpendicular to the anticipated approach of the raptor to the lure animal. As the raptor swoops in to grab the attractant, the raptor hits the net, which causes the net to detach from the pole frame and the cinch-line string to close the net behind the raptor. The closing net forms a net bag around the raptor.

The Swedish goshawk trap consists of two parts. The base consists of a cage made from wire mesh that holds a prey animal while the upper portion contains the trap. The trap portion attaches to the top of the cage containing the prey animal. A trigger stick holds the top part of the trap open. As a raptor attempts to land on the trigger stick to investigate the prey animal, the trigger stick falls away causing springs to close the doors of the trap quickly. Once shut, the raptor is unable to exit the trap.

Corral traps: The TWSP could use corral traps to live capture waterfowl or other birds that are unable to fly. TWSP personnel can slowly guide birds unable to fly into corral traps. Corral traps as described by Costanzo et al. (1995) are lightweight, portable panels (approximate size 4' x 10') that the TWSP could use to surround and slowly guide target birds into a moveable catch pen. Catch pens consist of panels erected and attached to form a "U" shape. TWSP personnel would guide a target bird or birds through the open end of the "U" using handheld panels. As the bird or birds enter the "U", the handheld panels are brought together to close the catch pen and prevent birds from exiting. Once TWSP personnel confine a target bird or birds inside the catch pen, employees can live-capture the bird or birds.

Hand nets: The hand nets TWSP personnel could use would be similar to those used during fishing, such as a dip net or hand-thrown net. Generally, dip nets have netting at one end of a long pole that a user uses to scoop up a target animal. A hand-thrown net would be a net that a TWSP employee throws over a target bird. Hand-thrown nets typical have weights on the edges of the net.

Cannon nets: The term cannon net refers to net deployment systems that use rockets, cannons, or compressed air to propel a net over a target area. Rocket nets and cannon nets are projectile-type net traps comprised of three to five rockets or cannons and a large net (*e.g.*, 33 x 57 foot with 2-inch square nylon mesh) (Dill and Thornberry 1950, Cox and Afton 1994). The user would anchor the rear of the net to 5- or 10-pound boat anchors or would tie the rear of the net with inner tubes to stakes driven into the ground. Smokeless powder or black powder charges propel the rockets or projectiles in the cannons that a user would ignite with an electric squib inside the charge. The user would place the charges inside the rockets or cannon tubes and test with a galvanometer for electrical continuity. The user would unspool at least 200 to 350 feet of 18 or larger gauge wire and connect one end to the charges and the other end to a blasting machine. When an adequate number of birds gather in front of the net, the user would charge the blasting machine and fire the net. Firing the blasting machine sends an electrical charge down the wire and ignites the charges in the rockets or cannon tubes, which discharge the net. Pneumatic cannon nets deploy under similar methodology as the cannon or rocket nets but do not use smokeless powder or black powder charges to deploy the net. Pneumatic cannons utilize compressed air to deploy the net. The user also remotely discharges the pneumatic air cannon through push button controls wired to a mechanism that releases the compressed air. TWSP personnel would primarily use cannon nets in areas where birds routinely congregate or loaf. In most cases, TWSP personnel would use an attractant (*e.g.*, food source) to acclimate target birds to feeding at the location and to position the birds in an area that ensures the net envelopes the target birds.

Drop nets: Although not a commonly used method for birds, the TWSP could occasionally use drop nets to capture target bird species. The use of drop nets is similar to cannon nets; however, instead of propelling the net outward when fired, TWSP personnel would drop the net on top of target birds. TWSP personnel could manually drop the net onto target birds or remotely trigger the net to drop onto target birds. When dropped, the net would envelope target birds. TWSP personnel would use attractants to ensure target birds were using the location and to ensure the net envelopes target birds. Attractants could include a food source or decoy birds.

Net guns: Net guns are another method that the TWSP does not frequently use to live-capture birds. Net guns are similar to cannon nets except the nets are smaller and the nets are propelled from a hand-held launcher similar to a gun. The hand-held gun launches a weighted net over a target bird or birds using a firearm blank or compressed air. Similar to the use of cannon nets and drop nets, the use of net guns is often associated with the use of an attractant. The TWSP may use net guns to capture individual birds or a small number of birds that the TWSP is unable to capture using other methods.

Mist nets: Mist nets consist of a fine black silk or nylon net that are generally three to 10 feet wide and 25 to 35 feet long. Users of mist nets generally suspend the net between two poles anchored into the ground. Mist nets contain overlapping pockets that extend the length of the net. As a bird flies into the net, the bird falls into the pocket and becomes entangled in the net. In general, the TWSP would use mist nets to capture small birds, such as sparrows, blackbirds, and starlings. However, the TWSP could occasionally use mist nets to catch larger bird species, such as raptors and waterfowl. When in use, TWSP personnel would monitor mist nets to address birds captured in the net. The TWSP may use decoys and/or electronic calls to enhance the effectiveness of mist nets.

Modified padded foothold traps: Another live-capture method that TWSP personnel could consider is a modified foothold trap with padded jaws. TWSP personnel would modify padded foothold traps by removing or weakening springs on the trap so that when the jaws snap shut on the leg of a bird, the jaws do not injure the bird. TWSP personnel would primarily use modified padded foothold traps at airports where TWSP personnel would place the trap atop poles (*i.e.*, pole traps). Pole traps live-capture raptors as they land atop a pole to perch. When landing atop the pole, the raptor triggers the modified padded foothold trap, which closes around the foot or leg of the bird. TWSP personnel would attach the modified padded foothold trap to a guide wire that runs from the trap down the pole to the ground. Once live-captured by the foothold trap, the trap and raptor slide down the guide wire to the ground for handling. The TWSP could occasionally place modified padded foothold traps on the ground or submerge the trap in shallow water to live-capture larger bird species, such as white pelicans.

Nest destruction: The destruction of nests involves the removal of nesting materials during the construction phase of the nesting cycle or the removal of an inactive nest. Nest destruction could also occur after destroying eggs in the nests or after euthanizing nestlings in the nest. The TWSP could destroy nests by hand, using hand tools, and/or using high-pressure water.

Live-capture and translocation: TWSP personnel could use live-capture methods to capture birds and then translocate those birds to other areas. Once live-captured, TWSP personnel would place the birds in appropriately sized containers (*e.g.*, pet carriers) for transport to a release site. Translocation would only occur when authorized by the USFWS and/or the TPWD. TWSP personnel would only release birds on properties where the appropriate property owner or manager agrees to allow the release of those birds. The TWSP would primarily translocate raptor species and primarily when those species present an aircraft strike risk at airports. The TWSP often uses translocation when damage or threats of damage occur during the migratory periods when many bird species do not have well defined territories as birds migrate to and/or through the state.

Aircraft: Surveying wildlife from an aircraft is a commonly used tool for evaluating and monitoring damage and establishing population estimates and locations of various species of wildlife. The TWSP could use fixed-winged aircraft and/or helicopters to conduct surveys to locate and/or estimate the number of birds in areas of the state. For example, the TWSP could use fixed-winged aircraft to identify locations where egrets roost or conduct surveys to estimate the number of colonial nesting species near airport facilities. Low-level flights would primarily occur in the fall and during the winter when the number of individuals from certain species increase in the state. Surveying could involve circling an area as an observer counts the number of birds present in an area.

The TWSP could also use fixed-winged aircraft and/or helicopters to identify movement patterns of birds. For example, TWSP personnel could place radio-transmitting collars on American white pelicans and then monitor their movements over a specified period. TWSP personnel would then attempt to locate the research subject using a hand-held antennae and radio receiver from the ground; however, occasionally birds could travel long distances that would prevent biologists from locating the bird from the ground. In those situations, the TWSP may utilize either fixed wing aircraft or helicopters and elevation to conduct aerial telemetry and locate the specific bird wherever it has moved to.

Unmanned Aerial Vehicles: UAVs have several applications to prevent or reduce damage caused by birds. UAVs are receiving increasing attention as a wildlife management tool (Watts et al. 2010, Koh and Wich 2012, Martin et al. 2012, Lyons et al. 2017, Wandrie et al. 2019, Wang et al. 2019). TWSP personnel could use UAVs to locate nuisance birds, haze birds, and monitor bird nests for the presence of eggs or chicks. Wandrie et al. (2019) found that red-winged blackbirds showed behavioral responses to UAVs when flown within 30 meters of the ground, which could reduce damage occurring to sunflower fields. Egan et al. (2020) also noted that drones with predatory characteristics exhibited greater alarm responses in blackbirds than other common drone models. Unmanned aircraft generally produce less noise, use less fuel, and are generally less expensive to operate than manned aircraft (Watts et al. 2010). Burr et al. (2019) used UAVs to estimate waterbird abundance on aquaculture ponds. When using UAVs, the TWSP would adhere to all federal, state, and local laws. The TWSP would also follow the guidelines established in the WS' Small Unmanned Aircraft System Flight Operations Procedures manual.

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

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

Anthraquinone: Anthraquinone is a taste repellent that is commercially available for the public to purchase and use. Anthraquinone is available to discourage geese from feeding on turf and to discourage pheasants, blackbirds, crows, grackles, cowbirds, starlings, and Sandhill cranes from feeding on planted corn and rice seed. Anthraquinone has shown effectiveness in protecting rice seed from red-winged blackbirds and boat-tailed grackles (Avery et al. 1997) and Canada geese from feeding on emerging soybeans (Werner et al. 2019). However, Kaiser (2019) found anthraquinone relatively ineffective at reducing avian consumption of sunflowers. Like other taste repellents, products containing anthraquinone require the user to apply the products directly to resources they are protecting so the target bird species ingest the product and results can vary depending on the specific circumstances. Anthraquinone is a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism. WS would very rarely use products containing anthraquinone operationally but could recommend the use of products through technical assistance. Therefore, the entity receiving technical assistance would be responsible for using the product.

Methyl anthranilate: Methyl anthranilate naturally occurs in grapes and often occurs as a flavor additive in food, candy, and soft drinks (Dolbeer et al. 1992). Methyl anthranilate is the active ingredient in repellents commercially available to disperse several bird species, primarily geese and blackbirds. Products containing methyl anthranilate are either taste repellents or olfactory repellents. Products containing methyl anthranilate are often liquids that people apply directly to susceptible resources and require target bird species to ingest the product. Applying products containing methyl anthranilate to a food source, such as turf, can make the food source unpalatable to a target bird species, such as waterfowl (Dolbeer et al. 1993). Some commercially available products allow the use of methyl anthranilate in fogging applications that act as an olfactory repellent. The use of methyl anthranilate in fogging applications can disperse target bird species in areas where they congregate in large numbers, such as a blackbird roost at an industrial company (Vogt 1997). When inhaled, the methyl anthranilate fog acts as a mild irritant to birds. Taste and olfactory repellents containing methyl anthranilate are commercially available and available for use by the public.

Cummings et al. (1995) found the effectiveness of methyl anthranilate declined after 7 days. Belant et al. (1996) found methyl anthranilate ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. Mason et al. (1984, 1989) evaluated methyl anthranilate as a livestock feed additive; however, formulations of methyl anthranilate are not available for use on livestock feed. The TWSP would infrequently use products containing methyl anthranilate but could recommend the use of products through technical assistance.

II. LETHAL METHODS

In addition to the use of non-lethal methods, TWSP personnel could also use lethal methods. The lethal removal of birds by WS would only occur when authorized by the USFWS and/or the TPWD (when required) and only at levels authorized. In addition, WS would only use those lethal methods authorized by the USFWS and/or the TPWD.

Egg destruction: TWSP personnel could make eggs of target birds unviable in several different ways. Egg destruction would involve puncturing an egg, breaking an egg, shaking an egg, or oiling an egg. When puncturing an egg, a person holds the egg securely in a hand that they brace against the ground and then inserts a long, thin metal probe into the pointed end of the egg with slow steady pressure. The person inserts the probe all of the way through the egg until the tip of the probe hits against the inside of the shell at the opposite side of entry. While the person has the probe inserted into the egg, the egg is swirled in a circular motion to emulsify the yolk sac, ensuring the embryo is unviable. After removing the metal probe from the egg, a person can seal the puncture hole with a small amount of glue to prevent the contents of the egg from leaking out of the egg. TWSP personnel can then place the egg back in the nest so that birds continue to incubate the egg.

TWSP personnel could destroy eggs by manually gathering the eggs and breaking them open or by vigorously shaking an egg numerous times, which causes the embryo to detach from the egg sac. Egg oiling involves spraying a small quantity of food grade corn oil on eggs in a nest. The oil prevents exchange of gases through the eggshell and causes asphyxiation of developing embryos. Puncturing eggs, shaking eggs, or oiling eggs often has advantages over breaking an egg open because the adults may continue to incubate the egg and do not re-nest. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under the FIFRA.

Firearm: TWSP personnel could use firearms to lethally remove and/or haze target bird species. Firearms are mechanical methods that the TWSP could use to remove birds lethally and to reinforce the noise associated with non-lethal methods, such as pyrotechnics or propane cannons. In addition, the noise associated with discharging a firearm can disperse birds. As appropriate, TWSP personnel could use suppressed firearms to minimize noise impacts. Pursuant to the standard conditions included with the current depredation permit issued to the TWSP, when using a shotgun, TWSP personnel would not use shotguns larger than 10-gauge. In addition, when using shotguns to take migratory birds pursuant to the current depredation permit, the TWSP would use non-toxic shot as listed in 50 CFR 20.21(j). When using rifles, the TWSP could use ammunition that contains lead. TWSP personnel would retrieve the carcasses of birds to the extent possible and would dispose of the carcasses in accordance with the TWSP Directive 2.515. As noted for pyrotechnics, some commercially available pyrotechnics require the use of a shotgun to fire the pyrotechnic. TWSP firearm use and safety would comply with WS Directive 2.615.

