FINAL ENVIRONMENTAL ASSESSMENT,
FINDING OF NO SIGNIFICANT IMPACT, AND DECISION

for

BIRD DAMAGE MANAGEMENT IN COLORADO

Prepared by:

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

In Consultation with:

Colorado Department of Agriculture

Colorado Division of Parks and Wildlife

United States Fish and Wildlife Service

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ACRONYMS USED

A-C	Alpha-chloralose
AI	Avian Influenza
APHIS	Animal and Plant Health Inspection Service
BBS	Breeding Bird Survey
BDM	Bird Damage Management
BO	Biological Opinion
CAFO	Confined Animal Feeding Operation
CBC	Christmas Bird Count
CDA	Colorado Department of Agriculture
CFO	Colorado Field Ornithologists
CFR	Codes of Federal Regulations
CPW	Colorado Division of Parks & Wildlife
CRS	Colorado Revised Statutes
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FY	Fiscal Year
HP	Highly Pathogenic
IWDM	Integrated Wildlife Damage Management
LC50	Lethal Concentration in Water that Kills 50%
LD50	Lethal Dose that Orally Kills 50%
MA	Methyl-anthranilate
MIS	Management Information System
MOU	Memorandum of Understanding
NAS	National Audubon Society
NASS	National Agricultural Statistics Service
NEP	Nonessential Experimental Population
NEPA	National Environmental Policy Act
NHPA	National Historical Preservation Act
NWRC	WS-National Wildlife Research Center
P	Probability
PIF	Partners in Flight
RMBO	Rocky Mountain Bird Observatory
RMS	Rocky Mountain States
SLS	Sodium Lauryl Sulfate
SMC	Species of Management Concern
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
TB	Tuberculosis
TGE	Transmissible Gastroenteritis Virus
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WDM	Wildlife Damage Management
WS	Wildlife Services

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

While wildlife is a valuable natural resource, some species of wildlife can cause problems with human interests. Many bird species, including those that reside in or migrate into or through Colorado, can come into conflict with human interests at one time or another, and may need to be managed to control their damage. The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program has personnel with expertise to respond to damage caused by wildlife, including birds.

USDA-APHIS-WS is authorized by Congress to manage a program to reduce human-wildlife conflicts. WS' mission, developed through a strategic planning process (APHIS 2012), is to "*...provide Federal leadership in managing problems caused by wildlife. WS recognizes that wildlife is an important public resource greatly valued by the American people. By its very nature, however, wildlife is a highly dynamic and mobile resource that can damage agricultural and industrial resources, pose risks to human health and safety, and affect other natural resources. The WS program carries out the Federal responsibility for helping to solve problems that occur when human activity and wildlife are in conflict with one another*."

This is accomplished through:

- training of wildlife damage management (WDM) professionals;
- development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
- the collection, evaluation, and dissemination of management information;
- cooperative WDM programs;
- informing and educating the public on how to reduce wildlife damage; and
- providing technical advice and a source of limited-use management materials and equipment such as cage traps.

This Environmental Assessment (EA) evaluates ways that this responsibility could be carried out to resolve conflicts with bird species in Colorado. Bird damage management (BDM) is an important function of the Colorado WS Program. Appendix C lists all wild bird species with their scientific names that have been found in Colorado (491 – Appendix C: Tables C1-C3) recognized by the Colorado Field Ornithologists (CFO 2012) and potential feral (*wild domesticated animals*), escaped exotics (*wild birds kept as pets that are not truly domesticated*), or experimental, non-essential T&E species (10) that could be found in Colorado (Appendix C: Table C4). Appendix C: Table C1 lists those species that have the highest probability of coming into conflict with people in Colorado or being part of disease surveillance projects (197). However, Colorado WS has targeted only a minimal number of species from FY06 (federal fiscal year 2006 = October 1, 2005 – September 30, 2006) to FY10 with the top ten species responsible for the majority of work tasks completed for cooperators in numerical order being the Rock Pigeon, Red-tailed Hawk, Canada Goose, Mourning Dove, Horned Lark, European Starling, Western Meadowlark, Mallard, Northern Harrier, and Red-winged Blackbird. Most BDM projects conducted by WS in Colorado are focused on the protection of human health and safety, property, and agriculture from damage. Colorado WS conducts airport wildlife hazard management programs which primarily hazes birds at these sites, but also takes some birds to augment wildlife hazard reductions and is conducted to protect crews and passengers in planes, and damage to aircraft. Colorado conducts several projects to protect agriculture; most projects involved livestock, their health, or feed with technical assistance given for the protection of crops. Colorado WS also conducts disease surveillance and monitoring, mostly as part of a national interagency effort. WS wildlife disease surveillance and research projects in Colorado have focused on waterfowl, shorebirds, and non-native House Sparrows, but many other bird species could be targeted in the future, as determined scientifically based on research or surveillance goals. Finally, natural resource protection is periodically the focus of a BDM project. These will be discussed.

WS is a cooperatively funded (funding sources for the program come from federal appropriations, state and county agency contracts, and individuals) and service oriented program. Before operational BDM is conducted, *Agreements for Control* or *WS Work Plans* must be signed by WS and the land owner/administrator. WS cooperates with private property owners and managers and with appropriate land and wildlife management agencies, as requested, with the goal of effectively and efficiently resolving wildlife damage problems in compliance with all applicable federal, state, and local laws.

The U.S. Fish and Wildlife Service (USFWS) regulates and manages migratory birds and threatened and endangered (T&E) species. Under their direction, the Colorado Parks and Wildlife (CPW) also regulates and manages these species and resident bird species populations with the exception of feral domestic pets. The species CPW manage are classified as game birds or protected species under Colorado Revised Statutes (CRS). Game birds include waterfowl, cranes, shorebirds, doves, and gallinaceous birds (turkey, grouse, and quail). Nongame birds include all other species of birds not hunted and can include threatened and endangered (T&E) species. Feral birds (*e.g.*, domestic waterfowl and escaped cage birds) are the responsibility of County and municipal Animal Control Offices or the County Sheriff Departments.

APHIS-WS has the Federal statutory authority under the Act of March 2, 1931, as amended, and the Act of December 22, 1987, to cooperate with other federal agencies and programs, states, local jurisdictions, individuals, public and private agencies, organizations, and institutions while conducting a program of wildlife services involving animal species that are injurious or a nuisance to, among other things, agriculture, horticulture, forestry, animal husbandry, natural resources such as wildlife, and human health and safety as well as conducting a program of wildlife services involving mammalian and avian (*bird*) species that are reservoirs for zoonotic diseases.

Under State law (CRS Title 33), WS may respond to complaints of animal damage, including birds, from private landowners or lessees when protected wildlife, including game and nongame, cause damage. WS also assists public entities such as county airports and Department of Defense airbases and Native American Tribes with BDM when requested and when they have the appropriate permits necessary from USFWS or CPW, as required.

1.1.1 The Colorado WS Program

WS is a cooperatively funded, service-oriented program that responds to wildlife damage complaints from cooperators ranging from private citizens to other agencies. WS has received requests for assistance for damage caused by 89 of the 500 bird species with the inclusion of feral domestic species and escaped exotics[1] (Appendix C: Table C4) from FY06 to FY10 (Table 1). Rock Pigeons[2], Red-tailed Hawks, and Canada Geese, in order of the number of work tasks received, were responsible for the majority of work tasks completed by WS Specialists. WS received requests for BDM assistance involving only 5 other species from FY95 to FY05. Thus, most species covered in this EA (81%) have not been the target of a BDM project in the past 16 FYs; however, the need could arise to assist with management projects for other species and therefore, most will be discussed.

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[1] The Mallard and domestic Mallard are the same species and are only considered 1 in terms of adding depredating species numbers.

[2] Rock Pigeons were brought to Atlantic coast settlements in North America in the early 17th-century as a domestic species (Schorger 1952). Domestic Rock Pigeons readily go feral, and have done so widely throughout the world. The feral birds have undergone artificial selection by humans and are actually better condsidered feral domestics rather than introduced wild Rock Pigeons (Johnston 1992) like the deliberately introduced European Starling and House Sparrow. For the sake of this EA, the names feral pigeon and Rock Pigeon will be used interchangeably, but they are truly escaped domesticated forms of the wild Rock Pigeon.

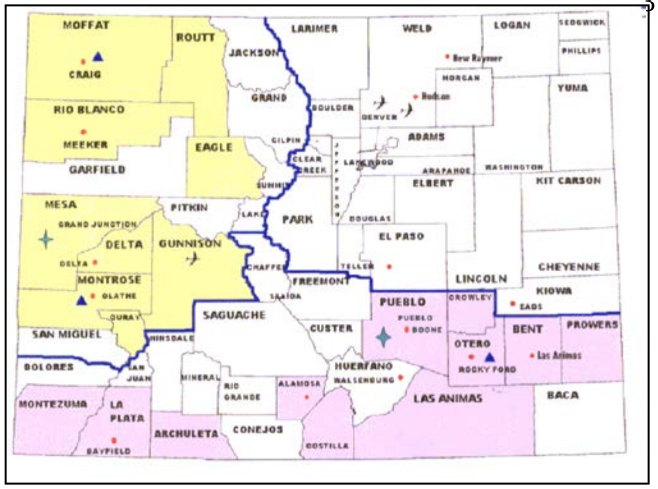

Figure 1. WS in Colorado has three Districts (Lakewood, Pueblo, and Grand Junction) that have personnel to respond to bird damage complaints in Colorado's 64 Counties.

WS works mostly in response to requests from the public, but conducts some BDM for agencies. WS can respond to requests for assistance involving damage from birds. In addition, Tribes are responsible for wildlife management on their properties and can request assistance from WS.

WS receives requests for BDM throughout Colorado. Colorado encompasses approximately 104,000 mi^2 in 64 Counties (Figure 1): Adams, Alamosa, Arapahoe, Archuleta, Baca, Bent, Boulder, Broomfield, Chaffee, Cheyenne, Clear Creek, Conejos, Costilla, Crowley, Custer, Delta, Denver, Dolores, Douglas, Eagle, Elbert, El Paso, Fremont, Garfield, Gilpin, Grand, Gunnison, Hinsdale, Huerfano, Jackson, Jefferson, Kiowa, Kit Carson, Lake, La Plata, Larimer, Las Animas, Lincoln, Logan, Mesa, Mineral, Moffat, Montezuma, Montrose, Morgan, Otero, Ouray, Park, Phillips, Pitkin, Prowers, Pueblo, Rio Blanco, Rio Grande, Routt, Saguache, San Juan, San Miguel, Sedgwick, Summit, Teller, Washington, Weld, and Yuma Counties. The State is divided into 3 WS Districts: Lakewood, Pueblo, and Grand Junction. WS personnel receive requests to conduct BDM in many counties and on a variety of land classes including mostly private and some federal, state, Tribal, county, and municipal lands. Colorado consists of about 55% private lands, 22% U.S. Forest Service, 13% Bureau of Land Management, and 3% other federal agency lands, 5% State lands, 2% Tribal lands, and less than 1% local government lands.

1.2 PURPOSE

The purpose of this EA is to analyze the effects of WS activities in Colorado to manage damage caused by bird species or species groups or to monitor wild bird populations for the presence of disease on the human environment. WS BDM activities are conducted to protect human health and safety at airports and threats of human disease, agricultural resources including livestock and their feed and health, crops, and aquaculture, property such as homes, aircraft, turf, machinery, electrical equipment, and ornamental trees, and natural resources such as threatened and endangered (T&E) species, other wildlife, fisheries, and public recreation areas. Colorado has 305 species of birds that can be found regularly in all or a portion of the State at some time during the year. An additional 186 species have been documented to occur in Colorado, but are normally outside of the species' normal range (accidentals); some of these species are seen annually and a few may even nest, but not in any abundance or regularity. Finally 10 feral domestic species (*e.g.*, guineafowl) and exotics (*e.g.*, Mute Swan), or experimentally released species (*e.g.*, California Condor) could be seen and targeted by a BDM project. Of the regular residents, 197 could be the focus of a BDM project, but only 98 would likely be targeted to protect resources other than aircraft and human health and safety at airports. The species that this EA will address are those that are normally found in Colorado and cause problems and are listed in Appendix C: Table C1. The primary species that WS responds to requests for assistance in order of the typical number of requests received are the Rock Pigeon, Red-tailed Hawk, Canada Goose, Mourning Dove, Horned Lark, European Starling, Western Meadowlark, Mallard, Northern Harrier, and Red-winged Blackbird. Several other species cause minor, but potentially locally serious, problems. Information is given on these and other species or their groups in Section 2.2.1.

Ordinarily, according to APHIS procedures implementing the National Environmental Policy Act (NEPA), individual WDM actions, and research and developmental activities may be categorically excluded (7 Code of Federal Regulation (CFR) 372.5(c), 60 Fed. Reg. 6000-6003, 1995). Many species involved in WS BDM actions in Colorado are individual actions because WS receives few requests for assistance for these species, even over several years; WS completed less than 10 work tasks annually for 50 species of the 89 species listed in Table 1 with 30 of these involving an average of 1 or less work tasks annually. Additionally, many of these are handled with technical assistance only which suggests that these activities would be categorically excluded from NEPA analysis. However, we prepared this EA on BDM in Colorado to facilitate planning and interagency coordination, to streamline program management, and to involve the public and obtain their input through comments and feedback. This EA documents the need for BDM in Colorado and assesses potential impacts and effects of various alternatives addressing the resolution of bird damage problems.

If a new issue arises or the analysis in monitoring reports concludes that WS BDM activities are outside the scope of that EA, the EA would be supplemented or an EIS written to include the new information and sent out for public review. Additionally, many new species have the potential for being involved in BDM, especially at airports and disease surveillance projects, and this EA will discuss all species that could potentially be involved in BDM in Colorado, though many likely never will be. This EA incorporates by reference applicable parts of the USDA-APHIS-WS programmatic Environmental Impact Statement (EIS) (*hereinafter referred to as* USDA 1997).

1.3 NEED FOR ACTION

Birds are responsible for damaging a wide variety of agricultural resources, property, and natural resources. In addition, birds can be a threat to human health and safety. From FY06 to FY10, 89 bird species (ave. 58 spp. per year - Table 1) were responsible for an annual average of 4,356 work tasks for BDM assistance to resolve associated damage, 3,900 for human health and safety, 360 for property, 77 for agriculture, and 9 for natural resources (Tables 2 and 3). In addition to these work tasks, WS was also involved in conducting disease surveillance and from FY06-FY10 collected 686 samples annually from birds and their droppings. This information is kept in the MIS[2]. The MIS has been in place since FY95 and an additional 5 species, to the 89 total species of birds, were responsible for damage from FY95 to FY05 indicating the low number of species that have caused requests for assistance. Requests for assistance are an indication of need, but the requests that WS receives likely represents only a portion of the need in actuality. WS loss reports do not actually reflect the total value of bird damage in Colorado, but provides an indicator of the annual losses. Also, some people are unaware of the WS program and may try to resolve problems themselves without requesting WS assistance.

1.3.1 Summary of Proposed Action

The proposed action is to continue the current portion of the WS program in Colorado that responds to requests for BDM to protect human health and safety, agricultural resources such as livestock feed, livestock, livestock health, aquaculture, and crops, property such as turf, landscaping, and structures, and natural resources such as T&E species, other wildlife, and forestry in Colorado. The three primary components of the WS BDM program in Colorado have been the goal of reducing threats or hazards to human health and safety at airports, the protection of livestock feed and the risk of bird-related livestock health problems caused by starlings[3] and blackbirds (includes blackbirds, grackles, and cowbirds, and starlings in the "Mixed Blackbird" MIS category – see Table 1) at dairies and feedlots, and property protection from feral pigeons. Additionally, property damage from waterfowl and livestock and T&E

[2] MIS - Computer-based Management Information System used by WS for tracking Program activities. WS in Colorado has had the SQL-based MIS system operational since FY92. However, a new system, the MIS 2000, replaced an old system 10/01/04. Differences in the systems have changed some outputs such as requests for assistance. Thus, information will be given for FY06 to FY10 in this document. MIS reports will not be referenced in the Literature Cited Section since most reports from the MIS are not kept on file. A database is kept that allows queries to be made to retrieve the information needed.

[3] Starling in this EA refers only to the European Starling, the only starling introduced into the United States.

species losses from birds that can be predatory such as Common Ravens are a much more minor program component. Program goals are also to minimize damage or the risk of damage to other agricultural resources, natural resources such as wildlife species, property, or other public or private resources from birds, and conduct disease surveillance. To meet these goals WS has the objective of responding to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when cooperative or congressional funding is available, direct control assistance where professional WS personnel conduct BDM. An Integrated Wildlife Damage Management (IWDM) approach is implemented which allows the use of any legal technique or method (discussed in Section 3.3.1.3), used singly or in combination, to meet the needs of requestors for resolving conflicts with birds. Agricultural producers and others requesting assistance are provided with information regarding the use of effective nonlethal and lethal techniques. Lethal methods used by WS would include shooting, trapping, egg addling/destruction, DRC-1339, Avitrol® (Avitrol Corporation, Tulsa Oklahoma), and live capture by trapping or use of the tranquilizer alpha-chloralose (A-C) which is often followed by euthanasia with an appropriate drug such as Fatal Plus® or cervical dislocation. Nonlethal methods used by WS may include wire barriers and deterrents such as porcupine wire, netting, and fencing, the tranquilizer A-C followed by relocation, chemical repellents (*e.g.*, methyl anthranilate, polybutene products), and harassment with auditory (*e.g.*, propane cannons, pyrotechnics, distress calls) and visual devices (*e.g.*, reflective tape, human effigies, balloons). In many situations, the implementation of nonlethal methods such as exclusion-type barriers would be the responsibility of the requestor to implement. BDM by WS would be allowed in the State, when requested, on private property sites or public facilities where a need has been documented, upon completion of an Agreement for Control. All management actions would comply with appropriate federal, state, and local laws.

Table 1. Value of damage caused by birds in Colorado as reported to or verified by Wildlife Services from FY06 to FY10. The damage reported is only a fraction of the actual damage caused by birds in Colorado.

SPECIES	FY06 (46)		FY07 (47)		FY08 (57)		FY09 (66)		FY10 (73)		Average	
	WT	Value	WT	Value	WT	Value	WT	Value	WT	Value	WT	Value
Snow Goose	1	$0	-	-	1	$0	-	-	-	-	0.4	$0
Canada Goose	59	$8,033,000	112	$258,200	355	$117,782	530	$25,000	610	$5,000	333	$1,687,796
Feral Goose	1	$0	-	-	-	-	-	-	-	-	0.2	$0
Gadwall	-	-	-	-	2	$0	11	$0	1	$0	3	$0
American Wigeon	-	-	-	-	1	$0	-	-	4	$0	1	$0
Mallard	81	$0	49	$0	92	$0	393	$0	353	$5,000	194	$1,000
Feral Duck	-	-	-	-	1	$0	-	-	-	-	0.2	$0
Blue-winged Teal	-	-	4	$0	1	$0	120	$0	14	$0	28	$0
Cinnamon Teal	-	-	1	$0	-	-	2	$0	2	$0	1	$0
Northern Shoveler	-	-	-	-	-	-	19	$0	17	$0	7	$0
Northern Pintail	-	-	1	$0	1	$0	1	$0	8	$0	2	$0
Green-winged Teal	1	$0	1	$0	1	$0	-	-	13	$0	3	$0
Canvasback	-	-	-	-	-	-	5	$0	1	$0	1	$0
Redhead	-	-	-	-	4	$0	-	-	4	$0	2	$0
Ring-necked Duck	-	-	-	-	1	$0	15	$0	14	$0	6	$0
Lesser Scaup	1	$0	-	-	5	$0	47	$0	3	$0	11	$0
Bufflehead	-	-	1	$0	-	-	-	-	7	$0	2	$0
Common Goldeneye	1	$0	-	-	-	-	-	-	1	$0	0.4	$0
Hooded Merganser	-	-	-	-	1	$0	-	-	-	-	0.2	$0
Common Merganser	2	$0	1	$0	-	-	1	$0	2	$0	1	$0
Ruddy Duck	-	-	-	-	-	-	46	$0	17	$0	13	$0
Scaled Quail	-	-	-	-	2	$0	1	$0	4	$0	1	$0
Western Grebe	-	-	-	-	-	-	-	-	1	$0	0.2	$0
American White Pelican	9	$22,200	2	$2,200	10	$2,200	43	$0	15	$0	16	$5,320
Double-Crested Cormorant	7	0	1	$0	2	$1,500	50	$0	34	$2,000	19	$700
Great Blue Heron	15	$0	3	$0	28	$1,500	99	$0	35	$0	36	$300
Snowy Egret	-	-	1	$0	1	$0	-	-	-	-	0.4	$0
Black-Crowned Night Heron	2	$10,000	-	-	-	-	-	-	1	$5,000	0.6	$3,000
White-faced Ibis	3	$0	-	-	-	-	1	$0	1	$0	1	$0
Turkey Vulture	2	$0	8	$0	88	$0	190	$0	143	$0	86	$0
Osprey	1	$0	-	-	-	-	-	-	-	-	0.2	$0
Bald Eagle	2	$0	-	-	7	$0	148	$0	166	$0	65	$0
Northern Harrier	6	$0	6	$0	170	$0	280	$0	484	$0	189	$0
Sharp-shinned Hawk	-	-	2	$0	1	$0	-	-	-	-	0.6	$0
Cooper's Hawk	-	-	-	-	-	-	27	$0	50	$0	15	$0
Northern Goshawk	-	-	-	-	1	$0	-	-	-	-	0.2	$0
Swainson’s Hawk	16	$0	38	$0	68	$0	260	$0	404	$0	157	$0
Red-tailed Hawk	14	$0	53	$12,000	360	$15,000	661	$0	958	$350,000	409	$75,400
Ferruginous Hawk	-	-	-	-	34	$0	231	$0	410	$0	135	$0
Rough-legged Hawk	9	$0	36	$0	6	$0	73	$0	227	$0	70	$0

Golden Eagle	1	$0	2	$0	3	$0	59	$0	163	$0	46	$0
American Kestrel	1	$0	32	$0	73	$0	201	$0	144	$0	90	$0
Peregrine Falcon	-	-	-	-	1	$0	-	-	2	$0	0.6	$0
Prairie Falcon	-	-	1	$0	2	$0	13	$0	93	$0	22	$0
American Coot	3	$0	1	$0	3	$0	47	$0	33	$0	17	$0
Sandhill Crane	1	$0	1	$0	2	$0	2	$0	11	$0	3	$0
Killdeer	-	-	1	$0	16	$0	60	$0	78	$0	31	$0
American Avocet	-	-	-	-	-	-	2	$0	1	$0	0.6	$0
Upland Sandpiper	1	$0	-	-	-	-	-	-	-	-	0.2	$0
Long-billed Curlew	-	-	-	-	-	-	6	$0	-	-	1	$0
Western Sandpiper	1	$0	-	-	-	-	-	-	-	-	0.2	$0
Baird's Sandpiper	3	$0	-	-	-	-	-	-	-	-	0.6	$0
Shorebirds (other)	8	$0	-	-	-	-	-	-	-	-	2	$0
Bonaparte's Gull	-	-	-	-	1	$0	-	-	1	$0	0.4	$0
Franklin's Gull	1	$0	1	$0	1	$0	16	$0	1	$0	4	$0
Ringed-billed Gull	3	$10,000	1	$0	8	$0	42	$0	35	$0	18	$2,000
California Gull	3	$0	8	$0	3	$0	88	$0	46	$500	30	$100
Herring Gull	-	-	-	-	-	-	1	$0	-	-	0.2	$0
Black Tern	-	-	-	-	-	-	32	$0	-	-	6	$0
Feral Rock Pigeon	296	$47,700	516	$9,000	494	$81,250	628	$5,358	585	$50	504	$28,672
Eurasian Collared-Dove	-	-	-	-	-	-	11	$900	5	$0	3	$180
Mourning Dove	22	$1,000	79	$0	365	$0	476	$0	623	$0	313	$200
Barn Owl	-	-	-	-	3	$0	20	$0	54	$0	15	$0
Great Horned Owl	2	$500	8	$0	12	$0	88	$0	202	$0	62	$100
Burrowing Owl	-	-	1	$0	7	$0	7	$0	4	$0	4	$0
Short-eared Owl	-	-	-	-	-	-	-	-	51	$0	10	$0
Common Nighthawk	-	-	-	-	1	$0	-	-	-	-	0.2	$0
Downy Woodpecker	-	-	-	-	-	-	1	$100	1	$1,000	0.4	$220
Hairy Woodpecker	-	-	-	-	-	-	1	$2,500	1	$500	0.4	$600
Northern Flicker	67	$168,900	88	$210,300	34	$87,800	76	$257,160	91	$209,525	71	$186,737
Western Kingbird	1	$0	9	$0	55	$0	226	$0	194	$0	97	$0
Loggerhead Shrike	-	-	-	-	-	-	7	$0	-	-	1	$0
Black-billed Magpie	1	$0	1	$0	10	$0	34	$0	11	$0	11	$0
American Crow	-	-	4	$1,000	7	$0	10	$0	34	$0	11	$200
Common Raven	25	$250	16	$1,600	107	$600	56	$0	53	$9,500	51	$2390
Horned Lark	17	$0	27	$0	228	$0	502	$0	522	$0	259	$0
Tree Swallow	-	-	2	$0	2	$0	1	$0	1	$0	1	$0
Bank Swallow	-	-	1	$0	-	-	1	$0	1	$0	0.6	$0
Cliff Swallows	-	-	14	$10,000	61	$0	153	$5,500	247	$0	95	$3,100
Barn Swallow	2	$0	2	$0	-	-	2	$1,000	14	$0	4	$200
White-breasted Nuthatch	-	-	1	$1,000	-	-	4	$4,825	3	$4,100	2	$1,985
American Robin	1	3,000	-	-	9	$3,500	34	$0	17	$2,000	12	$1,700
European Starling	9	$500	17	$0	251	$0	446	$15,058	367	$22,890	218	$7,690
Lark's Bunting	-	-	4	$0	2	$0	124	$0	109	$0	48	$0
Red-winged Blackbird	5	$0	9	$0	20	$0	374	$15,208	472	$0	176	$3,042
Western Meadowlark	15	$0	18	$0	192	$0	481	$0	380	$0	217	$0
Brewer's Blackbird	1	$0	-	-	-	-	2	$0	2	$0	1	$0
Common Grackle	-	-	-	-	22	$0	141	$0	14	$0	35	$0
Blackbird's (mixed)	1	$0	1	$0	8	$0	18	$6,000	6	$0	7	$1,200
House Finch	-	-	-	-	-	-	-	-	1	$0	0.2	$0
House Sparrow	3	$500	9	$0	3	$0	48	$0	90	$0	31	$100
Birds Unidentifiable	1	$11,000	-	-	22	$185,410	8	$0	6	$821,769	7	$203,636
Total 89 spp. (ave. 58 sp./yr.)	**728**	**8,308,550**	**1,195**	**505,300**	**3,272**	**496,542**	**7,803**	**338,609**	**8,773**	**1,438,834**	**4,354**	**$2,217,567**

WTs = number of work tasks entered into MIS system

1.3.2 Need for BDM to Protect Human Health and Safety

Birds represent a variety of health and safety hazards to the public. For example, birds have been implicated in the transmission of several diseases to humans (Figure 2) and are a hazard to aircraft and their passengers at airports. Birds can harass and injure people especially those protecting nests and can pose a concern where they carry off potentially infectious or unsanitary items at landfills and open water treatment plants. And finally, birds can cause general concerns or are a nuisance to some people, but really do not cause monetary damage per se. Examples of the latter include birds making excessive noise (i.e., communal bird roosts, nesting crows, feral peacocks, woodpeckers hammering on a house), they are injured (i.e., wrapped with fishing line, stuck with toy dart, or struck by a car and need to be trapped/hand captured to be taken to a rehabilitator), stuck in a building (i.e., Cooper's Hawk in a warehouse, European Starling in a flume), leaving excrement on sidewalks (i.e., geese, ducks, starlings, swallows), or creating an unpleasant stench (i.e., droppings at communal bird roosts near residences, vulture roosts from vomitus and droppings, pigeon nests near air-intake to buildings).

WS responded to an annual average of 3,900 human health and safety complaints (Table 3) involving birds from FY06 to FY10, but not including work tasks associated with disease surveillance. Of these, 3,810 were work tasks associated with protection of people at airports (it should be noted that human health and safety at airports increased from 334 in FY06 to 8,245 in FY10 as a result of increased WS BDM at airports and air bases in Colorado. Species that typically cause most complaints in Colorado are hawks, pigeons, blackbirds/starlings, wading birds/cormorants, waterfowl, and small flocking birds attracted to airfields (*e.g.*, Horned Larks).

Bird-Aircraft Hazards to Humans

An increase in air traffic (Federal Aviation Administration (FAA) 2011b) along with increases in certain wildlife species that are commonly involved in bird strikes (waterfowl, gulls, raptors, blackbirds/starlings, and other species) have contributed greatly to the increase in the number of reported strikes (Dolbeer 2006). From FY01 to FY10, Colorado aviation officials reported 3,200 strikes. From FY06 to FY10, 16 strikes caused significant damage: 5 with geese (3 Canada Geese), 1 Green-winged Teal, 1 American White Pelican, 1 Bald Eagle, 1 unknown hawk, 1 Sandhill Crane, 1 American Coot, 1 Great Horned Owl, and 4 unknown medium-sized birds (FAA 2011a). Several significant strikes that occurred in Colorado are given.

In FY06, two bird strikes causing substantial damage were reported at Colorado airports:

- In November, a Piper Navajo reported damage to the #1 Engine after a strike involving geese. Aircraft was taken out of service for 72 hours for repairs.
- In November, a Boeing 747-200 reported damage to the #1 and #2 engines after striking Canada Geese on approach. Damage to the leading edge flaps was also reported. Aircraft was out of service for repairs. Cost of repairs reported at over $222,000.

In FY07, two bird strikes causing substantial damage were reported at Colorado airports:

- In November, a Boeing 737-500 sustained damage to the #2 engine due to a Great Horned Owl strike on take-off. The damage forced the crew to shut the engine down. The strike damaged 12 fan blades, cost over $55,000 in repairs and the aircraft was out of service for 13 hours.
- In March, an Aerospatiale SA315 helicopter was forced to make a precautionary landing due to damage sustained during a bird strike while en-route between 300-400 feet AGL. Upon landing, 2 of 3 tail rotor blades were bent as was the drive shaft. The aircraft was taken out of service for repairs.

In FY08, five bird strikes causing substantial damage were reported at Colorado airports:

- In October, a CL –RJ700 reported striking Sandhill Cranes on climb just after take-off. The pilot reported hearing 4 thumps. The #2 engine ingested one crane and was idled because it was causing excessive vibrations. The left wing had also struck a crane and it was damaged. An amber alert was called and the plane returned for an emergency landing, though the pilot was unsure if he would make it because the plane was running rough. Post flight inspection revealed that the fan exit guide and housing was damaged along with the leading edge off the left wing. The aircraft was out of service for repairs.
- In April, a CL-601/604 business plane struck a flock of American White Pelicans on climb after take-off. The #1 and #2 engines were damaged with the #2 engine failing. Another pelican hit the nose area just below the windshield post and continued through the forward bulkhead. The pilot and copilot were covered in parts, but both were uninjured. The plane returned to the airport. The costs exceeded of repair $2,000,000.

In FY09, three bird strikes causing substantial damage were reported at Colorado airports:

- In October, a Boeing 757-200 ingested a Bald Eagle on climb just after take-off damaging the #2 engine cowling with a 2 foot dent followed by ingestion into the engine. The engine was not shut down because it continued to provide thrust, but the cabin began to fill with the smell of the burnt bird. It was estimated that the damage would cost about $17 million to repair. The plane was taken out of service by the airline for repairs.

- In January, a military C-130 ingested a Green-winged Teal, damaging the #4 engine. The pilot was able to land the plane safely.

In FY10, four bird strikes causing substantial damage were reported at Colorado airports:

- In October, the pilots of a CL –RJ700 reported striking an unknown, medium-sized bird on approach that he thought was a flock of gulls or Snow Geese. One of the aircraft wings had been severely damaged and the outgoing flight had to be cancelled. The crew had to stay in a hotel before they could get flights back to their hometowns.
- In March, a BE-1900 struck a hawk on approach. FAA reported the damage to the wing was substantial, but the plane landed without incident.