Sport hunting: In limited situations, TWSP personnel could recommend that a person allow sport hunting on their property when people can legally harvest the target species during a hunting season, such as allowing hunters to harvest waterfowl during the appropriate hunting season for waterfowl.

Cervical dislocation: TWSP personnel could use cervical dislocation to euthanize birds that are captured in live traps. The bird is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. The AVMA (2020) considers this technique as a conditionally acceptable method of euthanasia and states that cervical dislocation when properly executed may be a humane technique for euthanasia of poultry and other small birds. Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (AVMA 2020).

Carbon dioxide: Carbon dioxide is another method that TWSP personnel may use to euthanize birds after personnel live-capture those birds using other methods. After capture, TWSP personnel would place a bird or birds into a container or chamber that personnel seal shut. TWSP personnel would then slowly release carbon dioxide gas into the container or chamber. The carbon dioxide gas would begin to displace oxygen in the container or chamber. At high concentrations, inhaling carbon dioxide can induce anesthesia initially followed by loss of consciousness in bird species.

Snap traps: Snap traps are common household traps used for rats or mice. The TWSP could occasionally use modified snap traps to target bird species that use cavities, such as European starlings. Snap traps are available in many designs and shapes but generally consist of a rectangular wooden or plastic base, a spring, a hammer, a catch, and a holding bar. The spring holds the hammer down on the base when closed; however, setting or opening the hammer applies tension on the spring. The holding bar, which the user places over the hammer to prevent the hammer from closing, attaches to the catch. The catch holds the bar in place while the spring is under tension. The TWSP could use the modified rat snap traps inside nest boxes so the target bird would trigger the trap once the bird enters the trap. In some situations, TWSP personnel would bait the catch with peanut butter or other food attractants. As the target bird attempts to feed on the bait, they trip the catch causing the holding bar to release and allowing the spring to close the hammer forcibly onto the target bird. TWSP personnel would place snap traps near the damage area and in areas where the target bird is active.

4-Aminopyridine (Avitrol): Avitrol is a flock dispersal method available for public use to manage damage associated with some bird species. The active ingredient of Avitrol is 4-Aminopyridine. 4-

Aminopyridine is available to manage damage associated with house sparrows, red-winged blackbirds, common grackles, brown-headed cowbirds, European starlings, rock pigeons, American crows, and fish crows.

Avitrol acts as a flock-dispersing method because, when a target bird species ingests a treated bait particle, the bird becomes hyperactive, produces distress vocalizations, and displays abnormal flying behavior, which can elicit a flight response by other members of a flock. The distress calls and erratic behavior by a bird that ingests a treated particle can alarm the other birds in a flock causing them to leave the site. Only a small number of birds need to show erratic behavior and/or produce distress vocalizations to cause alarm in the rest of the flock. Although Avitrol is a flock dispersing method, birds that ingest a treated particle often die.

The EPA has approved the public use of several Avitrol formulations as restricted use pesticides. The different formulations involve the use of different bait types, such as chopped corn, whole corn, and mixed grains, which may be more palatable to the bird species the applicator is targeting when using Avitrol. Additionally, formulations may differ in the concentration of active ingredient. In Texas, the Texas Department of Agriculture has approved the use of several Avitrol formulations by people with the appropriate applicators license within the state.

DRC-1339: DRC-1339 is an avicide available to manage damage associated with pigeons, crows, blackbirds, grackles, cowbirds, starlings, Eurasian collared-doves, and gulls in certain locations (*e.g.*, feedlots, blackbird staging areas) using certain bait types (*e.g.*, cracked corn, brown rice). The active ingredient of DRC-1339 is 3-chloro-p-toluidine hydrochloride. Birds that ingest DRC-1339 probably die because of irreversible necrosis of the kidney and subsequent inability to excrete uric acid (*i.e.*, uremic poisoning) (DeCino et al. 1966, Felsenstein et al. 1974, Knittle et al. 1990, Eisemann et al. 2003). Birds ingesting a lethal dose of DRC-1339 usually die in one to three days.

The EPA has approved the use of DRC-1339 as a restricted use pesticide that only WS personnel and people under their direct supervision can use. WS has registered two formulations of DRC-1339 with the EPA and Texas Department of Agriculture, and those formulations would be available for the TWSP to use. One formulation of DRC-1339 is available to manage crows causing damage to livestock, crows causing damage to silage/fodder bags, and crows feeding on the eggs or young of federally designated threatened or endangered species (Compound DRC-1339 Concentrate – Livestock, Nest, and Fodder Depredations; EPA Reg. #56228-29). The other formulation of DRC-1339 is available to manage blackbirds, grackles, cowbirds, starlings, crows, pigeons, and Eurasian collared-doves at commercial animal operations and staging areas along with gulls at gull colonies and gull feeding or loafing sites (Compound DRC-1339 Concentrate – Bird Control; EPA Reg. #56228-63). The TWSP also has a Special Local Needs registration for DRC-1339 in Texas to protect pecans from crow and raven damage.

For all uses, the TWSP must mix technical DRC-1339 (powder) with water and in some cases, a binding agent (required by the label for specific bait types). Once the technical DRC-1339, water, and binding agent, if required, are mixed, the liquid is poured over the bait and mixed until the liquid is absorbed and evenly distributed. After mixing, the handler allows the treated bait to air dry. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Before application at bait locations, applicators would mix treated bait with untreated bait at ratios required by the product label to minimize non-target hazards and to avoid bait aversion by target species.

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

Through pre-baiting, applicators can acclimate target birds to feed at certain locations at certain times. By acclimating birds to a feeding schedule, baiting can occur at specific times to ensure that target birds quickly consume bait shortly after the applicator places the bait, especially when addressing large flocks of target species. For example, an applicator could condition target birds to feed at a specific location by placing pre-bait early each morning near a roost so as target birds leave the roost, they fly to the location knowing that food is available. Therefore, the acclimation period allows applicators to place treated bait at a location after conditioning the target birds to be present at the site at a certain time of day and provides a higher likelihood that target birds consume treated bait shortly after applicators place the bait. Conditioning target birds to feed at certain times and at certain locations minimizes the amount of time that treated bait is present at a location. For exposure to the bait to occur, a non-target animal would have to approach a bait site and consume treated bait. If target bird species had already consumed the bait or the TWSP had already removed the bait from the location, then treated bait would no longer be available for non-target animals to find and consume.

Sodium Lauryl Sulfate: Sodium lauryl sulfate is a wetting agent in managing European starling; red-winged, yellow-headed, and Brewer's blackbird; cowbird; grackle; American Crow; common raven and magpie roosts. Sodium lauryl sulfate is a surfactant commonly used in soap products. Application of sodium lauryl sulfate and water is through a ground-based sprinkler-head spray system in areas of the target roost where it will be most effective in bird coverage. When applied to birds, sodium lauryl sulfate allows water to penetrate and saturate the feathers so that with low temperatures (<41ºF) and sufficient water, birds die of hypothermia. Birds died as soon as 30 minutes after exposure to sodium lauryl sulfate. In 1996, the EPA exempted 31 minimum-risk pesticides from requirements of FIFRA if the pesticides satisfy certain conditions. In general, conditions claiming that a pesticide should be exempt from registration under FIFRA Section 25(b) are that claims cannot be made regarding control of public-health pests, and the product cannot be used on food or feed crops. Sodium lauryl sulfate (Chemical Abstract Service No. 151-21-3) was included on the list of 31 exempt compounds. The TWSP anticipates using this method in the future, especially to disperse blackbird roosts in urban areas.

APPENDIX C

BIRD SPECIES OF TEXAS

The Texas Birds Record Committee (Texas Bird Records Committee 2021) lists 655 bird species that have been documented in Texas. Two of these species have been extinct for some time and are not listed. Texas has 457 species that reside for some part of the year in the state (Table C-1 and C-2). Additionally, 192 species have been accidentally seen inside the state from outside their normal range or reside in remote areas and are seen infrequently (Table C-3). Most of these species will not ever be the focus of a bird damage management project in Texas, but all are listed in the following tables to let readers know the diversity of birds in the state and that the potential exists that these species could be encountered. The TWSP expects to conduct bird damage management for relatively few of these species and anticipates that bird damage management will have at most a minimal effect on any given species in Texas and the Central Flyway unless a population is specifically targeted for removal as an invasive species.

Table C-1. Common and scientific names are given for the 266 wild bird species that typically reside for some part of the year in Texas that have the potential of being the target of a bird damage management project. Even though all of these species have the potential to invoke a request, the majority will not be involved in bird damage management in Texas. About half of the species would only be involved in bird damage management at airports where they are perceived as a strike risk or for disease surveillance. If the species has the potential to be involved in a request for assistance other than bird damage management at airports or for disease surveillance, it is noted.

Species	***Scientific Name***
Order Anseriformes - Waterfowl	
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*
Fulvous Whistling-Duck	*Dendrocygna bicolor*
Greater White-fronted Goose[2]	*Anser albifrons*
Snow Goose[2]	*Chen caerulescens*
Ross's Goose[2]	*Chen rossii*
Cackling Goose[2]	*Branta hutchinsii*
Canada Goose[2,4,5,6]	*Branta canadensis*
Wood Duck[2]	*Aix sponsa*
Gadwall	*Anas strepera*
American Wigeon[6]	*Anas americana*
Mallard[2,4,5,6]	*Anas platyrhynchos*
Mottled Duck [AR]	*Anas fulvigula*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck[1]	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter[1]	*Melanitta perspicillata*
White-winged Scoter[1]	*Melanitta fusca*
Black Scoter[1]	*Melanitta nigra*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead[1]	*Bucephala albeola*
Common Goldeneye[1]	*Bucephala clangula*
Hooded Merganser[1]	*Lophodytes cucullatus*
Common Merganser[1]	*Mergus merganser*
Red-breasted Merganser[1]	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Order Galliformes – Pheasants, Grouse, Turkey, & Quail	
Plain Chachalaca	*Ortalis vetula*
Ring-necked Pheasant (I)[2]	*Phasianus colchicus*
Lesser Prairie-Chicken [FC AR BCC]	*Tympanuchus pallidicinctus*

Wild Turkey[2]	*Meleagris gallopavo*
Scaled Quail [AY]	*Callipepla squamata*
Gambel's Quail	*Callipepla gambelii*
Northern Bobwhite[2]	*Colinus virginianus*
Order Gaviiformes - Loons	
Common Loon[1]	*Gavia immer*
Order Podicipediformes - Grebes	
Least Grebe	*Tachybaptus dominicus*
Pied-billed Grebe[1]	*Podilymbus podiceps*
Horned Grebe[1]	*Podiceps auritus*
Eared Grebe[1]	*Podiceps nigricollis*
Western Grebe[1]	*Aechmophorus occidentalis*
Clark's Grebe [AY 1]	*Aechmophorus clarkii*
Order Pelecaniformes – Pelicans, Cormorants, & Allies	
Masked Booby [AY]	*Sula dactylatra*
Northern Gannet	*Morus bassanus*
American White Pelican[1]	*Pelecanus erythrorhynchos*
Brown Pelican[FE SE 1]	*Pelecanus occidentalis*
Neotropic Cormorant[1]	*Phalacrocorax brasilianus*
Double-crested Cormorant[1]	*Phalacrocorax auritus*
Anhinga[1]	*Anhinga anhinga*
Magnificent Frigatebird [AR]	*Fregata magnificens*
Order Ciconiiformes –Herons, Egrets, & Ibises	
American Bittern [BCC 1]	*Botaurus lentiginosus*
Least Bittern [BCC]	*Ixobrychus exilis*
Great Blue Heron[1]	*Ardea herodias*
Great Egret[1,4,6]	*Casmerodius albus*
Snowy Egret[1,4,6]	*Egretta thula*
Little Blue Heron [BCC 1,4,6]	*Egretta caerulea*
Tricolored Heron[1,4,6]	*Egretta tricolor*
Reddish Egret [ST AR BCC 1,4,6]	*Egretta rufescens*
Cattle Egret[1,4,6]	*Bubulcus ibis*
Green Heron[1]	*Butorides striatus*
Black-crowned Night-Heron[1,4,6]	*Nycticorax nycticorax*
Yellow-crowned Night-Heron[1]	*Nyctanassa violacea*
White Ibis	*Eudocimus albus*
Glossy Ibis	*Plegadis falcinellus*
White-faced Ibis [ST]	*Plegadis chihi*
Roseate Spoonbill	*Ajaia ajaja*
Wood Stork [ST 1]	*Mycteria americana*
Order Falconiformes – Vultures, Eagles, Kites, Hawks, & Falcons	
Black vulture[3,4,6]	*Coragyps atratus*
Turkey vulture[3,4,6]	*Cathartes aura*
Osprey[1]	*Pandion haliaetus*
Swallow-tailed Kite [ST AY BCC]	*Elanoides forficatus*
White-tailed Kite	*Elanus leucurus*
Mississippi Kite [BCC 4]	*Ictinia mississippiensis*
Bald Eagle [ST BCC 1,3]	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk[3]	*Accipiter striatus*
Cooper's Hawk[3]	*Accipiter cooperii*
Harris's Hawk [BCC]	*Parabuteo unicinctus*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Swainson's Hawk [AY BCC]	*Buteo swainsoni*
White-tailed Hawk [ST BCC]	*Buteo albicaudatus*
Zone-tailed Hawk [ST]	*Buteo albonotatus*
Red-tailed Hawk[3]	*Buteo jamaicensis*
Ferruginous Hawk [BCC]	*Buteo regalis*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle [BCC 3]	*Aquila chrysaetos*
Crested Caracara[3]	*Caracara plancus*
American Kestrel [BCC*]	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon [SE/T** BCC]	*Falco peregrinus*
Prairie Falcon [BCC]	*Falco mexicanus*
Order Gruiformes – Rails & Cranes	
Purple Gallinule	*Porphyrula martinica*
Common Gallinule	*Gallinula galeata*