To date, no documented bird strikes have resulted in loss of human life in Colorado; however, strikes continue to occur, increasing the risk for a catastrophic event. Such was the case at Elmendorf Air Force Base, Alaska in September 1995 where 24 human lives were lost when an "AWACS" aircraft crashed after ingesting four Canada Geese during takeoff (Cleary and Dolbeer 1999).

Colorado WS has three operational airport programs at Denver International Airport; Buckley Air Force Base; and Peterson Air Force/Colorado Springs Airport joint-use facility. Bird work at these airports has consisted of a combination of methods including habitat management, harassment, and lethal control. The species that have been identified to cause the most strikes in Colorado from FY01 to FY10 (Appendix D) are Horned Larks (520 – 34%), Mourning Doves (189 - 12%), Western Meadowlarks (128 – 8%), and Cliff Swallows (120 – 8%) causing 62% of the known bird species strikes; 52% of the strikes in Colorado are reported as unknown. Take of these species occurs at these airports, but the majority of birds are hazed from the air operating area.

Avian Diseases Transmittable to Humans

Feral pigeons and starlings have been suspected in the transmission of 29 different diseases to humans, (Weber 1979 and Davis et al. 1971). These include viral diseases such as meningitis and seven different forms of encephalitis; bacterial diseases such as erysipeloid, salmonellosis, paratyphoid, Pasteurellosis, and Listeriosis; mycotic (fungal) diseases such as aspergillosis, blastomycosis, candidiasis, cryptococcosis, histoplasmosis, and sarcosporidiosis; protozoal diseases such as American trypansomiasis and toxoplasmosis; and rickettsial/chlamydial diseases such as chlamydiosis and Q fever (Figure 2). As many as 65 different diseases transmittable to humans or domestic animals have been associated with feral pigeons, starlings, and House Sparrows (Weber 1979). In most cases in which human health concerns are a major reason for requesting BDM, no actual cases of bird transmission of disease to humans have been proven to occur. The risk of disease transmission from birds is often the underlying reason people request assistance from WS.

Many times, individuals or property owners that request assistance with feral domestic pigeons or nuisance blackbird or starling problems are concerned about potential disease risks but are unaware of the types of diseases that can be associated with these birds. In some situations, BDM is requested because the droppings left by concentrations of birds is aesthetically displeasing and can result in continual clean-up costs.

Further problems arise as resident Canada Geese and other waterfowl have become accustomed to and are successful in suitable urban habitats. These resident geese are becoming more and more of a nuisance around public parks, lakes, housing developments, and golf courses as they sometimes attack humans. The threat to human health from high fecal coliform (*e.g., Escherichia coli*) levels and other pathogens including *Cryptosporidium parvum*, *Giardia lambia*, and *Salmonella spp*. is also associated with large amounts of droppings (Clark 2003).

Disease	Human Symptoms	Potential for Human Fatality	Effects on Domestic Animals
BACTERIAL			
erysipeloid	skin eruption with pain, itching; headaches, chills, joint pain, prostration, fever, vomiting	sometimes - particularly in young children, old or infirm people	serious hazard for the swine industry
salmonellosis	gastroenteritis, septicemia, persistent infection	possible, especially in individuals weakened by other disease or old age	causes abortions in mature cattle, possible mortality in calves, decrease in milk production in dairy cattle
Pasteurellosis	respiratory infection, nasal discharge, conjunctivitis, bronchitis, pneumonia, appendicitis, urinary bladder inflammation, abscessed wound infections	Rarely	may fatally affect chickens, turkeys and other fowl
Listeriosis	conjunctivitis, skin infections, meningitis in newborns, abortions, premature delivery, stillbirth	sometimes - particularly with newborns	In cattle, sheep, and goats, difficulty swallowing, nasal discharge, paralysis of throat and facial muscles
VIRAL			
Meningitis	inflammation of membranes covering the brain , dizziness, and nervous movements	possible — can also result as a secondary infection with Listeriosis, salmonellosis, cryptococcosis	causes middle ear infection in swine, dogs, and cats
encephalitis (8 forms)	headache, fever, stiff neck, vomiting, nausea, drowsiness, disorientation	mortality rate for eastern equine encephalomyelitis may be around 60%	may cause mental retardation, convulsions and paralysis
MYCOTIC (FUNGAL)			
aspergillosis	affects lungs and broken skin, toxins poison blood, nerves, and body cells	not usually	causes abortions in cattle
blastomycosis	weight loss, fever, cough, bloody sputum and chest pains.	Rarely	affects horses, dogs and cats
candidiasis	infection of skin, fingernails, mouth, respiratory system, intestines, and urogenital tract	Rarely	causes mastitis, diarrhea, vaginal discharge and aborted fetuses in cattle
cryptococcosis	lung infection, cough, chest pain, weight loss, fever or dizziness, also causes meningitis	possible especially with meningitis	chronic mastitis in cattle, decreased milk flow and appetite loss
histoplasmosis	pulmonary or respiratory disease. May affect vision	possible, especially in infants and young children or if disease disseminates to the blood and bone marrow	actively grows and multiplies in soil and remains active long after birds have departed
PROTOZOAL			
American trypansomiasis	infection of mucous membranes of eyes or nose, swelling	possible death in 2-4 weeks	caused by the conenose bug found on pigeons
toxoplasmosis	inflammation of the retina, headaches, fever, drowsiness, pneumonia, strabismus, blindness, hydrocephalus, epilepsy, and deafness	possible	may cause abortion or still birth in humans, mental retardation
RICKETTSIAL/CHLAMYDIAL			
chlamydiosis	pneumonia, flu-like respiratory infection, high fever, chills, loss of appetite, cough, severe headaches, generalized aches and pains, vomiting, diarrhea, hepatitis, insomnia, restlessness, low pulse rate	occasionally, restricted to old, weak or those with concurrent diseases	in cattle, may result in abortion, arthritis, conjunctivitis, and enteritis
Q fever	sudden pneumonitis, chills, fever, weakness, severe sweating, chest pain, severe headaches and sore eyes	Possible	may cause abortions in sheep and goats

Figure 2. Diseases transmittable to humans and livestock associated with feral pigeons, starlings and House Sparrows (*copied from* Weber 1979).

Avian Influenza (AI). WS is 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 (HP) avian influenza (HP H5N1 AI). Both WS and USFWS collect samples to test for the presence of disease throughout the United States. Samples are obtained from live and dead birds, and their droppings, but certain species are often targeted depending on the specific disease (*e.g.,* West Nile virus).

This EA discusses the need to monitor, and possibly manage, wild and feral birds to reduce the risk of disease transmission to humans, livestock, and other wildlife. WS is receiving increasing requests for assistance with disease surveillance in wild and feral birds. In 2006 to 2009, WS was one of several agencies and organizations participating in surveillance for the HP H5N1 AI virus in North American migrating birds. Waterfowl and shorebirds were mostly targeted because of their potential to intermingle with birds from countries where the virus had been found.

AI is caused by viruses in the Orthomyxovirus group. Viruses in this group vary in the intensity of illness they may cause (virulence). Wild birds, in particular waterfowl and shorebirds, are considered natural reservoirs for AI (Clark 2003). Most strains of AI rarely cause severe illness or death in birds, although H5 and H7 strains can be highly virulent and very infectious (Clark 2003).

Recently, the occurrence of HP H5N1 AI virus has raised concerns regarding the potential impact on wild birds, domestic poultry, and human health should it be introduced into the U.S. It is thought that a change occurred in a low pathogenicity AI virus of wild birds, allowing the virus to infect chickens, followed by further change into the HP H5N1 AI. HP H5N1 AI has been circulating in Asian poultry and fowl resulting in death to these species. HP H5N1 AI likely underwent further changes allowing infection in additional species of birds, mammals, and humans. More recently, the virus moved back into wild birds resulting in significant mortality of some species of waterfowl, gulls, and cormorants. This is only the second time in history that a highly pathogenic form of AI has been recorded in wild birds. Numerous potential routes for introduction of the virus into the United States exist including illegal movement of domestic or wild birds, contaminated products, and the migration of infected wild birds.

The nationwide surveillance effort has detected some instances of low pathogenic AI viruses, as was expected given that waterfowl and shorebirds are considered natural reservoirs for AI. Tens of thousands of birds have been tested, but there has been no evidence of the HP H5N1 AI virus in North America.

Colorado WS has been involved in the nationwide surveillance effort for the HP H5N1 AI virus. The focus of surveillance in Colorado has concentrated on waterfowl and shorebirds and began in FY06. In FY06 through FY10, WS collected 3116 samples (avg. 623/year) from 15 waterfowl species, 15 shorebird species, and 7 other known species (droppings sampled are not identified to bird in the MIS) in Colorado.

Bird Attacks on People

Another type of human safety problem that occurs with birds in Colorado is attacks on people by nesting waterfowl, raptors, and passerines. Common species which attack people that WS receives complaints involve Canada Geese, feral Mute Swans, Northern Mockingbirds, Brewer's Blackbirds, and Northern Cardinals. Additionally, crows that have been hand-raised and subsequently released are serious problems and often find children at elementary schools easy to terrorize taking barrettes and pins to cache. These attacks are very infrequent, but WS responded to an average of 1 incident per year from FY06 to FY10. In Denver County for example, Canada Geese have attacked employees while nesting outside the entrance to a federal facility. One blind employee was struck and injured when he tripped and fell to the ground trying to get away from an aggressive adult male defending his nest. After several repeated attacks and threats to individuals nearby, WS personnel resolved the problem by coordinating the hand capture of the male goose. Once the male was removed, the aggressive, defensive behavior of the parent birds ceased and the problem was resolved.

1.3.3 Need for Bird Damage Management to Protect Agriculture

Colorado grows a variety of agricultural products that had an annual average sales valued at $6.0 billion from 2006 to 2010 (National Agricultural Statistics Service (NASS) 2011). Three primary areas of agriculture production are protected by WS BDM in Colorado, livestock, aquaculture, and crops.

Livestock which includes aquaculture accounts for 65% of sales while crops account for 35%. Aquaculture is a primary agriculture industry that is assisted by WS with BDM nationally. However, sales, included in livestock sales, only accounts for 0.03% of the agriculture in Colorado and consists mostly of trout production (NASS 2007), but private sport fisheries are not included in NASS (2007, 2011) and account for some BDM activities in Colorado. The primary livestock protected by WS BDM are cattle, sheep, poultry, and, to a minor extent, all other hoofed stock. Crops protected by WS BDM include primarily grain, feed, seed oil, vegetable, and fruit/nut crops. In Colorado, WS BDM works to protect feed and vegetable crops, primarily corn (feed and sweet corn account for 22% of the crop sales in Colorado), grain crops which consists almost entirely of wheat (19% of crop sales in Colorado), oil crops (1.4% of the crop sales in Colorado) which are almost exclusively from sunflower, and fruit and nut crops (1.4% of the crop sales in Colorado) which includes cherries, apples, peaches, and berries (NASS 2011). Aquaculture, livestock, and crops can be damaged by birds and WS had an average of 79 work tasks associated with $50,000 annual lost from FY06 to FY10 (Table 2). Many requests are received prior to the occurrence of damage, especially in areas with historic damage occurrence. Much of the assistance given is with the use of hazing methods to reduce damage.

Verified losses are defined as those losses examined by a WS specialist during a site visit and identified to have been caused by a specific bird species or group of birds. Often a WS 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 WS 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, and therefore, the WS Specialist must observe the birds in the area. However, a few species have 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 BDM necessary to resolve the problem. A WS specialist not only tries to confirm the predator responsible, but also records the extent of the damage when possible. Losses that cannot be confirmed (the best guess is recorded) or those that are reported by a cooperator, but not confirmed are defined as reported losses.

Table 2. The number of requests for assistance and value of damage to agricultural resources caused by birds in Colorado as reported to or verified by WS personnel from FY06 to FY10. The damage reported is only a fraction of the actual damage caused by birds in Colorado. One incident of livestock damage could involve multiple predations, one incident of crop damage could involve thousands of birds covering large acreages of cropland, and one incident for aquaculture damage could be losses for the entire year, including brood fish that would not be sold.

Category	Resource	FY06		FY07		FY08		FY09		FY10		Average	
		WT	$ Value $	WT	$ Value $	WT	$ Value $	WT	$ Value $	WT	$ Value $	WT	$ Value $
Livestock	Cattle	5	$0	9	$1,500	13	$0	3	$0	5	$9,500	7	$2,200
	Sheep/Goats	1	$6,000	6	$100	5	$0	0	$0	0	$0	2	$1,220
	Other Hoof Stock	0	$0	2	$0	22	$600	5	$0	0	$0	6	$120
	Poultry/Eggs	6	$0	0	$0	10	$0	4	$0	0	$0	4	$0
	Livestock Feed	5	$0	3	$0	61	$0	92	$14,608	50	$17,940	42	$6,510
Livestock Subtotal		17	$6,000	20	$1,600	114	$600	104	$14,608	55	$27,440	61	$10,050
Crops	Grains	2	$8,000	2	$6,000	1	$8,000	1	$6,000	0	$0	1	$5,600
	Fruit	1	$3,000	0	$0	1	$3,500	1	$0	1	$2,000	1	$1,700
	Other Crops	1	$25,000	1	$2,000	4	$50,000	34	$41,916	10	$0	10	$23,783
Crops Subtotal		4	$36,000	3	$8,000	6	$61,500	36	$47,916	11	$2,000	12	$31,083
Aquaculture	Food Fish	8	$42,200	1	$2,200	4	$5,200	0	$0	6	$7,500	4	$11,420
Aquaculture Subtotal		8	$42,200	1	$2,200	4	$5,200	0	$0	6	$7,500	3	$11,420
TOTAL AGRICULTURE		29	$84,200	24	$11,800	124	$67,300	140	$62,524	72	$36,940	77	$52,553

WTs = Work tasks associated with requests for BDM 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.

Livestock

Livestock production in the United States contributes greatly to local economies. Colorado produces a wide variety of livestock. Cattle and calf production in Colorado is the number one agricultural commodity with an annual average from 2006 to 2010 of $3.0 billion in sales from 2.6 million cows (NASS 2011); in Colorado, cattle were responsible for 76% of the livestock sales and 50% of all agricultural sales alone (NASS 2011). Other livestock and products that annually contributed significant sales from 2006 to 2010 (annual average) in Colorado included hogs ($180 million), sheep and lambs ($110 million), other livestock including poultry ($37 million), eggs ($150 million), and dairy ($440 million). Livestock along with their products and feed losses cause economic hardships to their owners, and without effective BDM to protect them, depredation losses and hence economic impacts would be greater (Nass 1977, 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 WS averaged about $10,050 between FY06 and FY10 and resulted in an average of 61 work tasks associated with requests from producers per year (Table 2). Though damage from birds is only a very small portion of the overall sales, it can be significant locally to a given rancher or group of ranchers.

Livestock Depredations. WS personnel respond to reports from resource owners of losses to birds that can be predatory which may or may not be verified. 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. These impacts, chiefly livestock injury or fatality, have been primarily attributed to Common Ravens and Great Horned Owls from FY06 to FY10. Additionally, several other birds have the potential to predate livestock and include Red-tailed Hawks, Chihuahuan Ravens, and American Crows. To a lesser extent, other owls, falcons, and other species have also impacted livestock resources. Predatory birds mostly kill or injure small (i.e., rabbits, poultry) or young livestock, or incapacitated (i.e., injured, calving) adult hoof-stock. Domestic fowl (i.e., chickens, ducks, geese, guineas) are reported as livestock and are included in this discussion as well.

WS considers non-lethal dispersal techniques (i.e., pyrotechnics, live trapping and relocation, modified animal husbandry practices, laser lights to disperse roosts) as the initial course of action. However, in situations where birds do not respond to non-lethal techniques, or where the use of these techniques is not practical, problems may be more effectively resolved using lethal methods. Population reduction or removal of specific problem-causing birds by live trapping and relocation, trapping and euthanasia, shooting, and the selective use of the avicide DRC-1339 (egg baits placed for problem causing ravens and crows) is sometimes required to resolve specific conflicts. WS also investigates and sometimes recommends that resource owners or managers be given depredation permits by USFWS to allow for lethal control of certain species (*e.g.*, turkey, vulture, raven). Avian depredation is often difficult to control, but eagle depredation can be particularly problematic due to additional protective laws. During FY06-FY10, WS reported an average of 19 occurrences of livestock depredation annually (Table 2), and provided operational and technical assistance to producers to resolve the issues.