American Coot[6]	*Fulica americana*
Sandhill Crane[2]	*Grus canadensis*
Order Charadriiformes – Shorebirds, Gulls, & Terns	
Black-bellied Plover	*Squatarola squatarola*
Black Turnstone	*Arenaria melanocephala*
American Golden-Plover [AY]	*Pluvialis dominica*
Snowy Plover [AY BCC]	*Charadrius alexandrinus*
Wilson's Plover [AY BCC]	*Charadrius wilsonia*
Semipalmated Plover	*Charadrius semipalmatus*
Piping Plover [FT ST AR]	*Charadrius melodus*
Killdeer	*Charadrius vociferus*
Mountain Plover [AR BCC]	*Charadrius montanus*
American Oystercatcher [BCC]	*Haematopus palliatus*
Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Spotted Sandpiper	*Actitus macularia*
Solitary Sandpiper [BCC]	*Tringa solitaria*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmata*
Lesser Yellowlegs [BCC]	*Tringa flavipes*
Upland Sandpiper [BCC]	*Bartramia longicauda*
Whimbrel [BCC]	*Numenius phaeopus*
Long-billed Curlew [AY BCC]	*Numenius americanus*
Hudsonian Godwit [AY BCC]	*Limosa haemastica*
Marbled Godwit [AY BCC]	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Red Knot [AY BCC#]	*Calidris canutus*
Sanderling [AY]	*Calidris alba*
Semipalmated Sandpiper [AY]	*Calidris pusilla*
Western Sandpiper [AY]	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
White-rumped Sandpiper [AY]	*Calidris fuscicollis*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt Sandpiper [AY]	*Calidris himantopus*
Buff-breasted Sandpiper [AR BCC]	*Tryngites subruficollis*
Short-billed Dowitcher [BCC]	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
American Woodcock	*Scolopax minor*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Sabine's Gull	*Xema sabini*
Bonaparte's Gull[1,4,6]	*Larus philadelphia*
Laughing Gull[1,4,6]	*Larus atricilla*
Franklin's Gull[1,4,6]	*Larus pipixcan*
Ring-billed Gull[1,4,6]	*Larus delawarensis*
California Gull[1,4,6]	*Larus californicus*
Herring Gull[1,4,6]	*Larus argentatus*
Lesser Black-backed Gull[1,4,6]	*Larus fuscus*
Glaucous Gull[1,4,6]	*Larus hyperboreus*
Sooty Tern [ST]	*Sterna fuscata*
Least Tern [FE SE AR BCC]	*Sterna antillarum*
Gull-billed Tern [AY BCC 1]	*Sterna nilotica*
Caspian Tern[1]	*Sterna caspia*
Black Tern [1]	*Childonias niger*
Common Tern[1]	*Sterna hirundo*
Forster's Tern[1]	*Sterna forsteri*
Royal Tern[1]	*Sterna maxima*
Sandwich Tern [BCC]	*Sterna sandvicensis*
Black Skimmer [AY BCC]	*Rhynchops niger*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Oreder Columbiformes – Doves & Pigeons	
Rock Pigeon (I)[2,3,4,5,6]	*Columba livia*
Red-billed Pigeon [BCC]	*Columba flavirostris*
Band-tailed Pigeon [2]	*Columba fasciata*

Eurasian Collared Dove (I) [2,3,4,5,6]	*Streptopelia decaocto*
White-winged Dove[2,3,4, 6]	*Zenaida asiatica*
Mourning Dove[2,3,4, 6]	*Zenaida macroura*
Inca Dove	*Scardafella inca*
Common Ground-Dove	*Columbina passerina*
White-tipped Dove	*Leptotila verreauxi*
Order Psittaciformes - Parrots	
Monk Parakeet (I) [6]	*Myiopsitta monachus*
Green Parakeet [AR BCC]	*Aratinga holochroa*
Red-crowned Parrot [AR BCC]	*Amazona viridigenalis*
Order Cuculiformes – Cuckoos & Roadrunners	
Greater Roadrunner [5]	*Geococcyx californianus*
Groove-billed Ani	*Crotophaga sulcirostris*
Order Strigiformes - Owls	
Barn Owl[4,6]	*Tyto alba*
Western Screech-Owl	*Otus kennicottii*
Eastern Screech-Owl	*Otus asio*
Great Horned Owl[3]	*Bubo virginianus*
Burrowing Owl [BCC]	*Athene cunicularia*
Barred Owl[3]	*Strix varia*
Long-eared Owl	*Asio otus*
Short-eared Owl [AY BCC]	*Asio flammeus*
Order Caprimulgiformes - Goatsuckers	
Lesser Nighthawk	*Chordeiles acutipennis*
Common Nighthawk	*Chordeiles minor*
Order Apodiformes - Swifts	
Chimney Swift[4,6]	*Chaetura pelagica*
White-throated Swift	*Aeronautes saxatilis*
Order Coraciiformes - Kingfishers	
Ringed Kingfisher[1]	*Ceryle torquata*
Belted Kingfisher[1]	*Ceryle alcyon*
Green Kingfisher[1]	*Chloroceryle americana*
Order Piciformes - Woodpeckers	
Red-headed Woodpecker [AY BCC 2,6]	*Melanerpes erythrocephalus*
Acorn Woodpecker[2,6]	*Melanerpes formicivorus*
Golden-fronted Woodpecker[2]	*Melanerpes aurifrons*
Red-bellied Woodpecker[2]	*Melanerpes carolinus*
Yellow-bellied Sapsucker[2,6]	*Sphyrapicus varias*
Red-naped Sapsucker[2,6]	*Sphyrapicus nuchalis*
Ladder-backed Woodpecker [2]	*Picoides scalaris*
Downy Woodpecker[2]	*Picoides pubescens*
Hairy Woodpecker[2]	*Picoides villosus*
Northern Flicker[2,6]	*Colaptes auratus*
Pileated Woodpecker[2]	*Dryocopus pileatus*
Order Passeriformes – Perching Birds	
Family Tyrannidae - Flycatchers	
Eastern Phoebe	*Sayornis phoebe*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Great Crested Flycatcher	*Myiarchus crinitus*
Brown-crested Flycatcher	*Myiarchus tyrannulus*
Great Kiskadee	*Pitangus sulphuratus*
Couch's Kingbird	*Tyrannus couchii*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
White Wagtail	*Motacilla aba*
Eastern Kingbird	*Tyrannus tyrannus*
Scissor-tailed Flycatcher [BCC]	*Tyrannus forficatus*
Family Laniidae - Shrikes	
Loggerhead Shrike [BCC]	*Lanius ludovicianus*
Northern Shrike	*Lanius excubitor*
Family Corvidae – Crows & Jays	
Steller's Jay	*Cyanocitta stelleri*
Blue Jay[2,4,6]	*Cyanocitta cristata*
Green Jay	*Cyanocitta yncas*
Woodhouse's Scrub-Jay[4]	*Aphelocoma californica*
Mexican Jay	*Aphelocoma ultramarina*
Pinyon Jay [AY]	*Gymnorhinus cyanocephalus*
American Crow[2,3,4,6]	*Corvus brachyrhynchos*

Fish Crow[2]	*Corvus ossifragus*
Chihuahuan Raven[2,3,4,5,6]	*Corvus cryptoleucus*
Common Raven[2,3,4,5,6]	*Corvus corax*
Family Alaudidae - Larks	
Horned Lark[2]	*Eremophila alpestris*
Family Hirundinidae - Swallows	
Purple Martin[6]	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Blue-and-White Swallow	*Pygochelidon cyanoleuca*
Bank Swallow	*Riparia riparia*
Cliff Swallow[6]	*Hirundo pyrrhonota*
Cave Swallow[6]	*Hirundo fulva*
Barn Swallow[3,6]	*Hirundo rustica*
Family Muscicapidae – Robins & Thrushes	
American Robin[2]	*Turdus migratorius*
Family Mimidae – Mockingbirds & Thrashers	
Northern Mockingbird[4]	*Mimus polyglottos*
Family Sturnidae - Starlings	
European Starling (I)[2,3,4,5,6]	*Sturnus vulgaris*
Family Motacillidae - Pipits	
American Pipit	*Anthus rubescens*
Sprague's Pipit [AY BCC]	*Anthus spragueii*
Family Bombycillidae - Waxwings	
Cedar Waxwing[2]	*Bombycilla cedrorum*
Family Emberizidae –Towhees & Sparrows	
Lark Bunting [AY BCC 2]	*Calamospiza melanocorys*
White-crowned Sparrow[2,6]	*Zonotrichia leucophrys*
McCown's Longspur [BCC]	*Calcarius mccownii*
Family Cardinalidae – Cardinals, Grosbeaks, & Buntings	
Northern Cardinal[4]	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Dickcissel [BCC]	*Spiza americana*
Family Icteridae – Blackbirds, Meadowlarks, & Orioles	
Bobolink	*Dolichonyx oryzivorus*
Red-winged Blackbird[2,3,6]	*Agelaius phoeniceus*
Eastern Meadowlark	*Sturnella magna*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird[2,3]	*Xanthocephalus xanthocephalus*
Rusty Blackbird [AY 6]	*Euphagus carolinus*
Brewer's Blackbird[2,3,6]	*Euphagus cyanocephalus*
Common Grackle[2,3,6]	*Quiscalus quiscula*
Boat-tailed Grackle[2,3,4]	*Quiscalus major*
Great-tailed Grackle[2,3,4,6]	*Quiscalus mexicanus*
Bronzed Cowbird[2,3]	*Molothrus aeneus*
Brown-headed Cowbird[2,3,5,6]	*Molothrus ater*
Bullock's Oriole	*Icterus bullockii*
Baltimore Oriole	*Icterus galbula*
Scott's Oriole	*Icterus parisorum*
Family Fringillidae – Finches	
Purple Finch[6]	*Carpodacus purpureus*
Cassin's Finch[6]	*Carpodacus cassinii*
House Finch[2,4,,6]	*Carpodacus mexicanus*
Red Crossbill	*Loxia curvirostra*
Lesser Goldfinch	*Carduelis psaltria*
American Goldfinch	*Carduelis tristis*
Family Passeridae – Old World Sparrows	
House Sparrow (I)[2,3,4,6]	*Passer domesticus*

(I) - Introduced Species, **F** = Federal, **S** = State, **E** = Endangered, **T** = Threatened, **C** = Candidate, **AY/AR** - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern, **BCC** = Birds of Conservation Concern (USFWS 2008)
1 = Aquaculture; **2** = Crops; **3** = Livestock and Feed; **4**= Human Health and Safety; **5** = Natural resources; **6** = Property
*****- Subspp. *paulus* only ******- Subspp. *anatum/tundrius* # - Subspp. *roselaari/rufa*

Table C-2. Common and scientific names are given for the 191 bird species commonly occurring in Texas that have little or no potential to be the target of a TWSP bird damage management project including bird damage management projects at airports because these species are mostly limited in their distribution in Texas, not typically associated with any type of damage, and are not found in habitat associated with areas of potential damage (*e.g.*, urban areas, croplands, airport operating areas). Thus, TWSP does not anticipate that it will conduct bird damage management for these species, but the possibility could always arise.

Species	***Scientific Name***
Greater Prairie-Chicken [FE* SE* AR]	*Tympanuchus cupido*
Montezuma Quail [AY]	*Cyrtonyx montezumae*
Audubon's Shearwater [AY BCC]	*Puffinus lherminieri*
Yellow Rail [AR BCC]	*Coturnicops noveboracensis*
Black Rail [AR BCC]	*Laterallus jamaicensis*
Clapper Rail [AY]	*Rallus longirostris*
King Rail [AY]	*Rallus elegans*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Common Crane	*Grus grus*
Whooping Crane	*Grus americana*
Yellow-billed Cuckoo [FC BCC]	*Coccyzus americanus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Flammulated Owl [AY BCC]	*Otus flammeolus*
Ferruginous Pygmy-Owl [ST]	*Glaucidium brasilianum*
Elf Owl [AY BCC]	*Micrathene whitneyi*
Spotted Owl [FT ST AR]	*Strix occidentalis*
Common Pauraque	*Nyctidromus albicollis*
Common Poorwill	*Phalaenoptilus nuttallii*
Chuck-will's-widow	*Caprimulgus carolinensis*
Eastern Whip-poor-will	*Caprimulgus vociferus*
Mexican Whip-poor-will	*Antrostomus arizonae*
Buff-bellied Hummingbird [BCC]	*Amazilia yucatanensis*
Ruby-throated Hummingbird	*Archilochus colubris*
Black-chinned Hummingbird	*Archilochus alexandri*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Rufous Hummingbird	*Selasphorus rufus*
Northern Beardless-Tyrannulet [ST BCC]	*Camptostoma imberbe*
Olive-sided Flycatcher [AY]	*Contopus borealis*
Western Wood-Pewee	*Contopus sordidulus*
Eastern Wood-Pewee	*Contopus virens*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Acadian Flycatcher	*Empidonax virescens*
Alder Flycatcher	*Empidonax alnorum*
Willow Flycatcher [FE** SE** AY BCC]	*Empidonax traillii*
Least Flycatcher	*Empidonax minimus*
Hammond's Flycatcher	*Empidonax hammondii*
Gray Flycatcher	*Empidonax wrightii*
Dusky Flycatcher	*Empidonax oberholseri*
Cordilleran Flycatcher	*Empidonax occidentalis*
Black Phoebe	*Sayornis nigricans*
Vermillion Flycatcher	*Pyrocephalus rubinus*
White-eyed Vireo	*Vireo griseus*
Bell's Vireo [AR BCC]	*Vireo bellii*
Black-capped Vireo [FE SE AR]	*Vireo atricapillus*
Gray Vireo [AR BCC]	*Vireo vicinior*
Yellow-throated Vireo	*Vireo flavifrons*
Plumbeous Vireo	*Vireo plumbeus*
Cassin's Vireo	*Vireo cassinii*
Blue-headed Vireo	*Vireo solitaries*
Hutton's Vireo	*Vireo huttoni*
Warbling Vireo	*Vireo gilvus*
Philadelphia Vireo	*Vireo philadelphicus*
Red-eyed Vireo	*Vireo olivaceus*
Carolina Chickadee	*Parus carolinensis*
Mountain Chickadee	*Parus gambeli*
Juniper Titmouse	*Parus ridgwayi*

Tufted Titmouse	*Parus bicolor*
Black-crested Titmouse	*Parus sennitti*
Verdin BCC	*Auriparus flaviceps*
Bushtit	*Psaltriparus minimus*
Red-breasted Nuthatch	*Sitta canadensis*
White-breasted Nuthatch	*Sitta carolinensis*
Pygmy Nuthatch	*Sitta pygmaea*
Brown-headed Nuthatch	*Sitta pusilla*
Brown Creeper	*Certhia americana*
Cactus Wren	*Campylorhynchus brunneicapillus*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
Carolina Wren	*Thryothorus ludovicianus*
Bewick's Wren	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes troglodytes*
Sedge Wren BCC	*Cistothorus platensis*
Marsh Wren	*Cistothorus palustris*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Black-tailed Gnatcatcher	*Polioptila melanura*
Eastern Bluebird	*Sialia sialis*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Veery	*Catharus fuscescens*
Gray-cheeked Thrush	*Catharus mimimus*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
Wood Thrush AY	*Hylocichla mustelina*
Gray Catbird	*Dumetella carolinensus*
Sage Thrasher	*Oreoscoptes montanus*
Brown Thrasher	*Toxostoma rufum*
Long-billed Thrasher	*Toxostoma longirostre*
Curve-billed Thrasher BCC	*Toxostoma curvirostre*
Crissal Thrasher	*Toxostoma dorsal*
Phainopepla	*Phainopepla nitens*
Blue-winged Warbler AY	*Vermivora pinus*
Golden-winged Warbler AR	*Vermivora chrysoptera*
Tennessee Warbler	*Vermivora peregrine*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Virginia's Warbler AY BCC	*Vermivora virginiae*
Colima Warbler AY BCC	*Vermivora crissalis*
Lucy's Warbler AY	*Vermivora luciae*
Northern Parula	*Parula americana*
Tropical Parula ST BCC	*Parula pitiayumi*
Yellow Warbler BCC*	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow-rumped Warbler	*Dendroica coronate*
Black-throated Gray Warbler	*Dendroica nigrescens*
Black-throated Green Warbler	*Dendroica virens*
Townsend's Warbler	*Dendroica townsendi*
Hermit Warbler AY	*Dendroica occidentalis*
Blackburnian Warbler	*Dendroica fusca*
Yellow-throated Warbler	*Dendroica dominica*
Grace's Warbler AY BCC	*Dendroica graciae*
Pine Warbler	*Dendroica pinus*
Prairie Warbler AY	*Dendroica discolor*
Palm Warbler	*Dendroica palmarum*
Bay-breasted Warbler AY	*Dendroica castanea*
Blackpoll Warbler	*Dendroica striata*
Cerulean Warbler AY	*Dendroica cerulea*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*

Prothonotary Warbler [AY BCC]	*Protonotaria citrea*
Worm-eating Warbler	*Helmitheros vermivorus*
Swainson's Warbler [AY BCC]	*Limnothylpis swainsonii*
Ovenbird	*Seiurus aurocapillus*
Northern Waterthrush	*Seiurus noveboracensis*
Louisiana Waterthrush	*Seiurus motacilla*
Kentucky Warbler [AY]	*Oporornis formosus*
Mourning Warbler	*Oporornis philadelphia*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Hooded Warbler	*Wilsonia citrina*
Wilson's Warbler	*Wilsonia pusilla*
Canada Warbler [AY]	*Wilsonia canadensis*
Painted Redstart [AY]	*Myioborus pictus*
Yellow-breasted Chat	*Icteria virens*
Hepatic Tanager	*Piranga flava*
Summer Tanager [BCC]	*Piranga rubra*
Scarlet Tanager	*Piranga olivacea*
Western Tanager	*Piranga ludoviciana*
Olive Sparrow	*Arremonops rufivirgatus*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
Eastern Towhee	*Pipilo erythrophthalmus*
Canyon Towhee	*Pipilo fuscus*
Cassin's Sparrow [BCC]	*Aimophila cassinii*
Bachman's Sparrow [ST AR]	*Aimophila aestivalis*
Botteri's Sparrow [ST BCC]	*Aimophila botterii*
Rufous-crowned Sparrow [BCC]	*Aimophila ruficeps*
American Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Clay-colored Sparrow	*Spizella pallida*
Brewer's Sparrow [AY]	*Spizella breweri*
Field Sparrow	*Spizella pusilla*
Black-chinned Sparrow [AR BCC]	*Spizella atrogularis*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Black-throated Sparrow	*Amphispiza bilineata*
Sage Sparrow [AY]	*Amphispiza belli*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow [BCC]	*Ammodramus savannarum*
Henslow's Sparrow [AR BCC]	*Ammodramus henslowii*
Le Conte's Sparrow [AR BCC]	*Ammodramus leconteii*
Nelson's Sharp-tailed Sparrow [AY BCC]	*Ammodramus nelsoni*
Seaside Sparrow [AR BCC]	*Ammodramus maritimus*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Harris's Sparrow [BCC]	*Zonotrichia querula*
Dark-eyed Junco	*Junco hyemalis*
Lapland Longspur	*Calcarius lapponicus*
Smith's Longspur [AY BCC]	*Calcarius pictus*
Chestnut-collared Longspur [AY BCC]	*Calcarius ornatus*
Pyrrhuloxia	*Cardinalis sinuatus*
Blue Grosbeak	*Guiraca caerulea*
Lazuli Bunting	*Passerina amoena*
Indigo Bunting	*Passerina cyanea*
Varied Bunting [AY BCC]	*Passerina versicolor*
Painted Bunting [AY BCC]	*Passerina ciris*
Orchard Oriole [BCC]	*Icterus spurius*
Hooded Oriole [BCC]	*Icterus cucullatus*
Altamira Oriole [BCC]	*Icterus gularis*
Audubon's Oriole [AY BCC]	*Icterus graduacauda*
Pine Siskin	*Carduelis pinus*

F = Federal, **S** = State, **E** = Endangered, **T** = Threatened, **AY/AR** - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern, **BCC** = Birds of Conservation Concern (USFWS 2008)
*****Subspp. a*ttwateri* ****** Subspp. *extimus* # Subspp. *sonorana*

Table C-3. Common and scientific names are given for the 193 bird species that are infrequently or accidentally seen in Texas (does not include extinct species). Some of these species have the potential of being the focus of a bird damage management project. Shaded species will not be or are not likely to ever be involved in a bird damage management project. These species are not discussed in the EA because they occur so infrequently or in such remote areas on the border, especially in the Lower Rio Grande Valley along the border of Texas, that it is highly unlikely in any given span of years that these would be the focus of a single bird damage management project. These are given to let the reader know that TWSP is aware of the other species potentially present in Texas.

Species	***Scientific Name***
Brant	*Branta bernicla*
Trumpeter Swan AY	*Cygnus buccinator*
Tundra Swan#	*Cygnus buccinator*
Muscovy Duck#	*Cairina moschata*
Eurasian Wigeon	*Anas penelope*
American Black Duck	*Anas rubripes*
White-cheeked Pintail	*Anas bahamensis*
Garganey	*Anas querquedula*
King Eider	*Somateria spectabilis*
Common Eider	*Somateria mollissima*
Harlequin Duck	*Histrionicus histrionicus*
Barrow's Goldeneye	*Bucephala islandica*
Masked Duck	*Oxyura dominica*
Red-throated loon#	*Gavia stellata*
Pacific Loon#	*Gavia pacifica*
Yellow-billed Loon AY	*Gavia adamsii*
Red-necked Grebe	*Podiceps grisegena*
American Flamingo	*Phoenicopterus ruber*
Cory's Shearwater	*Calonectris diomedea*
Yellow-nosed Albatross	*Diomedea chlororhynchos*
Black-capped Petrel AR	*Pterodroma hasitata*
Stejneger's Petrel	*Pterodroma longirostris*
White-chinned Petrel	*Procellaria aequinoctialis*
Greater Shearwater AY	*Puffinus gravis*
Sooty Shearwater AY	*Puffinus griseus*
Manx Shearwater AY	*Puffinus puffinus*
Wilson's Storm-Petrel	*Oceanites oceanicus*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Band-rumped Storm-Petrel# AR	*Oceanodroma castro*
Red-billed Tropicbird	*Phaethon aethereus*
White-tailed tropicbird	*Phaethon lepturus*
Blue-footed Booby	*Sula nebouxii*
Brown Booby	*Sula leucogaster*
Red-footed Booby	*Sula sula*
Jabiru	*Jabiru mycteria*
Hook-billed Kite#	*Chondrohierax uncinatus*
Snail Kite	*Rostrhamus sociabilis*
Double-toothed Kite	*Harpagus bidentatus*
Northern Goshawk	*Accpiter gentilis*
Crane Hawk	*Geranospiza caerulescens*
Common Black-Hawk# ST BCC	*Buteogallus anthracinus*
Roadside Hawk	*Buteo magnirostris*
Gray Hawk# ST	*Buteo nitidus*
Short-tailed Hawk	*Buteo brachyurus*
Great Black Hawk	*Buteogailus urubitinga*
Collared Forest-Falcon	*Micrastur semitorquatus*
Aplomado Falcon# FE SE	*Falco femoralis*
Gyrfalcon	*Falco rusticolus*
Paint-billed Crake	*Neocrex erythrops*
Spotted Rail	*Pardirallus maculates*
Bare-throated Tiger Heron	*Tigrisoma mexicanum*
Double-striped Thick-knee	*Burhinus bistriatus*
Pacific Golden-Plover	*Pluvalis fulva*