Livestock Feed Losses at Confined Animal Feeding Operations (CAFOs). Starlings, blackbirds, House Sparrows, feral domestic pigeons and, to a lesser extent, American Crows and Common Ravens often cause damage at cattle feedlots, dairies, and other CAFOs where congregations of these birds consume and contaminate feed. Losses are most significant in winter and spring months when tens of thousands of birds will concentrate at CAFOs. Colorado has an approximate 900 cattle CAFOs (dairies and feedlots) that market almost $3 billion (NASS 2011); while not every operation experiences heavy infestations of birds with associated damage, some will, and some of those request assistance from WS. Technical and direct control is used to provide a comprehensive BDM plan which may include both lethal and non-lethal BDM approaches. WS personnel responded to an average of 42 complaints involving livestock feed annually from FY06 to FY10 (Table 2) with an average of about $6,510 in losses. European Starlings and feral pigeons were the primary cause of the damage, especially in the eastern region of Colorado.

The problem of European Starling damage to livestock feed has been well documented in France and Great Britain (Feare 1984), and in the United States (Besser et. al. 1968). The concentration of larger numbers of cattle eating huge quantities of feed in confined pens results in a tremendous attraction to starlings, blackbirds, and feral domestic pigeons. Diet rations for cattle contain all of the nutrients and fiber that cattle need, and are so thoroughly mixed that cattle are unable to select any one component over others. The basic constituent of most rations is silage which is supplemented with a high energy portion like protein pellets or grains such as corn, milo, or barley (incorporated as whole grains, or crushed and ground cereal). While cattle cannot select individual ingredients from that ration, starlings and other birds will select the component they want which alters the energetic value of the complete diet. The removal of this high energy fraction by starlings, is believed to reduce milk yields, weight gains, and is economically significant (Feare 1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, and freezing temperatures and the number of livestock on feed. The economic significance of feed losses to starlings has been demonstrated by Besser et al. (1968) who concluded that the value of losses in feedlots near Denver, Colorado was $84 per 1,000 birds in 1967. Forbes (1995) reported starlings consume 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 with 6.3% experiencing significant 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.

An analysis of blackbird and starling depredation at 10 cattle feeding facilities in Arizona that used WS BDM services conservatively estimated that the value of feed losses on the 10 facilities would have been about $120,000 without WS BDM services which was reduced to $40,000/yr. (WS 1996) with operational assistance. Similar results conducting BDM at CAFOs was achieved in Nevada and Kansas and (WS 2006, 2008).

Livestock Health Problems. Pathogens of livestock disease (*e.g.*, coccidiosis, salmonella) are often associated with bird contamination from feces in feed and water troughs and in pastures and many of these and their problems associated with them are listed in Figure 3. A number of diseases that affect livestock have been associated with feral pigeons, starlings, various blackbirds, and House Sparrows (Weber 1979). Transmission of diseases such as transmissible gastroenteritis virus (TGE), tuberculosis (TB), and coccidiosis to livestock has been linked to migratory flocks of starlings and blackbirds. As a result of disease spread potential (from all causes), public health agencies began monitoring different aspects of livestock production. For example, Public Health Service activities in the area of milk sanitation began at the turn of the century with studies on the role of milk in the spread of disease. These studies led to the conclusion that effective public health control of milk borne disease requires the application of sanitation measures throughout the production, handling, pasteurization, and distribution of milk. The 1995 *Grade A Pasteurized Milk Ordinance* recommended by the United States Public Health Service and the Food and Drug Administration (FDA) is used as the sanitary regulation for milk and milk products. The Milk Ordinance says "Cows should not have access to piles of manure, in order to avoid the soiling of udders and the spread of diseases among cattle" and that manure may not accumulate so as to permit the soiling of udders. Regulations in some States require fowl to be kept out of milking barns, stables, cow yards, and loafing and housing areas for fear of contamination. These regulations have been issued for dairy cattle because the accumulation of bird feces where cattle can lay could potentially contaminate the udder with pathogens and contamination of feed bunks with bird feces could transmit disease. Pigeons, starlings, and blackbirds commonly create these concerns at dairies because of the sheer numbers that can invade feedlots. Estimates of the dollar value of this type of damage are not available.

WS often receives requests from CAFO operators to conduct BDM to protect their herds from the potential for disease. In FY06, a coccidiosis outbreak occurred in sheep from feral pigeons resulting in the loss of 50 sheep valued at $6,000. Because disease has the potential for catastrophic results at a facility, this is a real concern and WS assists those that request BDM for livestock protection where congregations of birds amass. From FY06 to FY10, WS assisted livestock owners with pigeons and starlings, and, to a much lesser extent, waterfowl.

Disease	Livestock affected	Symptoms	Comments
BACTERIAL			
erysipeloid	cattle, swine, horses, sheep, goats, chickens, turkeys, ducks	Pigs - arthritis, skin lesions, necrosis, septicemia Sheep – lameness	serious hazard for the swine industry, rejection of swine meat at slaughter due to septicemia, also affects dogs
salmonellosis	all domestic animals	abortions in mature cattle, mortality in calves, decrease in milk production in dairy cattle Colitis in pigs,	over 1700 serotypes
Pasteurellosis	cattle, swine, horses, rabbits, chickens, turkeys	Chickens and turkeys die suddenly without illness pneumonia, bovine mastitis, abortions in swine, septicemia, abscesses	also affects cats and dogs
avian tuberculosis	chickens, turkeys, swine, cattle, horses, sheep	Emaciation, decrease in egg production, and death in poultry. Mastitis in cattle	also affects dogs and cats
Streptococcosis	cattle, swine, sheep, horses, chickens, turkeys, geese, ducks, rabbits	Emaciation and death in poultry. Mastitis in cattle, abscesses and inflammation of the heart , and death in swine	feral pigeons are susceptible and aid in transmission
Yersinosis	cattle, sheep, goats, horses, turkeys, chickens, ducks	abortion in sheep and cattle	also affects dogs and cats
Vibriosis	cattle and sheep	In cattle, often a cause of infertility or early embryonic death. In sheep, the only known cause of infectious abortion in late pregnancy	of great economic importance
Listeriosis	Chickens, ducks, geese, cattle, horses, swine, sheep, goats	In cattle, sheep, and goats, difficulty swallowing, nasal discharge, paralysis of throat and facial muscles	also affects cats and dogs
VIRAL			
Meningitis	cattle, sheep, swine, poultry	inflammation of the brain, newborn calve unable to suckle	associated with Listeriosis, salmonellosis, cryptococcosis
encephalitis (8 forms)	horses, turkeys, ducks	drowsiness, inflammation of the brain	mosquitoes serve as vectors
MYCOTIC (FUNGAL)			
aspergillosis	cattle, chickens, turkeys, and ducks	abortions in cattle	common in turkey poults
		Rarely	affects horses, dogs and cats
candidiasis	cattle, swine, sheep, horses, chickens, turkeys	In cattle, mastitis, diarrhea, vaginal discharge, and aborted fetuses	causes unsatisfactory growth in chickens
cryptococcosis	cattle, swine, horses	chronic mastitis in cattle, decreased milk flow and appetite loss	also affects dogs and cats
histoplasmosis	horses cattle and swine	(in dogs) chronic cough, loss of appetite, weakness, depression, diarrhea, extreme weight loss	also affects dogs; actively grows and multiplies in soil and remains active long after birds have departed
PROTOZOAL			
Coccidiosis	poultry, cattle, and sheep	bloody diarrhea in chickens, dehydration, retardation of growth	almost always present in English sparrows; also found in pigeons and starlings
American trypanosomiasis	infection of mucous membranes of eyes or nose, swelling	possible death in 2-4 weeks	caused by the conenose bug found on pigeons
toxoplasmosis	cattle, swine, horses, sheep, chickens, turkeys	In cattle, muscular tremors, coughing, sneezing, nasal discharge, frothing at the mouth, prostration and abortion	also affects dogs and cats
RICKETTSIAL/CHLAMYDIAL			
chlamydiosis	cattle, horses, swine, sheep, goats, chickens, turkeys, ducks, geese	In cattle, abortion, arthritis, conjunctivitis, enteritis	also affects dogs and cats and many wild birds and mammals
Q fever	affects cattle, sheep, goats, and poultry	may cause abortions in sheep and goats	can be transmitted by infected ticks

Figure 3. Diseases of livestock linked to feral pigeons, starlings, blackbirds, and House Sparrows (*taken from* Weber 1979).

Crops

Colorado produces a wide variety of crops and many of them are damaged by birds. Corn, that used for livestock feed (silage corn) and human consumption (sweet corn), was the leading crop sold in Colorado with wheat production second, generating about $480 million in sales (NASS 2011); however, BDM is only requested occasionally to protect this resource and from FY06 to FY10. Of the crops, WS documented most damage during FY06-FY10 to sunflowers, cherries, barley, spinach, corn, alfalfa/hay, soybeans, milo, lettuce, strawberries, and garden vegetables from a variety of birds including feral pigeons, blackbirds, starlings, Canada Geese, robins, and quail.

Birds that cause the most damage to crops are mostly those that congregate into large flocks. Damage is often not widespread, but localized within short flying distance of nighttime roosts. The local producers that lie where these roosts form, which are not necessarily at the same location each year, can suffer extreme damage, whereas other producers may not be afflicted. WS has recorded an average of 12 work tasks associated with protecting crops in Colorado annually resulting in about $31,083 damage by birds (Table 2) from FY06 to FY10. Producers were primarily given technical assistance support.

Canada Geese can cause considerable damage to crops, particularly alfalfa, winter wheat, and pasturelands. The overall population of Canada Geese in North America has experienced drastic increases over the last few decades. Large goose flocks often congregate in Colorado on croplands to feed and take advantage of the large open spaces that the fields offer as a safety strategy. Damage to these crops during feeding by geese can be quite extensive; these species often pluck younger plants from the ground during feeding rather than clip off the vegetative portion of the older plants.

Several studies have shown that blackbirds can pose a significant economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, and Feare 1984). Blackbird damage to crops has often been identified as a serious problem in sunflowers and milo. Blackbirds congregate in fields where they can cause significant damage to individual producers who then seek assistance from WS. Federal and State governments recognize that blackbirds are important depredators of agricultural commodities. Although they are migratory birds, blackbirds are currently provided no protection under provisions of the Migratory Bird Treaty Act when they cause or threaten damage to crops (see 50 CFR, Part 21.43). No one blackbird control method has proven to be entirely satisfactory in alleviating rice or other crop damage. Hence, WS currently recommends and uses the IWDM approach to blackbird damage management, and IWDM methodologies are continuously updated as new blackbird management tools become available.

Aquaculture

Fish production in the United States is on the rise, particularly in the East, where millions of dollars of catfish, bass, trout, and other foodfish, baitfish, shellfish, and crawfish are grown and harvested annually. American aquaculturists raised a variety of aquaculture products which sold in 2005 for an estimated $1.1 billion (NASS 2007). In Colorado, aquaculturists raised a variety of aquaculture, but only trout exceeded the threshold to be counted (NASS 2007). From 2006 to 2010, sales from trout in Colorado annually averaged $1.7 million (NASS 2011).

This growing industry is not without its problems as aquaculturists report that fish-eating birds cause a significant economic loss (Gorenzel et al. 1994). American White Pelicans, Double-crested Cormorants, Great Blue Herons, Black-crowned Night-Herons, and California and Ring-billed Gulls caused damage to trout, tilapia, catfish, and privately stocked sport fish in Colorado from FY06 to FY10. Other birds that have the potential to cause damage to aquaculture include Ospreys, Belted Kingfishers, and other gulls, herons, and egrets (Gorenzel et al. 1994). In Colorado, American White Pelicans caused most damage. Double-crested Cormorants have been a primary contributor to depredation losses in aquaculture in the United States. Double-crested Cormorant are a species that has increased significantly in the interior States and responsible for significant depredations in certain regions (USFWS 2003a). Glahn et al. (2002) investigated predation losses to catfish by Double-crested Cormorants and found a 19.6% biomass production loss. Using this ratio, it was determined that Mississippi Delta producers may lose up to $25 million in catfish production annually from Double-crested Cormorants (USFWS 2003a). Several other species are similarly responsible for aquaculture production losses. In Colorado, aquaculturists have reported to WS or WS personnel have verified an average of about $11,420 in damage to fish annually from FY06 to FY10 in 4 work tasks associated with aquaculture.

In most cases, WS only provides advice (technical assistance) to aquaculture facility operators on how to resolve such problems through primarily nonlethal means such as barrier/deterrent wires or harassment. In some cases, the facility might need to obtain a depredation permit from the USFWS to kill a few of the birds to reinforce the remaining birds' fear of harassment and exclusionary techniques. Under the proposed action, WS could also be requested to provide on-site operational assistance involving the use of nonlethal and lethal means of resolving bird damage problems at these or similar facilities. Lethal methods would generally be restricted to taking only a few birds to reinforce the remaining birds' fear of harassment and exclusionary techniques.

1.3.4 Need for BDM to Protect Property

WS has conducted many BDM projects to protect property. Property encompasses a wide range of resources that are damaged by birds. Much of the damage is from bird droppings. Feral pigeons congregate under bridges and on building causing damage to these. Utility towers are sometimes used by turkey vultures for roosting where they, as well as other flocking birds such as starlings and crows, can cause damage problems, primarily from their droppings. Other property can be damaged because birds will feed on it such as landscaping, grass, and flowers. Finally, the bulky nests of some species can be damaging, but most are more of a fire hazard when built in or on structures.

Feral domestic and wild waterfowl sometimes congregate at golf courses, parks, and other recreational areas that have ponds or watercourses and cause damage by grazing on turf and the accumulation of droppings. A golf course manager reported $250,000 in damages to golf greens and fairway turf from the feeding activities of large flocks of Canada Geese. The greens on a golf course are particularly vulnerable and very costly to repair.

Bird droppings cause damage because they are acidic and have ammonia. Once dried, they become salts which react with water. Corrosion damage to metal structures and painted finishes, including those on automobiles and aircraft, can occur because of uric acid from bird droppings. Several incidents involving bird droppings on vehicles, equipment, and aircraft in storage buildings at airports and airbases have created concern. Estimates of damage to aircraft at an airbase in Oklahoma have been made (WS 2003) for repairing aircraft skin on a KC-135 damaged from bird droppings (primarily roosting starlings, pigeons, and House Sparrows) and ranged from $10,000-$15,000 in replacement materials with an additional estimated 100 hours labor at $95/hr. required for a full wing repair for a total cost of over $20,000. Spot repairs can be expected to require $3,000-$4,000 in materials with approximately 50 hours labor at $95/hr.

Birds damage structures such as houses on private property or public buildings and bridges with fecal contamination. Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Woodpeckers sometimes cause structural damage to wood siding and stucco on homes. Damage to buildings by birds was the most frequent property damage complaint in Colorado averaging 261 requests per year with a recorded average value of about $202,432 from FY06-FY10. The Northern Flicker was the most frequent species involved in these damage complaints. Most all property owners were given technical assistance to resolve the problem.

Rookeries, or nesting colonies, are established by egret and heron species, including Cattle Egrets, Great Egrets, Great Blue Herons, and Snowy Egrets. These nesting sites can encompass areas between 0.1 and 5 ha in size. Egret and heron activities can be destructive to desirable trees, shrubs, and other vegetation at these sites. Defoliation of the plants by bird movements through the canopy, removal of plant material for nest building, covering of leaves by droppings, and drastic increases in soil nutrients from bird droppings will destroy the vegetative community in 1-12 years depending on the plant species present and the number of birds (Telfair and Thompson 1986, Telfair 2006).

Finally, as discussed for livestock, birds can depredate pets and zoo animals or potentially be involved in the transmission of disease to them. Small dogs and cats can be killed by large raptors such as the Great Horned Owl. Small zoo animals, depending on size, are also vulnerable to attack by raptors. WS assisted one person and a zoo with predation from raptors from FY06 to FY10 (Table 3).

Table 3. The number of requests for assistance and value of damage caused by birds in Colorado as reported to or verified by WS from FY06 to FY10 for property and natural resources. The damage reported is only a fraction of the actual damage caused by birds in Colorado.

Category	Resource	FY06		FY07		FY08		FY09		FY10		Average	
		WT	$Value$	WT	$Value$	WT	$Value$	WT	$Value$	WT	$Value$	WT	$Value$
Property	Pets/Zoo Animals	1	$500	0	$0	0	$0	1	$0	0	$0	0	$100
	Aircraft*	3	$8,011,000	0	$0	78	$334,192	47	$0	81	$1,171,769	42	$1,903,392
	Vehicles	0	$0	1	$0	1	$0	2	$5,000	1	$0	1	$1,000
	Equipment/Machine	0	$0	38	$0	21	$0	7	$0	10	$0	15	$0
	Landscaping/Garden	3	$1,000	8	$250,200	1	$0	2	$0	8	$10,000	4	$52,240
	General Property	4	$0	10	$2,000	4	$0	6	$500	22	$4,000	9	$1,300
	Buildings/Houses	182	$206,100	403	$229,300	250	$90,050	215	$270,585	256	$216,125	261	$202,432
	Utilities	1	$0	2	$12,000	15	$0	15	$0	7	$0	8	$2,400
	Structures/Bridges	0	$0	0	$0	65	$0	1	$0	12	$0	16	$0
	Impoundments	4	$5,250	0	$0	5	$5,000	3	$0	3	$0	3	$2,050
TOTAL PROPERTY		198	$8,223,850	462	$493,500	440	$429,242	299	$276,085	400	$1,401,894	360	$2,164,914
Natural Resources	T&E Species	13	$0	1	$0	2	$0	0	$0	0	$0	3	$0
	Recreational Area	4	$500	1	$0	3	$0	7	$0	2	$0	3	$100
	Wildlife	0	$0	2	$0	3	$0	1	$0	4	$0	2	$0
	Trees	0	$0	0	$0	0	$0	2	$0	0	$0	1	$0
TOTAL NAT. RESOURCES		17	$500	4	$0	8	$0	10	$0	7	$0	9	$100
Human Health/Safety	Aviation	334	$0	587	$0	2,648	$0	7,234	$0	8,245	$0	3,810	$0
	General	151	$0	117	$0	51	$0	83	$0	49	$0	90	$0
TOTAL HUMAN HEALTH/SAFETY		485	$0	702	$0	2,699	$0	7,317	$0	8,294	$0	3,900	$0

WTs = Work tasks associated with requests for BDM 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 can be significant in one year to the loss of an aircraft or significant parts such as an engine, and thus data can be skewed to a given year when losses are significant.

1.3.5 Need for BDM to Protect Wildlife Including T&E Species

Some species of wildlife including those listed as T&E under the Endangered Species Act (ESA) of 1973 are preyed upon or otherwise adversely affected by certain bird species. Direct predation has been shown to seriously limit the recovery of T&E and sensitive bird species, particularly ground nesting birds. Loss of nesting habitat, usually the likely contributor to the decline of a species, and increases in predator population numbers can interact to be important causal factors in nest predation of ground-nesting birds (Evans 2004). Studies have been conducted in other states to determine population trends of Least Terns and Piping Plovers and these studies have shown that predation plays a significant role in nest losses (Kirsch 1993). Birds of prey, as well as mammalian carnivores, kill adult California Least Terns and their young, and destroy nests in nesting colonies of this endangered species. The California WS program trapped raptors at several breeding sites to protect this species at the request of land managing agencies which allowed for successful reproduction (Butchko and Small 1992). Bird species documented as potential threats to the long term nesting success of terns include Red-tailed Hawks, Great Horned Owls, American Kestrels, and Northern Harriers. Black-crowned Night-Herons are another potential predator of terns and plovers (Kirsch 1993). Colorado WS has recently gotten involved in protecting a small colony of Interior Least Terns and Piping Plovers from primarily California Gulls.

The Greater and Gunnison's Sage-Grouse are found in Colorado with Greater generally found north of I-70 and Gunnison's south. Many factors are believed to be responsible for their decline, especially habitat alterations. This has benefitted the Common Raven, a generalist predatory bird species able to increase as a result of human-altered habitats, which is a great conservation concern because they can substantially reduce prey populations (Garrott et al. 1993, Schneider 2001) and these predators continue depredating bird nests even at low prey densities (Polis et al. 1997, Sinclair et al. 1998). Common Ravens are generalist predators that use visual cues to locate eggs and young of many animals (Boarman and Heinrich 1999), including sage-grouse (Schroeder et al. 1999, Schroeder and Baydack 2001, Coates and Delehanty 2010). Ravens have been shown to impact prey populations (Boarman et al. 2006). In desert environments, population increases are thought to be caused by anthropogenic resource subsidies such as food from roadkills and at landfills (Boarman 1993, Webb et al. 2004) and better nesting habitat such as transmission towers and poles (Knight and Kawashima 1993). Coates and Delehanty (2010) found that Common Ravens were responsible for Greater Sage-Grouse nest depredations and that an increase of one raven per 10-km (6.21 miles) transect survey equated to a 7.4% increase in the odds of nest failure. An understanding of the effects of raven abundance on nest predation in relation to habitat factors would aid management efforts designed to promote sage-grouse population viability, such as managing nesting habitat to reduce raven population size and reduce the chance of ravens finding and depredating nests. BBS Common Raven and sage-grouse trends in Colorado mirror states in the West where these studies have occurred (Figure 4).

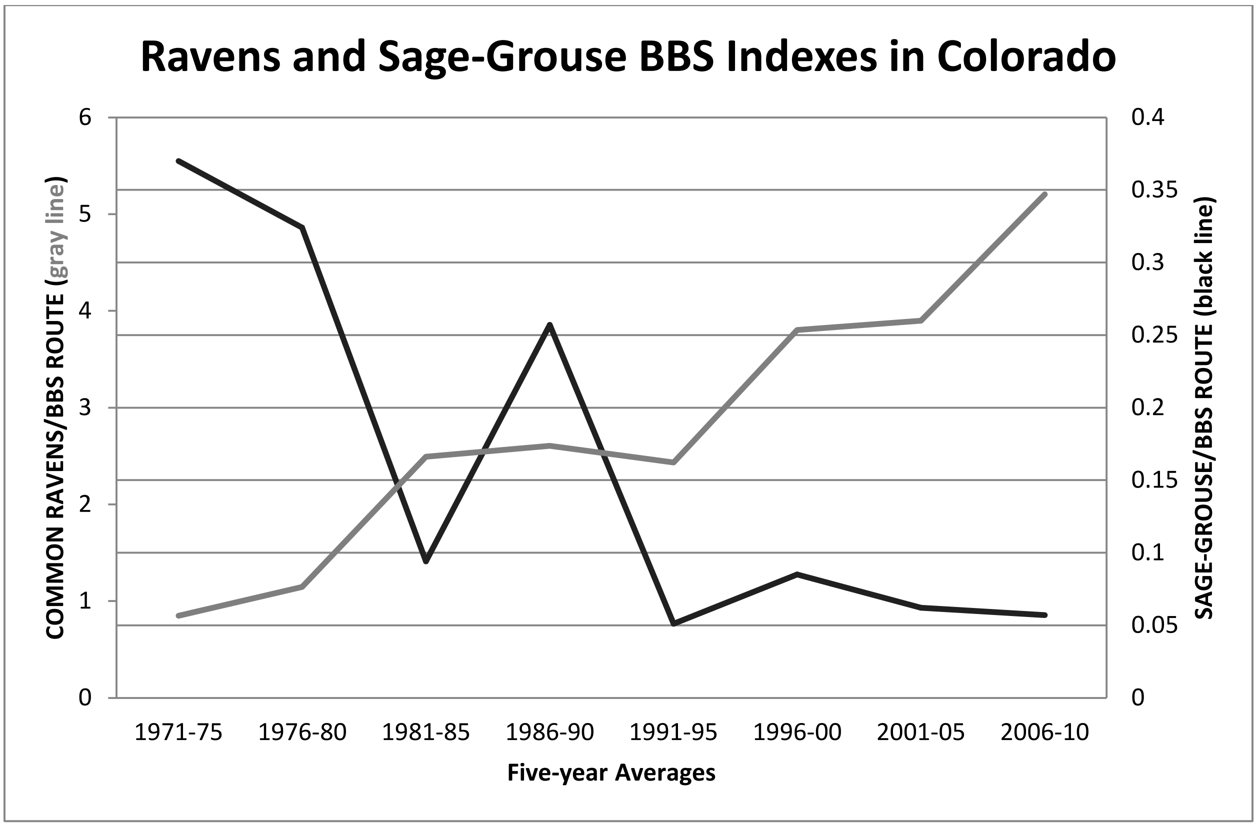

Figure 4. Common Raven, and Greater and Gunnisons's Sage Grouse, combined, BBS indexes for 5-year averages Colorado from 1971 to 2010. The Colorado Common Raven increased 612% in this time and the sage-grouse population, which includes the Gunnison's and Greater in Colorado, decreased 85%.

Lesser Prairie-Chickens were once common birds in southeastern Colorado. Colorado's population is currently estimated at fewer than 500 breeding birds, located for the most part on the Comanche National Grassland near Campo in southeastern Colorado, which is administered by the U.S. Forest Service. The Lesser Prairie-Chicken is currently at a critical period for long-term survival (Hagen 2003) and has been listed as a species "warranted but precluded" for listing under the ESA (Fed. Reg. Notice 63(110):31400-31406). While habitat fragmentation and availability are the over-arching issue for their decline, 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.

Interspecific nest competition has been well documented in starlings. Miller (1975) and Barnes (1991) reported starlings were responsible for a severe depletion of the Eastern Bluebird (*Sialia sialis*) 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), Red-bellied Woodpeckers, Gila Woodpeckers (*Centurus uropygialis*) (Ingold 1994, Kerpez and Smith 1990), and Wood Ducks (Shake 1967, Heusmann et al. 1977, Grabill 1977, McGilvery and Uhler 1971). Lewis's Woodpeckers are a species of concern in Colorado that has potentially been impacted by starlings, even if they win a battle for a nest site (Tobalske 1997). 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. Control operations as proposed under the current program could reduce very local starling populations, but it is not likely to reduce them enough unless BDM were focused at the time of nesting. Reduction in nest site competition would be a beneficial impact on the species listed above. Although such reductions are not likely to be significant over large areas, there could be some cases where some individual species limited by environmental factors could benefit by enhanced recruitment during nesting seasons to ensure their continued existence in a given area.

The nests of several endangered birds are frequently parasitized by Brown-headed Cowbirds. An endangered bird, though it does not exist in Colorado, that has been negatively affected by Brown-headed Cowbirds is the Black-capped Vireo (Brown 1994, Grzybowski 1995). The cowbirds lay their eggs in active nests of other bird species. Cowbirds are known to lay eggs in the nests of more than 100 different bird species. Each female will lay as many as 40 eggs per year in surrogate nests (Lowther 1993). The cowbird eggs hatch first and the young are cared for by the host bird as if they were its own. By the time that the host birds' own eggs hatch, the cowbird nestlings are already much larger, out-competing the host birds' young for food and frequently pushing them out of the nest. With endangered bird species, such parasitism can cause enough nest failures to jeopardize the host species. A number of agencies, including WS in Arizona, California, Michigan, and Texas, have historically conducted cowbird trapping and other population control measures in certain areas (*e.g.,* at feedlots and roost locations) to successfully reduce nest parasitism in areas where the host birds have been impacted. The only T&E species in Colorado that has been impacted by the cowbird, very heavily in some areas, is the Southwestern Willow Flycatcher (Sedgwick 2000).

Another natural resource protection activity is the protection of T&E fish and fisheries from fish-eating birds, especially where piscivorous birds congregate in large numbers. Some piscivorous bird populations such as the Double-crested Cormorant and American White Pelican have increased significantly over the last 40 years in many areas and could possibly deplete fisheries in local areas, (Hatch and Weseloh 1999, Idaho Fish and Game 2009) though hatchery fish are typically most affected while wild stocks are not easily taken (Hatch and Weseloh 1999).

Disease surveillance and research activities are often conducted to protect other wildlife, including T&E species, from the threat of disease. For example, WS in Colorado has been involved in West Nile Virus research due to its potential impact on numerous wild bird species. WS in Colorado has also been involved in HP H5N1 AI surveillance which serves to protect wild bird species as well as domestic poultry from the disease. Such disease surveillance activities to protect natural resources are expected to continue in the future, but the bird species targeted, the natural resources protected, and the diseases of concern cannot be predicted.

Other than the disease threats listed above, WS is currently not involved in operations to protect specific natural resources or T&E species from threats caused by wild birds in Colorado, but could be called upon to do so in the future.

1.4 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

WS issued a Final EIS on the national APHIS-WS program (USDA 1997). Pertinent information from USDA (1997) has been incorporated by reference into this EA.

1.5 DECISION TO BE MADE

Based on the scope of this EA, the decisions to be made are:

- Should BDM as currently implemented by WS be continued in the State?
- If not, how should WS fulfill its legislative responsibilities for managing bird damage in the State?
- What standard operating procedures (SOPs) should be implemented to lessen identified potential impacts?
- Do WS BDM activities have significant impacts requiring preparation of an EIS?

1.6 SCOPE OF THIS EA ANALYSIS

1.6.1 Actions Analyzed

This EA evaluates WS BDM to protect human health and safety, agricultural resources, property, and natural resources on private or public lands throughout Colorado wherever such management is requested. This includes BDM for the protection of resources and bird management for monitoring and surveillance purposes.

1.6.2 American Indian Lands and Tribes

WS only conducts BDM at a Tribe's request. WS has not been requested to provide assistance with BDM in Colorado on tribal lands. Since tribal lands are sovereign and the methods employed are the same as for any private land upon which WS provides services, tribal officials would determine if BDM is desired and the BDM methods that would be allowed. Because tribal officials have the ultimate decision on whether BDM is conducted, no conflict with traditional cultural properties or beliefs is anticipated. Therefore, this EA would cover BDM on tribal lands, where requested and implemented.

1.6.3 Federal Lands

Colorado has a number of different federal lands (*e.g.*, Bureau of Land Management, U.S. Forest Service) within its boundaries and WS could be requested to conduct BDM on them. The methods employed and potential impacts are the same on these lands as they would be on private lands upon which WS provides service. Therefore, if WS were requested to conduct BDM on federal lands for the protection of agriculture, property, human health and safety, or natural resources, this EA would cover the BDM actions implemented, if the impacts of BDM activities for such actions have been considered in this EA. NEPA compliance for BDM conducted to protect property or natural resources such as T&E species at the request of USFWS or other federal agency is the requesting agency's responsibility. However, WS could accept the NEPA responsibility at the request of another agency, but that agency would still be responsible for issuing a NEPA Decision.

1.6.4 Period for which this EA is Valid

This EA will remain valid until WS determines that new needs for action or new alternatives having different Environmental effects must be analyzed. At that time, this analysis and document will be reviewed and revised as necessary. This EA will be reviewed each year to ensure that it is complete and still appropriate for the scope of the BDM activities conducted by WS in Colorado.

1.6.5 Site Specificity

This EA analyzes potential impacts of BDM on the human environment as required by NEPA and addresses WS BDM activities on all lands under Cooperative Agreement or Agreements for Control or as otherwise covered by WS Work Plans (*e.g.,* on federal public lands) within Colorado. It also addresses the impacts of BDM on areas where additional agreements with WS may be written in the reasonably foreseeable future in Colorado. Because the proposed action is to continue the current BDM program, and because the current program's goal and responsibility is to provide service when requested within the constraints of available funding and manpower, it is conceivable that additional BDM efforts could occur. Thus, this EA anticipates potential expansion and analyzes the impacts of such expanded efforts as part of the current program.

Planning for the management of bird damage must be viewed as being conceptually similar to federal or other agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, insurance companies, and other emergency response agencies. Although some of the sites where bird damage is likely to occur and lead to requests to WS for assistance can be predicted, all specific locations or times where such damage will occur in any given year cannot be predicted. This EA emphasizes major issues as they relate to specific areas whenever possible; however, many issues apply wherever bird damage and resulting management occurs, and are treated as such.