Collared Plover	*Charadrius collaris*
Northern Jacana	*Jacana spinosa*
Wandering Tattler	*Heteroscelus incanus*
Spotted Redshank	*Tringa erythropus*
Eskimo Curlew [FE SE AR]	*Numenius borealis*
Surfbird [AY]	*Aphriza virgata*
Red-necked Stint	*Calidris ruficollis*
Sharp-tailed Sandpiper	*Calidris acuminate*
Purple Sandpiper	*Calidris maritime*
Curlew Sandpiper	*Calidris ferruginea*
Black Turnstone	*Arenaria melanocephala*
Ruff	*Philomachus pugnax*
Red Phalarope	*Phalaropus fulicaria*
Bar-tailed Godwit	*Limosa lapponica*
Black-tailed Godwit	*Limosa limosa*
Amazon Kingfisher	*Chloroceryle amazona*
Black-legged Kittiwake	*Rissa tridactyla*
Black-headed Gull	*Larus ridibundus*
Little Gull	*Larus minutus*
Black-tailed Gull	*Larus crassirostris*
Heermann's Gull [AY]	*Larus heermanni*
Mew Gull	*Larus canus*
Western Gull	*Larus occidentalis*
Yellow-legged Gull	*Larus michahellis*
Iceland Gull [AY]	*Larus glaucoides*
Slaty-backed Gull	*Larus schistisagus*
Glaucous-winged Gull	*Larus glaucescens*
Great Black-backed Gull	*Larus marinus*
Kelp Gull	*Larus dominicanus*
Brown Noddy	*Anous stolidus*
Black Noddy	*Anous minutus*
Bridled Tern [# AY]	*Sterna anaethetus*
Roseate Tern [AY]	*Sterna dougallii*
Arctic Tern	*Sterna paradisaea*
Elegant Tern [AY]	*Sterna elegans*
South Polar Skua	*Stercorarius maccormicki*
Long-tailed Jaeger	*Stercorarius longicaudus*
White-crowned Pigeon [AR]	*Columba leucocephala*
Ruddy Ground Dove	*Columbina talpacoti*
Ruddy Quail-Dove	*Geotrygon montana*
Dark-billed Cuckoo	*Coccyzus melacorhyphus*
Mangrove Cuckoo [AY]	*Coccyzus minor*
Snowy Owl	*Nyctea scandiaca*
Northern Pygmy-Owl	*Glaucidium gnoma*
Mottled Owl	*Ciccaba virgatta*
Stygian Owl	*Asio stygius*
Northern Saw-whet Owl	*Aegolius acadicus*
Black Swift	*Cypseloides niger*
White-collared Swift	*Streptoprocne zonaris*
Green Violet-ear	*Colibri thalassinus*
Green-breasted Mango	*Anthracothorax prevostii*
Broad-billed Hummingbird [#]	*Cynanthus latirostris*
White-eared Hummingbird	*Hylocharis leucotis*
Berylline Hummingbird	*Amazilia beryllina*
Violet-crowned Hummingbird	*Amazilia violaceps*
Blue-throated Hummingbird [# AY]	*Lampornis clemenciae*
Magnificent Hummingbird [#]	*Eugenes fulgens*
Lucifer Hummingbird [# BCC]	*Calothorax lucifer*
Anna's Hummingbird [#]	*Calypte anna*
Costa's Hummingbird [AY]	*Calypte costae*
Calliope Hummingbird [# AY]	*Stellula calliope*
Allen's Hummingbird [# AY]	*Selasphorus sasin*
Amethyst-throated Mountain Gem	*Lampornis amethystinus*
Elegant Trogon	*Trogon elegans*
Lewis's Woodpecker [# AR BCC]	*Melanerpes lewis*
Williamson's Sapsucker [# AY]	*Sphyrapicus thyroideus*
Red-breasted Sapsucker	*Sphyrapicus ruber*
Red-cockaded Woodpecker [# FE SE AR]	*Picoides borealis*
Barred Antshrike	*Thamnophilus doliatus*
Greenish Elaenia	*Myiopagis viridicata*
White-crested Elaenia	*Elaenia albiceps*

Tufted Flycatcher	*Mitrenphanes phaeocercus*
Greater Pewee	*Contopus pertinax*
Buff-breasted Flycatcher	*Empidonax fulvifrons*
Dusky-capped Flycatcher	*Myiarchus tuberculifer*
Social Flycatcher	*Myiozetetes similis*
Sulphur-bellied Flycatcher	*Myiodynastes luteiventris*
Piratic Flycatcher	*Legatus leucophaius*
Tropical Kingbird#	*Tyrannus melancholicus*
Thick-billed Kingbird AY	*Tyrannus crassirostris*
Gray Kingbird	*Tyrannus dominicensis*
Fork-tailed Flycatcher	*Tyrannus savanna*
Nutting's Flycatcher	*Mylarchus nuttingi*
Pacific-slope Flycatcher	*Empidonax difficilis*
Rose-throated Becard ST BCC	*Pachyramphus aglaiae*
Masked Tityra	*Tityra semifasciata*
Yellow-green Vireo#	*Vireo flavoviridis*
Black-whiskered Vireo	*Vireo altiloquus*
Yucatan Vireo	*Vireo magister*
Brown Jay	*Cyanocitta morio*
Clark's Nutcracker	*Nucifraga Columbiana*
Black-billed Magpie	*Pica pica*
Tamaulipas Crow	*Corvus imparatus*
Gray-breasted Martin	*Progne chalybea*
Black-capped Chickadee	*Parus atricapillus*
American Dipper	*Cinclus mexicanus*
Northern Wheatear	*Oenanthe oenanthe*
Orange-billed Nightingale-Thrush	*Catharus aurantiirostris*
Black-headed Nightingale-Thrush	*Catharus mexicanus*
Clay-colored Thrush#	*Turdus grayi*
White-throated Thrush	*Turdus assimilis*
Rufous-backed Robin	*Turdus rufopalliatus*
Varied Thrush AY	*Ixoreus naevius*
Aztec Thrush	*Ridgwayia pinicola*
Black Catbird	*Melanoptila glabrirostris*
Blue Mockingbird	*Melanotis caerulescens*
Bohemian Waxwing	*Bombycilla garrulous*
Gray Silky-Flycatcher	*Ptilogonys cinereus*
Olive Warbler	*Peucedramus laeniatus*
Red-necked Grebe	*Podiceps grisegena*
Connecticut Warbler	*Oporornis agilis*
Golden-cheeked Warbler	*Setophaga chrysoparia*
Gray-crowned Yellowthroat	*Geothlypis poliocephala*
Red-faced Warbler# AY BCC	*Cardellina rubrifrons*
Slate-throated Redstart	*Myioborus miniatus*
Fan-tailed Warbler	*Euthlypis lachrymose*
Golden-crowned Warbler	*Basileuterus culicivorus*
Rufous-capped Warbler	*Basileuterus rufifrons*
Flame-colored Tanager	*Piranga bidentata*
Yellow-faced Grassquit	*Tiaris olivaceus*
Baird's Sparrow# AR BCC	*Ammodramus bairdii*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Gray-crowned Rosy-finch	*Leucosticte tephrocotis*
Yellow-eyed Junco	*Junco phaeonotus*
Snow Bunting	*Plectrophenax nivalis*
Crimson-collared Grosbeak	*Rhodothraupis celaeno*
Blue Bunting	*Cyanocompsa parellina*
Shiny Cowbird	*Molothrus bonariensis*
Black-vented Oriole	*Icterus wagleri*
Streaked-backed Oriole	*Icterus pustulatus*
Pine Grosbeak	*Pinicola enucleator*
Yellow Grosbeak	*Pheucticus chrysopeplus*
White-winged Crossbill	*Loxia leucoptera*
Common Redpoll	*Carduelis flammea*
Lawrence's Goldfinch AY	*Carduelis lawrencei*
Evening Grosbeak	*Coccothraustes vespertinus*
Morelet's Seedeater	*Sporophila morelleti*
Red-legged Honeycreeper	*Cyanerpes cyaneus*
Yellow-faced Grasquit	*Tiaris olivaceus*

(I) - Introduced Species, **F** = Federal, **S** = State, **E** = Endangered, **T** = Threatened, **AY/AR** - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern, **BCC** = Birds of Conservation Concern (USFWS 2008)
- Rare species in Texas that are not TBRC (2008) review species, but restricted to small areas of the state or outside their normal range.

APPENDIX D
THREATENED AND ENDANGERED SPECIES THAT ARE FEDERALLY LISTED IN THE STATE OF TEXAS

Table D-1: Federal and stated listed avian T&E species in Texas and potential of them to be targeted in bird damage management (BDM) or the potential impact as a non-target species in bird damage management. The TWSP has determined implementation of the alternatives would have no effect on T&E species in Texas. If the TWSP receives a request for assist that may impact a T&E species, including impacts that could be beneficial to a threatened or endangered species (*e.g*., reducing predation risks), the TWSP would consult with the USFWS and/or the National Marine Fisheries Service as required by the ESA.

Species	***Scientific Name***	**Status**	**Locale**	**BDM Target**	**Protected by BDM**	**BDM Non-target**
Attwater's Greater Prairie-Chicken	*Tympanuchus cupido attwateri*	FE SE	Southeast	0	+ N P	0
Reddish Egret	*Egretta rufescens*	ST	Coast	A/S Aq P	0	- F
White-faced Ibis	*Plegadis chihi*	ST	Statewide	A/S	0	- F
Wood Stork	*Mycteria americana*	ST	Coast, East	A/S Aq	0	- F
Swallow-tailed Kite	*Elanoides forficatus*	ST	Coast	A	0	- F
Common Black-Hawk	*Buteogallus anthracinus*	ST	Big Bend	A	0	- F
Northern Gray Hawk	*Buteo nitidus maximus*	ST	Extreme South	A	0	- F
White-tailed Hawk	*Buteo albicaudatus*	ST	South	A L	0	- F R
Zone-tailed Hawk	*Buteo albonotatus*	ST	South, West	A/S L	0	- F R
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	FE SE	Extreme South	A	0	- F
American Peregrine Falcon	*Falco peregrinus anatum*	ST	Statewide	A L	0	- F
Whooping Crane	*Grus americana*	FE SE	Central, Coast	A/S Aq	0	- F T
Piping Plover	*Charadrius melodus*	FT ST	Statewide	A/S	+ N	- F M
Eskimo Curlew	*Numenius borealis*	FE SE	Central	0	0	0
Rufa Red Knot	*Calidris canutus rufa*	FT ST	Statewide	A/S	0	- F M
Sooty Tern	*Lasiurus fucata*	ST	Coast	A/S	+ N	- F
Interior Least Tern	*Sterna antillarum athalassos*	FE SE	Statewide	A/S Aq	+ N	- F M
Red-crowned Parrot	*Amazona viridigenalis*	ST	Extreme South	A	0	0
Golden-cheeked Warbler	*Setophaga chrysoparia*	FE SE	West	0	0	0
Cactus Ferruginous Pygmy-Owl	*Glaucidium brasilianum cactorum*	ST	Extreme South	0	0	0
Mexican Spotted Owl	*Strix occidentalis lucida*	FT ST	Extreme West	0	0	0
Red-cockaded Woodpecker	*Picoides borealis*	FE SE	Extreme East	P	0	0
Northern Beardless-Tyrannulet	*Camptostoma imberbe*	ST	Extreme South	0	0	0
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE SE	West	0	+ C	0
Rose-throated Becard	*Pachyramphus aglaiae*	ST	Extreme South	0	0	0
Black Rail	*Laterllus jamaicenis*	FC ST	Coast, East	A	0	0
Tropical Parula	*Parula pitiayumi nigrilora*	ST	Extreme South	0	+ C	0
Bachman's Sparrow	*Aimophila aestivalis*	ST	Extreme East	0	0	0
Texas/Arazona Botteri's Sparrow	*Aimophila botterii texana/arizonae*	ST	X South/West	0	0	0

STATUS
F - Federal
S - State
E - Endangered
T - Threatened
C - Candidate
0 – Not Targeted

BDM Target
A – Airport
Aq – Aquaculture
L – Livestock/Poultry
P – Property
S – Toxic Spill (e.g., oil)

BDM to Protect
C – Cowbird Nest Parasitism
N – Egg/Nestling Depredation
P – Predation Adults/Poults
0 - none
(+) - Positive

BDM - Nontarget
F –Frightening Devices
M – Mist Nets
R – Raptor Traps
T - Toxicants
0 – No Impact

Table D-2. Federal and State listed mammalian T&E species in Texas (land mammals only) and the potential impact as a nontarget species from TWSP bird damage management.

Species	*Scientific Name*	Status	Locale	BDM Impact
Texas Kangaroo Rat	*Dipodomys elator*	ST	North Central	0
Palo Duro Mouse	*Peromyscus truei comanche*	ST	Panhandle	0
Coues' Rice Rat	*Orozomys couesi aquaticus*	ST	Extreme South	0
Mexican Long-nosed Bat	*Leptonycteris nivalis*	FE SE	Big Bend	0
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	ST	Extreme East	- M
Spotted Bat	*Euderma maculatum*	ST	Big Bend	- M
Ocelot	*Leopardus pardalis*	FE SE	South	0
Jaguarundi	*Herpailurus yagouaroundi cacomitli*	FE SE	*Extreme South	0
Jaguar	*Panthera onca*	FE SE	*South	0
Mexican-Gray/Red Wolf	*Canis lupus baileyi/rufus*	FE SE	* West/East	0
Black bear	*Ursus Americana*	ST	West	0
Louisiana Black Bear	*Ursus americana luteolus*	ST	Extreme East	0
Tawny-bellied Cotton Rat	*Sigmodon europaeus*	ST	Big Bend	0
White-nosed Coati	*Nasua narica*	ST	Rio Grande Valley	0

STATUS
F - Federal
S - State
E - Endangered
T - Threatened
C – Candidate

BDM Nontarget Impact
F –Frightening Devices
M – Mist Nets
0 – No Impact
(-) – Negative

APPENDIX E
BIRD STRIKES IN THE UNITED STATES AND TEXAS

Bird strikes in the United States are reported to the Federal Aviation Administration on a form. Most bird strikes are not reported. However, pilots have become more aware of the importance of bird strike reporting and are doing so more frequently. In the 1990s, it was assumed that, at most, about 20% of the strikes were reported. However, pilots and airports have been reporting with more frequency. As a result, more air strikes are being reported, but increases in air traffic and several bird species populations have increased strikes, and the numbers being reported today far exceed the number reported in the 1990s. Table F-1 has all of the strikes reported in the United States and Texas from 2017 through 2019.

Table F-1. Bird strikes at airfields in the United States and Texas as reported to the Federal Aviation Administration from 2017 through 2019. The species included are only those that are commonly found in Texas. The other known categories include those species not found in Texas where the species was known such as “Other Duck” which includes American Black Duck, Long-tailed Duck, and others not commonly found in Texas. A total of 82,516 and 6,601 were recorded in the United States and Texas with about 50% of strikes from known species.