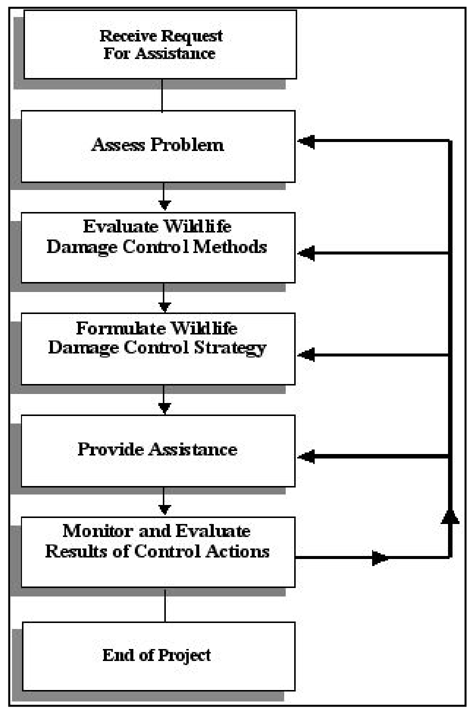

Figure 5. WS Decision Model used at the field level to evaluate a wildlife damage problem (*copied from* Slate et al. 1992).

The standard WS Decision Model (Figure 5) and WS Directive 2.105 is the site-specific routine thought process for determining methods and strategies to use or recommend for individual actions conducted by WS (see USDA 1997, Chapter 2 and Appendix N for a more complete description of the WS Decision Model and examples of its application). The Decision Model is not intended to require documentation or a written record each time it is used, and it necessarily oversimplifies complex thought processes (Slate et al. 1992). Decisions made using the model would be in accordance with SOPs described herein and adopted or established as part of the decision.

The analysis in this EA considers impacts on target and nontarget wildlife species, people, pets, and the environment. Wildlife populations, with the exception of T&E species, are typically monitored over large geographic areas (i.e., the West, the State) and smaller geographic areas by the State Wildlife agency (i.e., CPW game management units). WS monitors target bird and nontarget take for Colorado by county. The game management units and counties do not correspond to each other in Colorado, thus, analysis of wildlife population impacts is better analyzed at the statewide level. Additionally, because most birds migrate, harvest is analyzed better at the statewide and regional levels. Waterfowl harvest by sportsmen in Colorado is estimated by CPW and USFWS from mail and internet surveys. Statistically, the variance at the local level (i.e., the game management unit or County) is very high and can be ± 100% making the data not as useful. However, the variance is much lower at the statewide or Flyway level and therefore, much more reliable. Cumulative impacts, therefore, are more accurate, especially for migratory birds on a broader level and the statewide level is often used.

1.7 AUTHORITY AND COMPLIANCE

1.7.1 Authority of Federal and State Agencies for BDM in Colorado

1.7.1.1 WS Legislative Authority. USDA is authorized and directed by law to protect American agriculture and other resources from damage associated with wildlife. Under the Act of March 2, 1931, as amended (7 U.S.C.426-426b), APHIS-WS is authorized to conduct a program of wildlife services with respect to injurious animal species; and, under the Act of December 22, 1987 (7 U.S.C. 426c), APHIS-WS is authorized to control nuisance mammals and birds and those mammal and bird species that are reservoirs for zoonotic diseases.

WS conducts WDM in cooperation with and under the authorities of CDA and CPW. WS works cooperatively with local livestock associations and county governments to provide BDM assistance for its constituents. BDM assistance is provided statewide in areas where funding has been provided. BDM activities occur on both private and public lands as addressed in Section 1.6.2. The BDM methods that can be used in Colorado are discussed in Section 3.3.1.3 and each bird damage operational project may require the use of one or more of these.

1.7.1.2 U.S. Fish and Wildlife Service. USFWS is responsible for managing and regulating take of migratory bird species listed under the Migratory Bird Treaty Act. They are also responsible for regulating T&E species under ESA. Sections 1.7.2.2 and 1.7.2.3 below describe WS's interactions with the USFWS under these two laws.

1.7.1.3 Colorado Division of Parks and Wildlife. CPW is responsible under CRS Title 33 for managing most wildlife species in the State under the direction of the Colorado State Game Commission, and USFWS specifically for migratory birds and T&E species.

1.7.1.4 Colorado Department of Agriculture (CDA). CDA is authorized to cooperate with WS to conduct WDM. CDA regulates the pesticide laws in Colorado. WS registers any pesticides it uses with CDA. WS personnel that use pesticides in their job duties must be certified as a pesticide applicator through CDA or be supervised by a certified pesticide applicator. DRC-1339 and Avitrol are the only avicides registered for use in Colorado and pesticide users must be registered to use these under Colorado Administrative Code 21.17.57.1-11.

1.7.2 Compliance with Federal Laws

Several federal laws authorize, regulate, or otherwise affect WS WDM activities. WS complies with these laws, and consults and cooperates with other agencies as appropriate.

1.7.2.1 National Environmental Policy Act. WS prepares analyses of the Environmental impacts of program activities to meet procedural requirements of this law. This EA meets the NEPA requirement for the proposed action in Colorado. Most federal actions are subject to NEPA (Public Law 91-190, 42 USC

4321 et seq.) and its implementing regulations established by the Council on Environmental Quality (40 CFR 1500-1508). In addition, WS follows USDA (7 CFR 1b) and APHIS (7 CFR 372) NEPA implementing regulations as a part of the decision-making process. When WS operational assistance is requested by another federal agency, NEPA compliance is the responsibility of the other federal agency.

1.7.2.2 Endangered Species Act. It is federal policy, under ESA, that all federal agencies shall seek to conserve T&E species and shall utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS conducts Section 7 consultations with USFWS to use the expertise of the USFWS to ensure that "*any action authorized, funded or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species . . . Each agency shall use the best scientific and commercial data available . . .*" (Sec.7(a)(2)). WS obtained a Biological Opinion (BO) from USFWS in 1992 describing potential effects on T&E species and prescribing reasonable and prudent measures for avoiding jeopardy (USDA 1997, Appendix F). WS completed formal consultation at the statewide level to reevaluate relevant portions of the 1992 BO and to fully evaluate potential effects on T&E species listed or proposed for listing in Colorado, especially since the 1992 USFWS BO was somewhat outdated. WS (2011) completed a Section 7 consultation in Colorado with USFWS (2011b) and the results from that consultation are discussed in this EA.

1.7.2.3 Migratory Bird Treaty Act. The Migratory Bird Treaty Act of 1918 (16 USC 703-711; 40 Stat. 755), as amended, provides USFWS regulatory authority to protect species of birds classified as "migratory" and are listed in 50 CFR 10.13 (most all bird species except gallinaceous (*e.g.,* Wild Turkey, grouse) and introduced birds (*E.g.,* feral pigeon, starling). The law prohibits any "*take*" of bird species, eggs, and nests and possession of birds or bird parts by private entities, except as permitted by the USFWS; therefore, the USFWS issues permits to private and public entities, including WS, for reducing bird damage. A draft Memorandum of Understanding (MOU) for the purpose of migratory bird conservation is currently being developed between WS and USFWS to comply with Executive Order 13186 of January 10, 2001, the Responsibilities of Federal Agencies to Protect Migratory Birds (see Section 1.7.2.7 below).

WS may provide on-site assessments for persons experiencing migratory bird damage to obtain information on which to base damage management recommendations. Damage management recommendations could be in the form of technical assistance or operational assistance. When appropriate, WS may provide recommendations to the USFWS for the issuance of depredation permits to private entities to resolve a bird damage problem. The ultimate responsibility for issuing such permits rests with the USFWS (50 CFR 21.41). Starlings, feral domestic pigeons, House Sparrows, domestic waterfowl, and other non-native birds as well as resident, non-migratory birds such as grouse are not classified as protected migratory birds and therefore, have no protection under this Act. USFWS depredation permits are not required to kill blackbirds (Rusty Blackbird not included), cowbirds, all grackles, crows, or magpies in Colorado found committing or about to commit depredation upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance. Based on evidence that migratory game birds have accumulated in such numbers to threaten or damage agriculture, horticulture or aquaculture, the Director of the USFWS is authorized to issue a depredation order to permit the killing of such birds (50 CFR 21.42-47).

1.7.2.4 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All chemical methods used or recommended by WS are registered with and regulated by the EPA and CDA, and are used by WS in compliance with labeling procedures and requirements.

1.7.2.5 Food, Drug, and Cosmetic Act. This Act, as amended, gives the FDA the authorization to regulate the study and use of animal drugs. FDA regulates A-C and other immobilization drugs used by WS under this Act.

1.7.2.6 National Historic Preservation Act (NHPA). NHPA of 1966, as amended, and its implementing regulations (36 CFR 800) requires federal agencies to: 1) determine whether activities they propose constitute "*undertakings*" that can result in changes in the character or use of historic properties and, 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian Tribes to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings. Tribe's request WS BDM and sign agreements for WS to conduct BDM on their lands; thus, tribes have control over any potential conflict with cultural resources on tribal properties. WS activities as described under the proposed action do not cause ground disturbances nor do they otherwise have the potential to significantly affect visual, audible, or atmospheric elements of historic properties and are, thus, not undertakings as defined by NHPA. BDM could benefit historic properties if birds were damaging such properties. In those cases, the officials responsible for management of such properties would make the request and would have decision-making authority over the methods to be used. Harassment techniques that involve noise-making could conceivably disturb users of historic properties if they were used at or in close proximity to such properties; however, it would be an exceedingly rare event for noise-producing devices to be used in close proximity to such a property unless the resource being protected from bird damage was the property itself, in which case the primary effect would be beneficial. Also, the use of such devices is generally short term and could be discontinued if any conflicts with historic properties arose. WS has determined BDM actions are not undertakings as defined by the NHPA because such actions do not have the potential to result in changes in the character or use of historic properties.

1.7.2.7 Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act of 1940 (16 USC, 668-668d), as amended, allows for the protection and preservation of Bald Eagles and Golden Eagles by prohibiting, except under certain specified conditions, the taking, possession, and commerce of these birds. The Secretary of the Interior can permit the taking, possession, and transportation of specimens for scientific or exhibition purposes or for the religious purposes of Native American Tribes if the action is determined to be compatible with the preservation of the Bald or Golden Eagle. USFWS has recently drafted an EA to amend the Act to allow the "incidental take" of both Bald and Golden Eagles. Incidental take was formerly allowed only for the endangered Bald Eagle.

BDM could benefit eagles by providing protection from a direct wildlife threat to birds, nests or eggs by predation or disease, protection to individuals from being killed by aircraft strikes, or prevent eagles from being killed illegally by frustrated or careless individuals experiencing eagle damage or damage threats to resources. Although limited in Colorado, depredation of livestock and wildlife has been documented for both Bald Eagles and Golden Eagles. Generally, though, most predation of livestock is associated with Golden Eagles. Any interaction with eagles by WS is further tempered by WS Policy (WS Directive 2.315).

1.7.2.8 Executive Order 13186 - Responsibilities of Federal Agencies to Protect Migratory Birds. Executive Order 13186 of January 10, 2001 directs federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement, within 2 years, an MOU with USFWS that shall promote the conservation of migratory birds. WS currently has been working with USFWS on the MOU to cover such activities.

1.7.2.9 Executive Order 13112 - Invasive Species. Nonnative plants and animals that inadvertently find their way to the United States are of increasing concern as they threaten our natural resources. One study estimated that the total cost of invasive species in the United States amounted to more than $100 billion each year (Pimentel et. al. 1999, 2005). Invasive species impact nearly half of the species currently listed as T&E under ESA. On February 3, 1999, Executive Order 13112 was signed establishing the National Invasive Species Council. The Council is an inter-Departmental body that helps coordinate cost-effective federal activities regarding invasive species and ensure that activities are complementary. Council members include the Departments of the Interior, Agriculture, Commerce, State, Treasury, Transportation, Defense, and Health and Human Services, EPA, and the U.S. Agency for International Development. Together with the Invasive Species Advisory Committee, stakeholders, concerned members of the public, and member departments, the National Invasive Species Council (2001) formulated an action plan for the nation. The Council issued the National Invasive Species Management Plan early in 2001 to provide an overall blueprint for federal action. The Plan recommends specific action items to improve coordination, prevention, control and management of invasive species by the federal agency members of the National Invasive Species Council.

1.7.2.10 Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Environmental Justice is a movement promoting 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, also known as Environmental Equity, has been defined as the pursuit of equal justice and equal protection under the law for all Environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. This Executive Order is a priority within both APHIS and WS. 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. APHIS plans to implement Executive Order 12898 principally through its compliance with the provisions of NEPA. All WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to insure Environmental justice. WS personnel use WDM methods as selectively and environmentally conscientiously as possible. It is not anticipated that the proposed action would result in any adverse or disproportionate Environmental impacts to minority and low-income persons or populations.

1.7.3 Compliance with State Laws

Several Colorado laws regulate WS and BDM. WS complies with these laws as applicable, and consults and cooperates with State agencies as appropriate. These laws are in the CRS.

CRS 33-1-102. Defines protected small game birds (all birds hunted in Colorado) and nongame wildlife.

CRS 33-2-105. Endangered species. This provides special protection to State designated T&E species.

CRS 33-3-106. Permit to capture or destroy protected game damaging crops or property; . . . CPW can issue permits to take game and protected birds under this Statute.

CRS 33-6-107{9}. Predatory wild animals and rodent pests. These statutes allow the State of Colorado to cooperate with and fund WS WDM.

CRS 33-3-106. Procedures for CPW to handle depredations caused by wildlife. These sections of provide information for CPW and private landowners on how to handle wildlife damage on private and leased lands. In essence, these set the time frames for handling wildlife complaints for CPW. CPW will provide landowners with short- and long-term solutions for depredation problems.

1.8 A PREVIEW OF THE REMAINING CHAPTERS IN THIS EA

This EA is composed of 5 chapters and appendices. Chapter 2 discusses and analyzes the issues and affected environment. Chapter 3 contains a description of each alternative, alternatives not considered in detail, and SOPs to reduce potential problems associated with implementing BDM. Chapter 4 analyzes the Environmental impacts associated with each alternative considered in detail. Chapter 5 contains the list of preparers of this EA, persons consulted, and literature cited in the EA.

CHAPTER 2: DISCUSSION OF ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that will not be considered in detail, with rationale. Pertinent portions of the affected environment will be discussed with the issues used to develop SOPs in this chapter. Additional information on the affected environment will be incorporated into the discussion of the environmental impacts in Chapter 4.

A major overarching factor in determining which issues to include for analysis of the potential environmental impacts of WS's involvement in BDM in Colorado is that if, for whatever reason, the BDM conducted by WS were discontinued, similar types and levels of BDM will most likely be continued by State or local governments or private entities as allowed by state and federal laws. Thus, many of the BDM activities could take place without federal assistance, and, hence, would not trigger NEPA. From a practical perspective, this means that the Federal WS program has limited ability to affect the environmental outcome of BDM in Colorado, except that, based on WS employees' years of professional expertise and experience in dealing with BDM actions, WS is likely to have lower risks to and effects on nontarget species and the human environment in general, including people, than some other programs or alternatives available to State agencies and private landowners. Therefore, WS has a less likely chance of negatively affecting the human environment affected by BDM actions than would non-federal or private entities. In other words, WS BDM activities most likely have less of an adverse effect on the human environment than would BDM programs that would be likely to occur in the absence of WS BDM assistance. Thus, WS has a limited ability to affect the environmental status quo in Colorado. Despite this limitation of Federal decision-making in this situation, this EA process is valuable for informing the public and decision-makers of relevant environmental issues and analyzing these under the potential alternatives of BDM to address the various needs for action described in the EA.

2.1 ISSUES

The following issues or concerns about BDM have been identified through interagency planning and coordination, from EAs in Colorado which preceded this document such as (WS 2005), WS EAs in other states (WS 1996, 1998, 1999, 2001, 2003, 2006, 2008, 2009), and USDA (1997) as areas of primary concern that will be addressed in this EA.

- Effects of BDM on Target Bird Species Populations
- Effects of BDM on Nontarget Species Populations, including T&E Species
- Effects of BDM on Public and Pet Safety and the Environment
- Effects of BDM on Aesthetics

2.1.1 Effects of BDM on Target Bird Species Populations

A common concern among members of the public, wildlife management agencies, and WS is whether BDM actions adversely affect the viability of target native species populations. The target species selected for analysis in this EA are the primary ones which may be affected by WS BDM activities, especially those species that more than just a few individuals would likely be killed with lethal control measures under the proposed action in any one year. From FY06 to FY10, species taken lethally by WS with an average of more than ten taken included four nonindigenous commensal birds (European Starling, feral domestic Rock Pigeon, House Sparrow, and Eurasian Collared-Dove), one native dove (Mourning Dove), two blackbirds (Red-winged Blackbird and Common Grackle), one swallow (Cliff Swallow), four grassland passerines[4] (Horned Lark, Western Meadowlark, Western Kingbird, and Lark Bunting), two

[4] Categories of birds for this EA are given in Section 2.1.1.1.

waterfowl (Canada Goose and Mallard), two corvids (Common Raven and American Crow), and four raptors (Red-tailed, Swainson's, and Ferruginous Hawks, and Northern Harrier) (Table 8). Additionally, 30 other species were taken, but annual take averaged less than 10 for FY6 to FY10 (Table 8). No other species were taken by WS in BDM from FY95-FY05, other than those given in Table 8 of Chapter 4. This analysis will address impacts to these species as well as others that WS anticipates may be taken. In addition, some concerns are voiced about potential impacts from WS' harassment and hazing activities on birds (Table 10). Finally, some species of birds taken or harassed by WS are also harvested by hunters. Where data is available, harvest will be used with WS take to determine cumulative impacts.

Scoping during USDA (1997) revealed that some persons believe WDM interrupts the "balance of nature" which should be avoided. Others believe that the "balance" has shifted to unfairly favor generalist species, including birds. Several species' populations have steadily increased over the forty five years due to adaptability to human-made environments and damage from these species has increased accordingly (International Association of Fish and Wildlife Agencies 2004). To address these concerns, the effects of the alternatives on populations for the target species are examined. To fully understand the need for BDM, it is important to have knowledge about the species that cause damage and the likelihood of damage. Full accounts of life histories for these species can be found in bird reference books. Some background information is given here for the bird species in Colorado covered by this EA, especially information pertaining to their seasonal movements in Colorado. Species are primarily given in order of WS BDM efforts directed towards them, their subsequent take, and the occurrence and value of damage that the species cause in Colorado. However, less damaging species may be combined with species that cause more damage where life history and damage are somewhat similar. Finally, it should be noted that jurisdiction and management of these species mostly lies with USFWS and CPW which was discussed in Sections 1.7.1.3 and 1.7.1.4.

2.1.1.1 Basic Bird Species Information.

Bird species that cause damage, especially to particular resources, do not fall into regularly designated groups of birds. For this document, we have designated the following groups of birds: blackbirds (blackbirds, cowbirds, and grackles and not the entire family Icteridae which also includes meadowlarks and orioles), introduced/invasive commensal birds (feral or Rock Pigeons[5], Eurasian Collared-Dove, European Starlings (also just starlings in this document for brevity), House Sparrows, feral poultry [emus, chickens, peafowl, and guineas], and several parrots), corvids (jays, magpies, crows, and ravens), raptors (hawks, eagles, kites, harriers, accipiters, vultures, owls, and shrikes), larids (gulls, terns, jaegers, and skimmers), shorebirds (plovers, sandpipers, and allies), wading birds (herons, egrets, ibis, bitterns, flamingoes, and storks), waterbirds (loons, grebes, boobies, cormorants, pelicans, frigatebirds, tubenoses, and kingfishers), grassland species (meadowlarks, Lark Buntings, kingbirds, Horned Larks, pipits, Dickcissels, Bobolinks, longspurs, orioles, and goldfinches), native doves and pigeons, aerialists (swifts, nightjars, and swallows), woodpeckers, gallinaceous birds (pheasant, prairie-chicken, turkey, and quail), frugivorous birds (robins, waxwings, and finches), and other miscellaneous birds such as mockingbirds and roadrunners that can cause damage and hummingbirds and wrens which usually are not involved in damage (many of these requests involve injured birds, birds that get indoors and cannot escape, or build a nest in an area where it is not welcome, especially those species that attack passer byes like the Northern Mockingbird). Many species of birds can belong to more than one category, but they are placed more by the primary BDM program that they fit into (*e.g.*, grassland passerines are species that are often encountered at airports).

[5] Rock Pigeons in North America were actually from domestic stocks brought to the United States by early settlers and escaped (Johnston 1992). Therefore, they are truly feral domestic pigeons with less genetic variability than wild Rock Pigeons, the species they are derived from, and are referred to as feral or domestic pigeons or Rock Pigeons in this EA. This is similar to the most common domestic ducks which were derived from wild Mallards and Muscovy Ducks (both wild and feral populations exist in Colorado of these two species).

Introduced/Invasive Commensal Birds. Several species of birds have been introduced into the United States from other parts of the world or have escaped captivity. Most of these are considered invasive or non-native species to the ecosystem (introduced) and cause economic or environmental harm or harm to human health (National Invasive Species Council 2001, 2008). These species often compete with native wildlife (see Section1.3.4) and cause billions of dollars of damage in the United States annually (Pimentel et al. 2005). Several different exotic species have been found in Colorado. Some species have been established for many decades with established breeding populations throughout the United States such as feral pigeons, starlings, and House Sparrows, all introduced from Europe. Other species have only recently been found in the United States, but have rapidly expanded their population throughout the United States (Eurasian Collared-Dove) or persist in small numbers locally (domestic species such as feral waterfowl and other poultry). Appendix C lists many introduced species, but Table C4 lists most escapes not acknowledged as established in Colorado that could be the focus of a BDM project. As invasive species, the goal of BDM may be eradication, especially for those species that cause significant damage to resources such as the European Starling. It should be noted that a few introduced species have not received the status of "invasive species" primarily because they do not meet the definition of the National Invasive Species Council (2001) such as Ring-necked Pheasants.

European Starlings. Starlings are common residents and migrants in Colorado. They have long beaks, compared to blackbirds, and are stockier with a shorter tail. They have iridescent feathers, but appear speckled in winter following their molt (these wear off by breeding). Starlings were introduced into North America from Europe in the late 1800s into New York and expanded nationwide within decades after their release. Starlings are cavity nesters and will use any structures with holes for nesting. They often compete for nesting cavities with native birds such as the Eastern Bluebird and usually dominate the native species because they are much more aggressive. Starlings are gregarious, especially in winter when they form roosts in the thousands, often with blackbirds. Large flocks begin to form roosts as early as August and disband in April. Starlings require a high protein diet consisting of mainly fruits, insects, and some grains. The starling is unprotected by State and Federal laws and can be taken at any time. Starlings cause significant damage to livestock operations through consumption and contamination of feed and the potential for infecting livestock with disease. Starlings are considered a great threat to aviation because of the large flocks they form and have been responsible for catastrophic incidences involving the loss of aircraft and lives. In addition, winter roosts are a noise nuisance and their droppings damage buildings and property; if droppings are allowed to build up, they can become a source of several infectious diseases. Nesting by starlings can create a number of problems, including nuisance and fire hazards to buildings. The starling population BBS survey-wide and in Colorado has been declining at a significant ($P<.05$) rate of -1.2% and -1.0% annually from 1966 to 2009 (Sauer et al. 2011). The estimated population for Colorado is 1.6 million (Table 4). However, during winter the population increases with migrants from northern states. They often concentrate in feedlots, especially in eastern Colorado and along the Front Range. BDM methods to control starlings are discussed in Johnson and Glahn (1994) and Section 3.3.1.3.

Feral Pigeons and Collared-Doves. Feral pigeons (Rock Pigeons) and Eurasian Collared-Doves are found throughout Colorado. The Rock Pigeon was introduced to North America in the early 17th-century by colonists who brought domestic pigeons to Atlantic coast settlements that escaped and became feral (Schorger 1952, Johnston 1992). Domestic pigeons differ from true wild Rock Pigeons, similar to the domestic Mallard, in that people selected for specific genetic attributes which reduces the genetic pool that exists in the wild population. It is actually one of the few domesticated species that was able to establish a widespread feral population that thrives. The feral pigeon, interchangeable in this EA with Rock Pigeon, has been most successful in urban areas where they can cause a great deal of damage and represent a significant health risk to people. The Rock Pigeon has been established in Colorado for many decades. The Eurasian Collared-Dove, an invasive species, is rapidly becoming common after self-introduction into Florida from a population introduced to the Bahamas in the 1970s (Romagosa 2012). In addition to these two species, escaped African Collared-Doves (*Streptopelia roesogrisea*), formerly the domestic Ringed Turtle-Dove (*Streptopelia risoria*) (Romagosa 2012), can also be found in Colorado. This species is typically not associated with damage as often as the other species and rarely establish a self-sustaining population in the wild. Several BDM methods are used to manage damage caused by pigeons and doves (see Section 3.3.1.3) with most emphasis placed on controlling Rock Pigeon damage to property (Williams and Corrigan 1994) and dispersing birds from damage situations such as feedlots and airports (Booth 1994, Godin 1994).

Feral pigeons are mid-sized familiar urban birds. Eurasian Collared-Doves are smaller, but larger than most other doves. African Collared-Doves are smaller, but similar to the Eurasian Collared-Dove. These birds have robust bodies with small heads and short beaks, and are powerful fliers. Feral pigeons are found in urban and agricultural areas in close association with man, especially inhabiting buildings because they provide desirable nesting areas (i.e. flat surfaces under eaves). Eurasian Collared-Doves are common in a wide variety of habitats, but most common near wooded streams, in agricultural and weedy fields, and in urban areas. African Collared-Doves are usually found in urban areas for the most part, but usually will not survive in the wild for long periods of time.

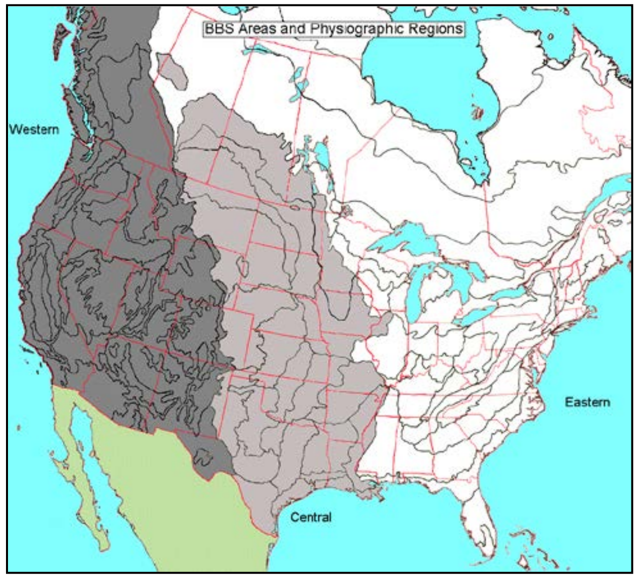

Figure 6. The BBS areas and physiographic regions analyzed by Sauer et al. (2011) for trends.

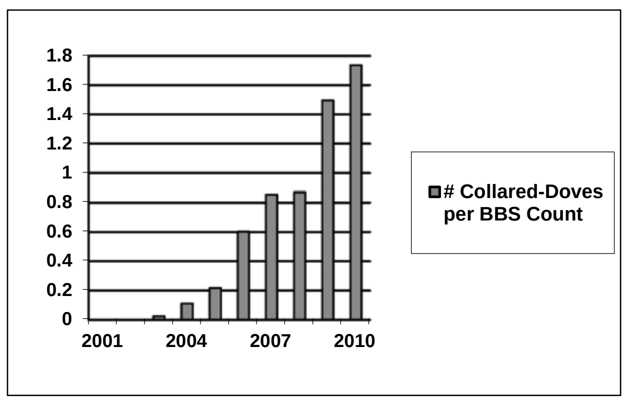

Figure 7. The average number of Eurasian Collared-Doves seen on an average of 99 BBS routes surveyed in Colorado from 2000 to 2010.

Rock Pigeons and collared-doves cause a wide variety of damage and are a threat to aviation due to size and flocking behavior, abundance, and medium size. Feral pigeons have an impact on property from their droppings; their droppings will deface buildings and paint on airplanes in hangars. Pigeons and their droppings, if allowed to build up, are a source of several diseases such as psittacosis that can infect people. From FY06 to FY10, feral pigeons had an annual average of 503 work tasks associated with them for an average of $29,000 damage (Table 1). Eurasian Collared-Doves only had an average 3 work task associated with it from FY06 to FY10 with a value of $200. It should be noted that Eurasian Collared-Doves only recently got established in Colorado and the first work task associated with them occurred in FY09. It is expected that work tasks associated with these doves will increase drastically over the next few years as their population has increased exponentially across the Country.

Feral pigeons have no federal or state regulations in Colorado. Eurasian Collared-Doves have year-round unlimited bag in Colorado. These species are considered exotics and can be taken at any time. The estimated breeding population of Rock Pigeons in Colorado is 320,000, a decrease over the last 30 years. The rate of decrease has been significant ($P<0.05$) at -0.8%, -1.1%, and -1.9% BBS survey-wide, in the central BBS area (Figure 6 shows BBS Areas[6]), and in Colorado from 1966 to 2009 (Sauer et al. 2011).

[6] Much of WS BDM in Colorado is conducted in BBS physiographic region 36 in the Central BBS region.

This decline could mostly be attributed to a loss of habitat as buildings and other structures are built more today to keep them from nesting. The Eurasian Collared-Dove is a recent arrival in Colorado, being recorded in the BBS for the first time in 2003 (3 in 118 counts). Since then the number has risen to 142 for the 99 counts conducted in 2009 (USGS 2012). It has had a significant increase (Figure 7) in the population from 1999 to 2009 ($P<.05$) of about 100% annually in Colorado (Sauer et al. 2011). Using Rocky Mountain Bird Observatory's (RMBO) (2007) adjustment parameters, the population from 2005 to 2009 could be estimated at 88,000 for Colorado. This suggests that WS will be getting more requests for assistance with these birds because their population is still increasing at an exponential rate in all available habitats.

House Sparrows. The House Sparrow, sometimes referred to as the English Sparrow (especially in laws and regulations), is a common bird in urban and agricultural areas. They were introduced into the United States from Europe and have become established from coast to coast. They are very common in Colorado. House Sparrows are small chunky birds with thick bills. Males have a gray crown, chestnut nape, black bib, and black bill. Females are brown overall with streaked backs, buffy eye-stripes, and unstreaked breasts. House Sparrows are found in close association to people, especially on farms, where cavities for nesting, dense trees for roosting, and food sources are available. House Sparrows are primarily granivorous; seeds, grains, and fruits make up almost their entire diet, but they will also feed on refuse from trash bins and in parking lots. Damage includes consumption and contamination of stored grains and damage to structures and other property from pecking. Their bulky nests in the cavities of buildings and other structures create a fire hazard and require constant cleaning maintenance. Their winter roosts, often in the thousands, are a noise nuisance and their droppings are a source of several diseases and parasites that increase custodial maintenance costs. House Sparrows are not usually considered a great airstrike hazard. House Sparrows are classified as unprotected nongame birds and can be taken at any time without a permit. Their estimated breeding population in Colorado using BBS data from 2006 to 2010 (U.S. Geological Survey (USGS) 2011) is 1.7 million using population parameters from RMBO (2007), about the same as it was in the 1990s (RMBO 2007). Their population is thought to be declining from their population high in the early 1900's to today from a reduction in habitat and feed such as seed gleaned from horse droppings. In Colorado and BBS survey-wide, the House Sparrow population is declining significantly at -2.4%/year and -3.7%/year. Since they are an invasive species, their take is not considered to have an impact on the human environment and may actually be beneficial. BDM methods for House Sparrows are discussed in Fitzwater (1994) and Section 3.3.1.3.