SPECIES	UNITED STATES					TEXAS				
	Number of Strikes	% of Strikes With Known Sp.	Damaging Strikes	% Strikes With Reported Damage	# Strikes With No Damage Data	Number of Strikes	% of Strikes With Known Sp.	Damaging Strikes	% Strikes With Reported Damage	# Strikes With No Damage Data
Waterfowl (Geese, Swans, Ducks)										
Black-bellied Whistling-Duck	-	-	-	-	-	11	35.5%	3	27%	2
Greater White-fronted Goose	15	2.0%	11	73%	6	-	-	-	-	-
Snow Goose	30	3.5%	15	50%	9	1	3.2%%	1	100%	1
Canada/Cackling Goose	204	24%	80	39%	59	3	9.7%	1	33%	0
Other Goose (Brant)	11	1.3%	5	45%	3	-	-	-	-	-
Unknown Goose	38	4.3%	14	37%	9	1	3.2%	0	0	0
All Swans	70	0.8%	4	57%	2	-	-	-	-	-
Wood Duck	18	2.0%	3	17%	1	-	-	-	-	-
Gadwall	15	1.7%	7	47%	5	-	-	-	-	-
American Wigeon	17	2.0%	10	59%	9	-	-	-	-	-
Mallard	195	22.5%	26	13%	15	4	13.0%	2	50%	2
Mottled Duck	4	0.5%	2	50%	2	-	-	-	-	-
Blue-winged Teal	27	3.1%	9	33%	7	1	3.2%	1	100%	0
Cinnamon Teal	2	0.2%	1	50%	1	-	-	-	-	-
Northern Shoveler	32	3.7%	16	50%	8	-	-	-	-	-
Northern Pintail	51	5.9%	24	47%	17	3	9.7%	1	33%	2
Green-winged Teal	23	2.6%	2	9%	11	-	-	-	-	-
Canvasback	4	0.5%	4	100%	2	-	-	-	-	-
Redhead	12	1.4%	9	75%	5	-	-	-	-	-
Ring-necked Duck	7	0.8%	2	29%	-	-	-	-	-	-
Greater Scaup	5	0.6%	-	50%	1	-	-	-	-	-
Lesser Scaup	16	1.8%	8	50%	6	1	3.2%	0	0	1
Surf Scoter	1	0.1%	0	N/A	0	-	-	-	-	-
White-winged Scoter	1	0.1%	1	100%	0	-	-	-	-	-
Long-tailed Duck	1	0.1%	0	-	0	-	-	-	-	-
Bufflehead	8	0.9%	2	25%	2	-	-	-	-	-
Common Goldeneye	2	0.2%	0	-	0	-	-	-	-	-
Hooded Merganser	4	0.5%	1	33%	1	-	-	-	-	-
Common Merganser	4	0.5%	0	-	0	-	-	-	-	-
Red-breasted Merganser	1	0.1%	0	-	0	-	-	-	-	-
Ruddy Duck	17	2.0%	5	13%	2	3	9.7%	0	0	0
Other Duck*	17	2.0%	2	12%	2	-	-	-	-	-
Unknown Ducks	78	9.0%	20	26%	13	3	9.7%	1	33%	1
Waterfowl Total	**868**	**91.0%**	**282**	**33%**	**184**	**31**	**90.3%**	**11**	**37%**	**9**
Gallinaceous Bird (Quail, Grouse, Turkey and Introduced Pheasant, Francolin, and Partridge)										
Northern Bobwhite	2	6%	0	0.00%	2	-	-	-	-	-
Unknown Quail	1	3%	0	N/A	0	1	-	-	-	1
Ring-necked Pheasant	11	34%	0	0.00%	0	-	-	-	-	-
Other Grouse*	16	50%	0	N/A	0	-	-	-	-	-
Gray Partridge	7	22%	0	N/A	0	-	-	-	-	-
Unknown Partridges	1	3%	0	N/A	0	1	-	-	-	-
Wild Turkey	18	56%	5	27%	2	-	-	-	-	-

Unknown Turkeys	2	6%	1	50%	1	-	-	-	-	-
Gallinaceous Bird Total	**32**	**87%**	**6**	**19%**	**5**	**2**	**-**	**-**	**-**	**1**
Waterbirds (Loons, Grebes, Pelicans, Cormorants, Pelagics, Kingfishers)										
Common Loon	10	7.5%	4	40%	1	-	-	-	-	-
Pacific Loon	1	1%	0	0%	0	-	-	-	-	-
Red-throated Loon	5	4%	3	60%	3	-	-	-	-	-
Pied-billed Grebe	6	4%	1	17%	1	-	-	-	-	-
Horned Grebe	5	4%	2	40%	1	-	-	-	-	-
Eared Grebe	9	7%	4	45%	2	-	-	-	-	-
Western Grebe	11	8%	4	36%	3	-	-	-	-	-
Clark's Grebe	2	1.5%	1	50%	1	-	-	-	-	-
Red-necked Grebe (Other)	1	1%	1	100%	1	-	-	-	-	-
Unknown Grebe	2	1.5%	2	100%	1	-	-	-	-	-
Pelagic Birds*	5	4%	0	N/A	0	-	-	-	-	-
American White Pelican	4	3%	1	25%	1	1	0.03%	0	0%	0
Brown Pelican	12	9%	3	25%	2	-	-	-	-	-
Unknown Pelicans	5	4%	0	0%	0	-	-	-	-	-
Double-crested Cormorant	37	27%	8	22%	4	-	-	-	-	-
Anhinga	13	10%	7	54%	6	1	0%	1	100%	1
Other Pelecaniformes*	12	9%	4	33%	1	-	-	-	-	-
Belted Kingfisher	4	3%	0	0%	0	-	-	-	-	-
Waterbird Total	**136**	**0.61%**	**40**	**29%**	**27**	**2**	**%**	**1**	**50%**	**1**
Wading Birds (Herons, Egrets, Ibises, Storks, Bitterns, Rails, Gallinules, Cranes)										
Wood Stork	4	.6%	1	25%	1	-	-	-	-	-
American Bittern	5	.8%	1	20%	1	-	-	-	-	-
Least Bittern	4	.6%	0	0%	0	-	-	-	-	-
Great Blue Heron	91	15%	14	15%	11	8	24%	2	25%	1
Great Egret	30	5%	0	0%	0	3	9%	0	0%	0
Snowy Egret	11	2%	2	18%	2	-	-	-	-	-
Tricolored Heron	2	.3%	0	0%	0	-	-	-	-	-
Little Blue Heron	8	1%	1		1	1	-	0	0%	0
Cattle Egret	160	27%	8	5%	5	7	21%	1	14%	1
Green Heron	16	3%	2	13%	2	1	3%	0	0%	0
Black-Crowned Night Heron	24	4%	0	0%	0	-	-	-	-	-
Yellow-crowned Night-Heron	25	4%	0	0%	0	8	24%	0	0%	0
Unknown Egret/Heron	32	5%	2	6%	2	1	3%	0	0%	0
White Ibis	1	.2%	0	0%	0	-	-	-	-	-
White-faced Ibis	6	1%	3	50%	1	-	-	-	-	-
Unknown Ibises	2	.3%	0	0%	0	-	-	-	-	-
Roseate Spoonbill	1	.2%	0	0%	0	-	-	-	-	-
Sora	31	5%	2	10%	1	1	3%	0	0%	0
Clapper Rail	1	.2%	0	N/A	0	-	-	-	-	-
King Rail	2	.3%	0	N/A	0	-	-	-	-	-
Virginia Rail	8	1%	0	N/A	0	1	3%	0	N/A	0
Unknown Rails	5	.8%	0	0%	0	-	-	-	-	-
Common Gallinule	1	.2%	0	0%	0	-	-	-	-	-
American Coot	93	16%	19	20%	14	2	6%	1	50%	1
Sandhill Crane	29	5%	8	28%	6	-	-	-	-	-
Total Wading Birds	**592**	**11%**	**63**	**10%**	**46**	**33**	**97%**	**4**	**12%**	**3**
Raptors (Vultures, Kites, Eagles, Harriers, Accipiters, Hawks, Falcons, Owls, Shrikes)										
Turkey Vulture	202	5%	83	41%	63	22	8%	10	45%	8
Black Vulture	76	2%	49	64%	39	7	3%	6	86%	1
Osprey	109	3%	29	27%	20	1	.4%	0	-98	0
Swallow-tailed Kite	1	.02%	-	-	-	-	-	-	-	-
White-tailed Kite	33	.8%	-	-	-	-	-	-	-	-
Mississippi Kite	6	.1%	-	-	-	1	.4%	0	0%	0
Bald Eagle	68	1.5%	22	32%	18	1	.4%	1	100%	1
Golden Eagle	6	.14%	2	33%	0	-	-	-	-	-
Northern Harrier	34	.8%	0	0%	0	3	1%	0	0%	0
Sharp-shinned Hawk	9	.2%	0	0%	0	2	1%	0	0%	0
Cooper's Hawk	41	.96%	3	7%	2	6	2%	0	0%	0
Northern Goshawk	1	%	0	-	0	-	-	-	-	-
Harris's Hawk	3	.07%	0	-	0	-	-	-	-	-
Red-shouldered Hawk	21	.5%	1	5%	1	3	1%	0	0%	0
Broad-winged Hawk	10	.2%	5	50%	4	2	1%	1	50%	1
Swainson's Hawk	39	.91%	3	8%	2	10	4%	0	0%	0
White-tailed Hawk	3	.07%	0	0	0	2	1%	0	0%	0
Red-tailed Hawk	693	16%	125	18%	61	29	11%	4	14%	2
Ferruginous Hawk	16	.27%	0	0%	0	-	-	-	-	-
Rough-legged Hawk	22	.51%	4	18%	3	-	-	-	-	-
Unknown Hawk	131	3%	31	24%	16	19	7%	5	26%	4
American Kestrel	1637	39%	12	1%	8	83	31%	1	1%	0

Merlin	38	.89%	0	-	0	-	-	-	-	-
Peregrine Falcon	114	3%	4	4%	2	2	1%	0	0%	0
Prairie Falcon	6	.14%	0	-	0	-	-	-	-	-
Crested Caracara	7	.16%	3	43%	3	5	2%	2	40%	2
Unknown Falcon	10	.23%	1	10%	0	1	.4%	1	100%	0
Barn Owl	351	8%	10	3%	6	28	10%	3	11%	2
Flammulated Owl	1	.02%	0	-	0	-	-	-	-	-
Western Screech-Owl	1	.02%	0	-%	0	-	-	-	-	-
Great Horned Owl	76	2%	7	10%	5	5	2%	0	0%	0
Burrowing Owl	93	2%	0	-	0	24	9%	0	0%	0
Barred Owl	10	.23%	0	-	0	-	-	-	-	-
Long-eared Owl	2	.04%	0	-	0	-	-	-	-	-
Short-eared Owl	156	4%	4	3%	4	1	.4%	0	0%	0
Northern Saw-whet Owl	2	.04%	1	50%	1	-	-	-	-	-
Other Owl*	112	3%	10	9%	8	-	-	-	-	-
Unknown Owl	43	1%	1	2%	0	3	1%	0	0%	0
Loggerhead Shrike	22	.51%	0	-	0	1	.4%	0	0%	0
Raptor Total	**4,205**	**95%**	**410**	**10%**	**265**	**261**	**98%**	**34**	**13%**	**21**
Shorebirds (Plovers, Sandpipers, Curlews, Godwits, Turnstones, Snipe, Phalaropes)										
Black-bellied Plover	34	1%	1	3%	1	1	%	0	0%	1
American Golden-Plover	48	2%	0	0%	0	8	%	0	0%	0
Wilson’s Plover	2	.06%	0	0%	0	-	-	-	-	-
Semipalmated Plover	25	.86%	0	0%	0	-	-	-	-	-
Piping Plover	2	.06%	0	0%	0	-	-	-	-	-
Killdeer	2016	69%	10	0.5%	5	170	0%	0	0%	0
Unknown Plover	28	.9%	0	0%	0	-	-	-	-	-
American Oystercatcher	7	.24%	0	0%	0	1	%	0	0%	0
Black-necked Stilt	3	.10%	0	0%	0	-	-	-	-	-
American Avocet	4	.13%	0	0%	0	-	-	-	-	-
Spotted Sandpiper	13	.44%	0	0%	0	1	0%	0	0	0
Solitary Sandpiper	7	%	0	0%	0	-	-	-	-	-
Stilt Sandpiper	1	.008%	0	N/A	0	1	%	0	N/A	0
Greater Yellowlegs	6	.20%	0	0%	0	2	0%	0	0%	0
Willet	5	.17%	0	0%	0	-	-	-	-	-
Lesser Yellowlegs	4	.13%	2	50%	1	-	-	-	-	-
Upland Sandpiper	73	3%	1	1%	1	40	%	1	3%	0
Whimbrel	2	.07%	0	0%	0	-	-	-	-	-
Long-billed Curlew	2	.07%	0	0%	0	-	-	-	-	-
Hudsonian Godwit	1	.008%	0	0%	0	-	-	-	-	-
Marbled Godwit	2	.06%	0	0%	0	-	-	-	-	-
Ruddy Turnstone	6	.20%	0	0%	0	-	-	-	-	-
Sanderling	10	.34%	0	0%	0	1	%	0	0%	0
Semipalmated Sandpiper	37	1%	1	3%	0	-	-	-	-	-
Western Sandpiper	71	2%	1	1%	1	1	%	0	0%	0
Least Sandpiper	77	3%	1	1%	0	4	%	0	0%	0
White-rumped Sandpiper	2	.07%	0	0%	0	-	-	-	-	-
Baird's Sandpiper	15	.51%	1	7%	1	6	0%	0	0	0
Pectoral Sandpiper	10	.34%	3	30%	1	-	-	-	-	-
Dunlin	22	.75%	2	9%	2	-	-	-	-	-
Buff-breasted Sandpiper	17	.58%	0	0%	0	4	%	0	0%	0
Unknown Sandpiper	43	1%	1	2%	1	1	%	0	0%	0
Short-billed Dowitcher	7	.24%	2	29%	2	-	-	-	-	-
Long-billed Dowitcher	3	.10%	0	0%	0	1	%	0	0%	0
Wilson’s Snipe	50	2%	4	8%	3	3	%	1	33%	0
American Woodcock	49	2%	2	4%	2	-	-	-	-	-
Wilson’s Phalarope	8	.27%	0	0%	0	1	%	0	0%	0
Other Shorebird*	179	6%	2	1%	1	-	-	-	-	-
Unknown Shorebird	10	.34%	0	0%	0	-	-	-	-	-
Shorebird Total	**2901**	**97%**	**34**	**1%**	**22**	**246**	**99%**	**2**	**9%**	**1**
Larids (Gulls, Terns, Skimmers, Jaegers)										
Bonaparte's Gull	24	1%	1	4%	1	-	-	-	-	-
Laughing Gull	159	8%	1	0.6%	1	18	26%	0	0%	0
Franklin's Gull	58	3%	7	12%	7	17	25%	4	24%	4
Ring-billed Gull	259	13%	16	6%	8	5	7%	1	20%	1
California Gull	61	3%	6	10%	5	-	-	-	-	-
Herring Gull	253	13%	18	7%	12	1	1%	0	0%	0
Glaucous Gull	22	1%	2	9%	0	-	-	-	-	-
Other Gull*	84	4%	7	8%	3	-	-	-	-	-
Unknown Gulls	484	25%	43	9%	33	16	23%	1	6%	0
Least Tern	5	.25%	0	0%	0	-	-	-	-	-
Gull-billed Tern	2	.10%	0	0%	0	-	-	-	-	-
Caspian Tern	15	.77%	1	7%	0	-	-	-	-	-
Black Tern	4	.20%	0	0%	0	-	-	-	-	-

Common Tern	6	.30%	0	0%	0	-	-	-	-	-
Forster's Tern	6	.30%	0	N/A	0	-	-	-	-	-
Royal Tern	3	.15%	0	N/A	0	1	1%	1	100%	0
Sooty Tern	1	.05%	0	N/A	0	-	-	-	-	-
Black Skimmer	5	.25%	0	N/A	0	-	-	-	-	-
Parasitic Jaeger	1	.05%	0	N/A	0	-	-	-	-	-
Other Tern/Larid*	3	.15%	0	0%	0	-	-	-	-	-
Unknown Gull/Tern	488	25%	53	11%	0	11	16%	1	9%	1
Larid Total	**1,943**	**%**	**155**	**8%**	**70**	**69**	**84%**	**8**	**12%**	**6**
Invasive Species (Introduced Parrots, Doves, Starlings, Sparrows)										
Budgerigar	1	.08%	0	0%	0	-	-	-	-	-
Feral Rock Pigeon	25	2%	0	N/A	0	4	10%	0	N/A	0
Eurasian Collared-Dove	28	2%	3	11%	3	1	3%	0	N/A	0
Spotted Dove	43	4%	0	0%	0	-	-	-	-	-
Unknown Pigeon/Dove	12	1%	0	N/A	0	2	5%	0	N/A	0
European Starling	889	77%	10	11%	4	19	48%	0	N/A	0
House Sparrow	120	10%	0	N/A	0	14	35%	0	N/A	0
Invasive Parrots	6	.51%	0	N/A	0	-	-	-	-	-
HI Invasive Passerines	34	3%	2	6%	2	-	-	-	-	-
Egyptian Goose	2	.2%	0	N/A	0	-	-	-	-	-
Invasive Spp. Total	**1160**	**1.3%**	**15**	**1%**	**9**	**40**	**95%**	**0**	**N/A%**	**0**
Natives Doves and Pigeons										
Band-tailed Pigeon	7	.23%	2	28%	2	-	-	-	-	-
White-winged Dove	38	1%	0	N/A	0	24	4%	0	N/A	0
Mourning Dove	2,788	93%	42	2%	32	503	88%	3	.6%	2
Common Ground-Dove	15	.50%	0	N/A	0	-	-	-	-	-
Unknown Dove	128	4%	2	2%	1	44	8%	0	N/A	0
Native Dove Total	**2,976**	**96%**	**46**	**2%**	**35**	**571**	**92%**	**3**	**.5%**	**2**
Aerialists (Nightjars, Swifts, Swallows, Hummingbirds)										
Common Nighthawk	304	7%	3	1%	3	40	14%	0	N/A	0
Lesser Nighthawk	10	.21%	0	N/A	0	3	1%	0	N/A	0
Common Poorwill	4	.08%	0	N/A	0	-	-	-	-	-
Chuck-will's-widow	6	.13%	1	16%	1	1	.35%	0	N/A	0
Whip-poor-will	7	.15%	0	N/A	0	3	1%	0	N/A	0
Nightjar	7	.15%	0	N/A	0	3	1%	0	N/A	0
Chimney Swift	473	9%	3	0.6%	1	16	6%	0	N/A	0
White-throated Swift	30	.65%	2	6%	1	-	-	-	-	-
Unknown Swift spp.	11	.23%	0	N/A	0	-	-	-	-	-
Hummingbird spp.*	51	1%	0	N/A	0	5	2%	0	N/A	0
Purple Martin	92	2%	4	4%	4	5	2%	0	N/A	0
Tree Swallow	234	5%	0	N/A	0	-	-	-	-	-
Violet-green Swallow	11	.23%	1	9%	0	-	-	-	-	-
N. Rough-winged Swallow	34	.7%	0	N/A	0	-	-	-	-	-
Bank Swallow	146	3%	0	N/A	0	5	2%	0	N/A	0
Cliff Swallow	666	14%	3	0.45%	2	110	39%	0	N/A	0
Cave Swallow	26	.56%	2	8%	2	22	8%	2	9%	2
Barn Swallow	2293	50%	14	1%	13	45	16%	0	N/A	0
Unknown Swallows	209	5%	3	1%	2	24	9%	0	N/A	0
Aerialist Total	**4614**	**10.86%**	**36**	**1%**	**29**	**282**	**8.36%**	**2**	**6%**	**2**
Other Non-passerines (Woodpeckers, Cuckoos, Roadrunners)										
Yellow-bellied Sapsucker	44	30%	5	11%	4	-	-	-	-	-
Red-naped Sapsucker	1	.68%	1	100%	1	-	-	-	-	-
Downy Woodpecker	5	3%	0	N/A	0	-	-	-	-	-
Ladder-backed Woodpecker	1	.68%	1	100	0	-	-	-	-	-
Red-bellied Woodpecker	4	3%	0	N/A	0	-	-	-	-	-
Northern Flicker	42	29%	3	7%	3	1	35%	0	N/A	0
Unknown Woodpeckers	5	3%	0	N/A	0	3	75%	0	N/A	0
Yellow-billed Cuckoo	35	24%	6	17%	3	-	-	-	-	-
Black-billed Cuckoo	6	4%	1	16%	1	-	-	-	-	-
Unknown Cuckoo / Roadrunner	1	.68%	0	N/A	0	-	-	-	-	-
Unknown Cuckoos	1	.68%	0	N/A	0	-	-	-	-	-
Other Bird Total	**145**	**96%**	**17**	**12%**	**12**	**4**	**25%**	**0**	**0%**	**0**
Grassland Species (Larks, Pipits, Longspurs, Sparrows, Meadowlarks)										
Horned Lark	1556	30%	11	1%	7	16	5%	0	N/A	0
Unknown Larks	4	.07%	0	N/A	0	-	-	-	-	-
American Pipit	105	2%	0	N/A	0	9	3%	0	N/A	0
Sprague's Pipit	1	.01%	0	N/A	0	-	-	-	-	-
Lapland Longspur	27	.51%	0	N/A	0	1	.3%	0	N/A	0
Chestnut-collared Longspur	2	.03%	0	0%	0	-	-	-	-	-
Smith's Longspur	2	.03%	0	0%	0	-	-	-	-	-

McCown's Longspur	2	.03%	0	0%	0	1	.3%	0	N/A	0
Other Longspur*	94	2%	1	1%	1	3	1%	0	N/A	0
Lark's Bunting	18	.34%	1	5%	1	6	2%	0	N/A	0
Eastern Towhee	10	.2%	0	N/A	0	-	-	-	-	-
California Towhee	2	.03%	0	N/A	0	-	-	-	-	-
Green-tailed Towhee	2	.03%	1	50%	1	-	-	-	-	-
Spotted Towhee	4	.07%	0	N/A	0	-	-	-	-	-
American Tree Sparrow	11	.20%	0	N/A	0	0	%	0	N/A	0
Baird's Sparrow	2	.03%	0	N/A	0	-	-	-	-	-
Brewer's Sparrow	12	.22%	0	N/A	0	-	-	-	-	-
Cassin's Sparrow	2	.03%	0	N/A	0	2	.69%	0	N/A	0
Clay-colored Sparrow	10	.2%	0	N/A	0	-	-	-	-	-
Chipping Sparrow	55	1%	1	2%	1	2	.69%	0	N/A	0
Golden-crowned Sparrow	24	.46%	0	N/A	0	-	-	-	-	-
Field Sparrow	12	.23%	0	N/A	0	1	.3%	0	N/A	0
Lark Sparrow	16	.30%	0	N/A	0	4	1%	0	N/A	0
LeConte's Sparrow	4	.07%	0	N/A	0	2	.69%	0	N/A	0
Vesper Sparrow	21	.40%	0	N/A	0	1	.3%	0	N/A	0
Black-throated Sparrow	1	.01%	0	N/A	0	-	-	-	-	-
Savannah Sparrow	405	8%	5	1%	5	28	10%	0	N/A	0
Grasshopper Sparrow	34	.64%	0	N/A	0	3	1%	0	N/A	0
Nelson's Sparrow	1	.01%	0	N/A	0	-	-	-	-	-
Olive Sparrow	2	.03%	0	N/A	0	1	.3%	0	N/A	0
Fox Sparrow	41	.77%	2	5%	2	-	-	-	-	-
Song Sparrow	204	4%	3	1%	2	5	1%	0	N/A	0
Lincoln's Sparrow	65	1%	3	4%	3	6	2%	0	N/A	0
Swamp Sparrow	58	1%	1	2%	0	-	-	-	-	-
White-throated Sparrow	129	2%	2	1%	1	-	-	-	-	-
Harris's Sparrow	2	.03%	0	N/A	0	-	-	-	-	-
White-crowned Sparrow	43	.81%	1	2%	1	-	-	-	-	-
Dark-eyed Junco	111	2%	0	N/A	0	1	.3%	0	N/A	0
Unknown Sparrows	433	8%	8	2%	7	42	14%	1	2%	1
Dickcissel	10	.19%	0	N/A	0	6	2%	0	N/A	0
Bobolink	14	.26%	1	7%	1	-	-	-	-	-
Eastern Meadowlark	1005	19%	10	10%	8	10	3%	0	N/A	0
Western Meadowlark	551	10%	4	1%	2	49	17%	1	2%	0
Unknown Meadowlarks	152	3%	0	N/A	0	95	32%	0	N/A	0
Grassland Species Total	**5259**	**88%**	**55**	**2%**	**43**	**294**	**53%**	**2**	**.68%**	**1**
Corvids (Ravens, Crows, Magpies, Jays)										
Blue Jay	11	9%	0	N/A	0	-	-	-	-	-
Black-billed Magpie	6	5%	0	N/A	0	-	-	-	-	-
American Crow	73	57%	4	5%	3	3	100%	1	33%	1
Common Raven	16	13%	2	12%	2	-	-	-	-	-
Unknown Ravens	1	.8%	0	N/A	0	-	-	-	-	-
Fish Crow	2	2%	0	N/A	0	-	-	-	-	-
Unknown Crow	19	15%	1	5%	1	-	-	-	-	-
Corvid Total	**128**	**84%**	**7**	**5%**	**6**	**3**	**33%**	**1**	**33%**	**1**
Woodland Birds (Vireos, Chickadees, Nuthatches, Thrushes, Waxwings, Warblers)										
Bell's Vireo	1	.04%	0	N/A	0	-	-	-	-	-
Blue-headed Vireo	12	.5%	1	8%	1	-	-	-	-	-
Cassin's Vireo	3	.1%	0	N/A	0	-	-	-	-	-
Philadelphia Vireo	5	.2%	0	N/A	0	-	-	-	-	-
Red-eyed Vireo	119	5%	4	3%	2	2	3%	0	N/A	0
Warbling Vireo	21	.8%	0	N/A	0	-	-	-	-	-
White-eyed Vireo	4	.16%	0	N/A	0	-	-	-	-	-
Yellow-throated Vireo	1	.04%	0	N/A	0	-	-	-	-	-
Black-capped Chickadee	2	.08%	0	N/A	0	1	2%	0	N/A	0
Mountain Chickadee	1	.04%	0	N/A	0	-	-	-	-	-
Red-breasted Nuthatch	4	.16%	0	N/A	0	-	-	-	-	-
Unknown Nuthatches	1	.04%	0	N/A	0	-	-	-	-	-
Golden-crowned Kinglet	31	1%	0	N/A	0	-	-	-	-	-
Ruby-crowned Kinglet	86	3%	0	N/A	0	-	-	-	-	-
Eastern Bluebird	7	.3%	0	N/A	0	-	-	-	-	-
Western Bluebird	5	.2%	0	N/A	0	-	-	-	-	-
Mountain Bluebird	9	.4%	0	N/A	0	-	-	-	-	-
Veery	25	1%	3	12%	3	-	-	-	-	-
Bicknell's Thrush	2	.08%	0	N/A	0	-	-	-	-	-
Gray-cheeked Thrush	22	.9%	0	N/A	0	-	-	-	-	-
Swainson's Thrush	204	8%	15	7%	11	3	5%	0	N/A	0
Hermit Thrush	114	5%	4	4%	3	2	3%	0	N/A	0
Wood Thrush	28	1%	3	11%	2	-	-	-	-	-
Varied Thrush	28	1%	3	11%	3	-	-	-	-	-

Unknown Thrushes	14	.6%	0	N/A	0	1	2%	0	N/A	0
American Robin	514	21%	37	7%	28	7	12%	1	14%	1
Cedar Waxwing	165	7%	2	1%	2	21	36%	0	N/A	0
Ovenbird	74	3%	2	3%	2	-	-	-	-	-
Louisiana Waterthrush	1	.04%	0	N/A	0	-	-	-	-	-
Northern Waterthrush	18	.7%	0	N/A	0	-	-	-	-	-
Black-and-white Warbler	33	1%	1	3%	1	2	3%	0	N/A	0
Bay-breasted Warbler	18	.7%	0	N/A	0	-	-	-	-	-
Blackburnian Warbler	16	.6%	0	N/A	0	-	-	-	-	-
Blackpoll Warbler	54	2%	0	N/A	0	1	2%	0	N/A	0
Black-throated Blue Warbler	30	1%	0	N/A	0	-	-	-	-	-
Black-throated Gray Warbler	2	.08%	0	N/A	0	-	-	-	-	-
Black-throated Green Warbler	18	.7%	0	N/A	0	1	2%	0	N/A	0
Blue-winged Warbler	1	.04%	0	N/A	0	-	-	-	-	-
Canada Warbler	8	.3%	0	N/A	0	-	-	-	-	-
Cape May Warbler	10	.4%	0	N/A	0	-	-	-	-	-
Chestnut-sided Warbler	13	.5%	0	N/A	0	-	-	-	-	-
Connecticut Warbler	4	.16%	0	N/A	0	-	-	-	-	-
Common Yellowthroat	86	3%	4	5%	2	1	2%	0	N/A	0
Golden-winged Warbler	1	.04%	0	N/A	0	-	-	-	-	-
Hermit Warbler	5	.2%	0	N/A	0	-	-	-	-	-
Hooded Warbler	4	.16%	0	N/A	0	-	-	-	-	-
American Redstart	50	2%	0	N/A	0	-	-	-	-	-
Kentucky Warbler	1	.04%	0	N/A	0	-	-	-	-	-
Lawrence's Warbler	2	.08%	0	N/A	0	-	-	-	-	-
MacGillivray's Warbler	11	.4%	0	N/A	0	-	-	-	-	-
Magnolia Warbler	15	.6%	0	N/A	0	-	-	-	-	-
Mourning Warbler	4	.16%	0	N/A	0	-	-	-	-	-
Nashville Warbler	22	.9%	0	N/A	0	-	-	-	-	-
Northern Parula	24	1%	0	N/A	0	-	-	-	-	-
Orange-crowned Warbler	32	1%	0	N/A	0	2	3%	0	N/A	0
Palm Warbler	45	.32%	0	N/A	0	-	-	-	-	-
Pine Warbler	8	.32%	0	N/A	0	-	-	-	-	-
Prairie Warbler	4	.16%	0	N/A	0	-	-	-	-	-
Prothonotary Warbler	2	.08%	0	N/A	0	-	-	-	-	-
Tennessee Warbler	26	1%	0	N/A	0	-	-	-	-	-
Townsend's Warbler	12	.5%	0	N/A	0	-	-	-	-	-
Wilson's Warbler	65	3%	0	N/A	0	-	-	-	-	-
Worm-eating Warbler	3	.1%	0	N/A	0	-	-	-	-	-
Yellow-breasted Chat	24	1%	1	4%	1	5	7%	0	N/A	0
Yellow-rumped Warbler	203	8%	1	0.5%	1	6	10%	0	N/A	0
Yellow-throated Warbler	9	.36%	0	N/A	0	-	-	-	-	-
Yellow-Warbler	66	3%	0	N/A	0	3	5%	0	N/A	0
Unk. New World Wood Warblers	10	.4%	0	N/A	0	-	-	-	-	-
Woodland Bird Total	**2462**	**98%**	**81**	**%**	**62**	**58**	**100%**	**1**	**1%**	**1**
Open Woodland Birds (Flycatchers, Wrens, Thrashers, Grosbeaks, Cardinal, Finches)										
Acadian Flycatcher	8	.8%	0	N/A	0	1	.7%	0	N/A	0
Alder Flycatcher	24	2%	0	N/A	0	-	-	-	-	-
Ash-throated Flycatcher	5	.5%	0	N/A	0	-	-	-	-	-
Dusky Flycatcher	1	.09%	0	N/A	0	-	-	-	-	-
Great Crested Flycatcher	16	2%	0	N/A	0	2	1%	0	N/A	0
Hammond's Flycatcher	13	1%	0	N/A	0	-	-	-	-	-
Least Flycatcher	11	1%	0	N/A	0	-	-	-	-	-
Olive-sided Flycatcher	1	.09%	0	N/A	0	-	-	-	-	-
Pacific-slope Flycatcher	30	3%	0	N/A	0	-	-	-	-	-
Scissor-tailed Flycatcher	49	5%	0	N/A	0	37	26%	0	N/A	0
Willow Flycatcher	6	.6%	0	N/A	0	-	-	-	-	-
Yellow-bellied Flycatcher	16	2%	1	6%	1	-	-	-	-	-
Unknown Tyrant Flycatchers	7	.7%	0	N/A	0	2	1%	0	N/A	0
Black Phoebe	3	.3%	0	N/A	0	-	-	-	-	-
Eastern Phoebe	22	2%	1	5%	1	5	3%	0	N/A	0
Say's Phoebe	10	1%	0	N/A	0	-	-	-	-	-
Eastern Wood-pewee	13	1%	0	N/A	0	1	.7%	0	N/A	0
Western Wood-pewee	2	.2%	0	N/A	0	-	-	-	-	-
Couch's Kingbird	2	.2%	0	N/A	0	1	.7 %	0	N/A	0
Eastern Kingbird	24	2%	0	N/A	0	2	1%	0	N/A	0
Gray Kingbird	6	.6%	0	N/A	0	1	.7%	0	N/A	0
Loggerhead Kingbird	1	.09%	0	N/A	0	-	-	-	-	-
Tropical Kingbird	1	.09%	0	N/A	0	-	-	-	-	-
Western Kingbird	95	9%	0	N/A	0	33	23%	0	N/A	0
Bewick's Wren	1	.09%	0	N/A	0	-	-	-	-	-
Cactus Wren	1	.09%	0	N/A	0	-	-	-	-	-
Carolina Wren	5	.5%	0	N/A	0	1	.7%	0	N/A	0
House Wren	20	2%	0	N/A	0	2	1%	0	N/A	0

Marsh Wren	18	2%	0	N/A	0	-	-	-	-	-
Pacific Wren	2	.2%	0	N/A	0	-	-	-	-	-
Sedge Wren	6	.6%	0	N/A	0	4	3%	0	N/A	0
Winter Wren	7	.7%	0	N/A	0	-	-	-	-	-
Unknown Wrens	15	1%	0	N/A	0	2	1%	0	N/A	0
Blue-gray Gnatcatcher	37	3%	0	N/A	0	3	2%	0	N/A	0
Gray Catbird	121	12%	4	3%	4	1	.7%	0	N/A	0
Northern Mockingbird	30	3%	0	N/A	0	10	7%	0	N/A	0
Unknown Mockingbirds	10	1%	1	10%	1	4	3%	0	N/A	0
Brown Thrasher	11	1%	1	9%	1	2	1%	0	N/A	0
Curve-billed Thrasher	1	.09%	0	N/A	0	1	.7%	0	N/A	0
Long-billed Thrasher	7	.7%	0	N/A	0	7	5%	0	N/A	0
Sage Thrasher	4	.4%	0	N/A	0	-	-	-	-	-
Scarlet Tanager	21	2%	0	N/A	0	-	-	-	-	-
Summer Tanager	4	.4%	0	N/A	0	-	-	-	-	-
Western Tanager	43	4%	2	5%	1	1	.7%	0	N/A	0
Northern Cardinal	1	.09%	0	N/A	0	-	-	-	-	-
Black-headed Grosbeak	13	.1%	1	8%	1	-	-	-	-	-
Blue Grosbeak	7	.7%	1	14%	1	1	.7%	1	100%	1
Rose-breasted Grosbeak	20	2%	0	N/A	0	1	.7%	0	N/A	0
Indigo Bunting	31	3%	0	N/A	0	2	1%	0	N/A	0
Lark Bunting	18	2%	1	5%	1	6	4%	0	N/A	0
Lazuli Bunting	2	.2%	0	N/A	0	-	-	-	-	-
Painted Bunting	2	.2%	0	N/A	0	1	.7%	0	N/A	0
Snow Bunting	59	6%	0	N/A	0	-	-	-	-	-
House Finch	48	5%	0	N/A	0	7	5%	0	N/A	0
Purple Finch	4	.4%	0	N/A	0	-	-	-	-	-
Saffron Finch	2	.2%	0	N/A	0	-	-	-	-	-
Unknown Finches	30	3%	1	3%	1	2	1%	0	N/A	0
White-winged Crossbill	3	.3%	1	33%	1	-	-	-	-	-
Eurasian Siskin	1	.09%	0	N/A	0	-	-	-	-	-
Pine Siskin	9	.9%	0	N/A	0	-	-	-	-	-
American Goldfinch	42	4%	0	N/A	0	1	.7%	0	N/A	0
Lesser Goldfinch	4	.4%	0	N/A	0	-	-	-	-	-
Open Woodland Species Total	**1026**	**95%**	**15**	**2%**	**14**	**144**	**97%**	**1**	**0%**	**1**
Blackbirds (Blackbirds, Cowbirds, Grackles, Orioles)										
Brewer's Blackbird	15	3%	0	N/A	0	-	-	-	-	-
Red-winged Blackbird	165	36%	1	0.6%	1	6	12%	0	N/A	0
Rusty Blackbird	6	1%	0	N/A	0	-	-	-	-	-
Yellow-headed Blackbird	7	2%	3	43%	3	-	-	-	-	-
Other Blackbirds	26	6%	1	4%	1	6	12%	1	17%	1
Boat-tailed Grackle	20	4%	0	N/A	0	-	-	-	-	-
Common Grackle	66	14%	1	1%	1	6	12%	0	N/A	0
Great-tailed Grackle	15	3%	0	N/A	0	13	27%	0	N/A	0
Unknown Grackles	15	3%	2	13%	0	8	16%	1	12%	0
Brown-headed Cowbird	100	22%	0	N/A	0	6	12%	0	N/A	0
Baltimore Oriole	14	3%	0	N/A	0	3	6%	0	N/A	0
Bullock's Oriole	1	.2%	0	N/A	0	-	-	-	-	-
Orchard Oriole	6	1%	0	N/A	0	1	2%	0	N/A	0
Unknown Orioles	2	.4%	0	N/A	0	-	-	-	-	-
Blackbird Total	**458**	**96%**	**8**	**2%**	**6**	**49**	**84%**	**2**	**4%**	**1**
SPECIES	**# Strikes**	**% of All Strikes**	**Damaging Strikes**	**% Strikes That Cause Damage**	**# Strikes w/ No Damage Data**	**# Strikes**	**% of All Strikes**	**Damaging Strikes**	**% Strikes That Cause Damage**	**# Strikes w/ No Damage Data**
Identified Bird Strikes (Total of Species Above)										
Known Bird Spp. Total	**28905**	**100%**	**1270**	**4%**	**835**	**2089**	**100%**	**72**	**3%**	**51**
Unidentified Birds Strikes										
Unknown Bird – (All)	14198	99%	736	5.2%	577	1546	99%	57	4%	41
Unknown Bird/Bat (Less Bats)	97	.7%	2	2%	2	18	1%	1	5.5%	1
Unknown Total	**14295**	**51.0%**	**738**	**5%**	**579**	**1564**	**49.5%**	**58**	**4%**	**189**
BIRD STRIKE TOTAL FY17 TO FY19										
ALL BIRD STRIKE TOTAL	**43200**	**100%**	**5,752**	**11.0%**	**22,063**	**6,601**	**100%**	**436**	**7%**	**291**