Feral Poultry. Feral poultry includes a variety of birds with the most common being domestic ducks, geese, Mute Swans, chickens, peafowl, and guineas. Feral ducks and geese are common in Colorado, especially in urban area parks. However, WS only had 2 work tasks associated with feral domestic waterfowl from FY06 to FY10. These commonly damage turf, landscaping, and other property, and have the potential for closing swimming areas from high coliform counts and other potential diseases. Additionally, feral domestic ducks and geese hybridize with their wild counterparts and have an effect on the gene pool of wild ducks and geese such as Mallards and Canada Geese. Hybrids are often found in parks along with the feral domestic ducks. Mute Swans are often escaped ornamental pets, but some possibly could arrive from the eastern United States where a feral population exists. Their primary damage, human health and safety concerns, occurs in the breeding season when they can get very aggressive and attack people. If a feral population were to get started, this species can cause damage to natural resources such as they have in the eastern United States. Feral chicken, peafowl, and guinea problems are not common, and WS had no work tasks associated with them from FY06 to FY10. Some poultry are more of a nuisance to homeowners in urban areas.

Exotic Birds. Colorado has few exotic birds that have escaped captivity or intentionally released. Most exotic species would not survive the winters in Colorado. The most common of these are different species in the parrot family. WS had no work tasks associated with them from FY06 to FY10. Some exotics have been released in the state, but are not considered invasive species or cause damage problems (*e.g.*, Chukar). However, a primary concern to most biologists is the potential impact to native species from the exotics.

Native Pigeons and Doves. Band-tailed Pigeons, and White-winged and Mourning Doves are native to Colorado with Mourning Doves being the most numerous (Appendix C: Table C1). Two other species have been documented in Colorado, but outside their normal range (Appendix C: Table C3). From FY06 to FY10, Mourning Doves caused an annual average of 313 work tasks with damage documented at $200 (Table 1). No other native dove species caused damage from FY06 to FY10. Several BDM methods are used to manage damage caused by pigeons and doves (see Section 3.3.1.3), especially dispersing birds from damage situations such as crop fields and airports (Booth 1994, Godin 1994).

Band-tailed Pigeons are mid-sized, stocky birds that look similar to feral Rock Pigeons. White-winged and Mourning Doves are smaller and more slender. Inca Doves and Common Ground-Doves, accidental in Colorado, are much smaller. All have robust bodies with small heads and short beaks. All are powerful fliers; Mourning Doves typically fly close to the ground near cover between feeding and roosting areas, while pigeons will fly at higher altitudes. Mourning, White-winged, and Inca Doves and Common Ground-Doves are common in a wide variety of habitats, but most common near wooded streams, in agricultural and weedy fields, and in urban areas. Band-tailed Pigeons are found in ponderosa pine (*Pinus ponderosa*) and pinion (*Pinus delis*)-juniper (*Junipers spp*.) forests, and oak (*Quercus spp*.) woodlands.

Pigeons and doves cause a wide variety of damage and are a threat to aviation due to size and flocking behavior, abundance, and medium size. Band-tailed Pigeons can cause crop damage, especially to fruits. Mourning and White-winged Doves can cause some damage to grain crops. Native doves and pigeons are migratory game birds and have established hunting seasons with bag limits. The estimated breeding populations of pigeons and doves in Colorado are 8,100 Band-tailed Pigeons, 210 White-winged Doves, and 4.2 million Mourning Doves. Band-tailed Pigeons have been declining nonsignificant ($P > 0.05$) from 1966-2009 in Colorado at -2.2%/year while Mourning Doves have been increasing at 0.1%/year nonsignificantly ($P>0.05$) (not enough data for the White-winged Dove in Colorado) (Sauer et al. 2011). Survey-wide data for Band-tailed Pigeons and Mourning Doves reflect significant ($P < 0.05$) declining trends of -2.8%/year and -0.3%/year from 1966-2009, while the White-winged Dove shows a significant increasing trend ($P<0.05$) of 3.4%/year from 1999-2009 (Sauer et al. 2011). Band-tailed Pigeon and Mourning Dove populations are thought to be decreasing as a result of habitat loss and White-winged Doves are increasing from range expansion.

Blackbirds. Six species of blackbirds (blackbirds, grackles, and cowbirds as discussed in Section are commonly found in Colorado at some time during the year (Appendix C), the Red-winged, Yellow-headed, and Brewer's Blackbirds, Common and Great-tailed Grackles, and Brown-headed Cowbirds. All of these species are abundant seasonally. Additionally, Rusty Blackbirds and Bronzed Cowbirds have been documented in Colorado. From FY06 to FY10, blackbirds, sometimes mixed with starlings (Table 1), had an average of 219 work tasks associated with them and an average of about $4,200 damage (attributing half the value of damage caused by mixed flocks of starlings and blackbirds to blackbirds). Several BDM methods are used to manage damage caused by blackbirds (Dolbeer 1994) with the most applicable and current techniques discussed in Section 3.3.1.3.

Blackbirds are medium sized songbirds with heavy bills. They have iridescent black feathers and medium length tails. All are gregarious, especially in winter when they form mixed species roosts in the thousands. Large flocks begin to form roosts as early as August and disband in April. Blackbirds are primarily granivorous with the exception being the Rusty Blackbird. Blackbirds are attracted to a variety of habitats depending on the species. Brewer's Blackbirds are attracted to urban areas such as at an airport, grass and weedy fields, fallow croplands, and livestock feeding operations. Great-tailed Grackles and often Common Grackles are found in open areas with scattered trees including residential neighborhoods and marshlands. Brown-headed Cowbirds are found in similar environments and open woodlands. Red-winged and Yellow-headed Blackbirds, and Common Grackles are attracted to croplands and weedy fields, and roost and nest in marshy areas, especially cattails. Rusty Blackbirds are most common in wet woodlands where they prefer a diet of invertebrates rather than grain. This species roosts with other blackbird species, but often is found foraging in single species flocks or together with Common Grackles in or near wooded wetlands and not as frequently in agricultural fields or feedlots with other blackbirds (Avery 1995); this is especially true in Colorado where they are only rarely found in winter.

The six species of blackbirds that are primarily found in Colorado are found year-round with most migrating out of the state in winter. During migration numbers of the species can increase dramatically from migrating birds in northern states. Most BDM projects are conducted by WS from late fall to spring when most species are absent from the state. From most to least abundant, the Red-winged Blackbird, Common Grackle, Brewer's Blackbird, Yellow-headed Blackbird, Brown-headed Cowbird, and Great-tailed Grackle have estimated breeding populations in Colorado, using BBS raw data from 2005 to 2009, of 2.9 million, 1.3 million, 1.2 million, 570,000, 200,000, and 62,000, respectively. All these species, except the Great-tailed Grackle, are found throughout Colorado; the Great-tailed Grackle which has been expanding its range northward is found primarily on the Plains. The Rusty Blackbird nests in the boreal forests of Canada. It has declined precipitously over the last 40 years and has an estimated population of 2 million throughout its range (National Audubon Society (NAS) 2011a). A small percentage of Rusty Blackbirds migrate through Colorado to their wintering grounds in the Southeast. The Bronzed Cowbird is a rarity in Colorado, for the most part breeding south of the State.

Blackbirds are classified as migratory nongame birds, but can be taken under a USFWS Depredation Order when concentrated in a manner that constitutes a health hazard except for the Rusty Blackbird, an Audubon Watchlist species (NAS 2007) , also published as Butcher et al. 2007). The Rusty Blackbird was removed from the Order (FR 75(231):75153-75156, Dec. 2, 2010) because the species population has declined significantly over the last 40 years. Blackbirds are considered a great threat to aviation because of the large flocks they form. In addition, winter roosts are a noise nuisance and their droppings damage buildings and property, and, where droppings are allowed to build up, they can become a source of several infectious diseases. Brewer's Blackbirds, in particular, are very aggressive nest protectors and will often attack people nearing their nest. Finally, the Brown-headed and Bronzed Cowbirds, a rarity in Colorado, are parasitic nesters, laying eggs in other bird nests. This has been linked to add to the decline of several song birds such as the Golden-cheeked Warbler by the Brown-headed Cowbird (Ladd and Gass 1999) and the Audubon's Oriole by the Bronzed Cowbird (Flood 1990), but usually not the primary a causative factor for the species' declines because habitat loss and fragmentation usually is considered the primary factor. Friedmann (1963) and Friedmann and Kiff (1985) summarized information on host species. Over 220 host species have been reported as being parasitized and 144 of these species have actually reared cowbird young. Cowbird hosts have ranged in size from a third of an ounce such as Brown Creepers, kinglets, and gnatcatchers to 5 ounces such as meadowlarks.

Swallows, Nighthawks, and Swifts. Six species of swallows, the Purple Martin, 3 swifts, the Common Nighthawk, and the Poor-will are found in Colorado regularly during the breeding season. Swallows and swifts are slender aerialists with long-pointed wings. Nighthawks are similar, but much larger and primarily nocturnal. Swifts are especially fast fliers. They all feed on insects caught on the wing with their wide, gaping mouths. Cliff and Barn Swallows build mud nests under eaves and bridges. The other swallows, and swifts, nest in cavities of rocks, banks, and trees. Nighthawks nest on the ground or large branches. These species are attracted to areas with an abundance of flying insects. They also are attracted to areas with suitable roosting or nesting habitat (barren to sparsely vegetated ground with large trees for nighthawks, dead snags in riparian areas for tree swallows, eaves or tunnels for mud-nest builders, crevices and cracks in buildings or rocks for the others). The nightjars are typically found in forested habitats and mostly nest on the ground; none of these is anticipated to cause damage concerns.

The primary damage from the other species in this group is from the mud-nest builders, and especially the colonial nesting Cliff Swallow (Barn Swallows are usually tolerated because they nest singly). Mud-nest builders can cause damage from falling debris and droppings, especially in and around buildings, causing continual clean-up costs during the nesting season. Additionally, parasites (bugs such as mites and fleas) in the nest can cause problem for domestic animals and people. Chimney swifts can cause damage from their twig nests in chimneys and other structures. All of these species can be a problem at airports where colonies of them are found because they are commonly on the wing, like bats, searching for insects; nighthawks can cause more damage to aircraft than the other species because they are somewhat large. Swallows, swifts, and nighthawks are migratory nongame birds and protected by USFWS and CPW. The Black Swift is an Audubon Watchlist species (NAS 2007). From FY06 to FY10, WS had an annual average of 101work tasks associated with these species valued at $3,300 (Table 1). BDM methods specifically for swallows are discussed in Gorenzel and Salmon (1994), and for all of these species, as appropriate, in Section 3.3.1.3.

Grassland Species. Western Meadowlarks, Lark Buntings, kingbirds, phoebes, flycatchers, Horned Larks, pipits, Dickcissels, Bobolinks, Emberizidae sparrows, longspurs, Snow Buntings, orioles, rosy finches, and goldfinches are often found in grasslands or semi-open country and are common grassland species in Colorado (some species in groups such as flycatchers are actually woodland species, but for ease, included here – most do not cause problems and are included in Table C2). Western Meadowlarks are similar in size and appearance to starlings except they are light brown with black V's on their breasts and yellow underparts. Dickcissels are somewhat smaller versions of meadowlarks. Kingbirds, phoebes, and flycatchers are smaller birds that are often found in somewhat open country using perches to hawk for insects. Horned Larks, pipits, Lark Buntings, longspurs, Snow Buntings, White-crowned and Savannah Sparrows are slender, sparrow sized ground-dwellers. Orioles are similar to blackbirds in size and shape, but have bold orange or yellow with black colors. Orioles tend to stay near edge or riparian areas adjacent to grasslands and forage on primarily insects and usually are not a damage problem. American Tree Sparrows, small brown and gray birds, also tend to stay near brushy areas at the edge of fields. Goldfinches are small birds with stout short beaks with black wings and yellow or green bodies (have breeding and winter plumages). They feed on weed seeds in grasslands or edge areas. Many of these species such as meadowlarks, Horned Larks, and goldfinches form loose-knit flocks in winter. These species are attracted to short grass habitats and agricultural fields where seeds and insects are abundant. These species tend to stay near the ground; however, meadowlarks and kingbirds will use perches such as telephone wires. Orioles and goldfinches typically stay near edge areas. These species are often abundant at airports where they are struck by aircraft. Though most of these species are small which reduces damage to aircraft considerably, these species often will be in flocks of up to several hundred (Horned Larks, buntings, and longspurs), presenting a hazardous situation. Grassland species were responsible for 5,218 strikes in the United States with 764 of those in Colorado from FY02 to FY11; the Horned Lark had the highest number of strikes at 1,624, 4.4% of all United States strikes, with 520 in Colorado, 33.8% of known species strikes so a serious concern at Colorado airports (Appendix D: Table D1). These species often need to be controlled at airports and to protect some agricultural crops. White-crowned Sparrows can cause damage to landscaping and crops, especially in those fields and gardens adjacent to river bottoms (Clark and Hygnstrom 1994a) and Horned Larks to agricultural crops (Clark and Hygnstrom 1994b).

The grassland species are migratory nongame birds and managed by USFWS and CPW. The Sprague's Pipit[7] is a federal candidate species, but rarely found in Colorado (one was documented to be struck at an airport in Colorado) (Appendix D: Table D1). The Lark Bunting, McCown's Longspur, Brown-capped Rosy Finch, and Black Rosy Finch are birds of conservation concern (USFWS 2008a); three of these species in this category are not expected to cause damage. Additionally, the Audubon Watchlist species

[7] The Sprague's Pipit would have been included in Appendix C: Table C3 because it is a rarity in Colorado, but was included in C1 since it was in the strike record with one killed at a Colorado airport. Thus we anticipate that this species could be targeted.

(NAS 2007) lists 3 species not expected to cause damage and 4 accidental species. Finally, it should be noted that the BBS trend for several of these species and the Eastern Kingbird, Baltimore and Bullock's Orioles, and Eastern (rarity in Colorado, but in FAA bird strike record at Colorado airports) and Western Meadowlarks significantly declined from 1966 to 2007 survey-wide with most declines determined to be loss of extensive grassland habitat. BDM methods for grassland birds are discussed in Section 3.3.1.3 and for White-crowned Sparrows and Horned Larks, specifically, in Clark and Hygnstrom (1994a, b). These species were annually responsible for 621 work tasks with no value (Table 1).

Waterfowl. Waterfowl primarily refers to ducks, geese, swans, cranes, moorhens, and coots because these species are mostly managed as migratory game birds which frequent wetland areas. Ducks can be further subdivided into surface feeders and divers. Nine species of surface feeding ducks, 10 species of diving ducks, 5 geese, 1 crane, and a coot can be regularly found in Colorado. Most are only common seasonally, with many migrating through or wintering in Colorado. Of all of the species of waterfowl, 16 have been found in BBS surveys from 2006 to 2010 (USGS 2012). The most common year-round residents are the Canada Geese, Mallards, Gadwalls, American Wigeons, Northern Shovelers, Green-winged Teals, Lesser Scaups, and the Common Mergansers. Several species such as the Snow Goose and Lesser Scaup are abundant during migration or winter migrating into Colorado from northern breeding areas. Ducks, geese, and swans are aquatic birds with webbed feet, long necks, narrow pointed wings, and short legs. Cranes are tall birds with long legs, beak, and neck, and non-webbed feet. Coots and moorhens are black and the Purple Gallinule purple; all have short tails, stubby, rounded wings, lobed toes and short beaks. In addition to those given, Colorado has also documented 15 other swans, ducks, and geese, and Common Moorhen and Purple Gallinule in Colorado which are only infrequently found or accidental. Finally, several feral or escaped waterfowl can be found in Colorado which was discussed above. From FY06 to FY10, waterfowl had an annual average of 530 work tasks associated with them valued at $1.7 million (Table 1). Several BDM methods are used to manage damage caused by waterfowl (see Section 3.3.1.3) and are specifically discussed in Cleary (1994). Waterfowl are flocking from late summer through winter causing associated damage problems and BDM efforts can be focused on dispersing these birds from damage situations such as crop fields and airports (Booth 1994, Godin 1994).

Waterfowl, cranes, and coots are attracted to wetland habitats. Several species of ducks, geese, cranes, and coots are attracted to field crops such as wheat. Geese, swans, and to a lesser extent, wigeons and coots, frequent grass and winter wheat fields. Other species, especially the divers, are attracted to open water where they feed on fish and submerged aquatic vegetation and some can be a problem at aquaculture facilities. Canada Geese and Mallards can be a nuisance in urban areas at parks and in residential areas where they cause property damage and fecal contamination of water and lawns. Additionally, nesting Canada Geese can be very aggressive and injure people nearing their nests. Waterfowl are particularly hazardous to aircraft because of their size and weight, flocking behavior, and relative abundance. Waterfowl, cranes, and coots are protected as migratory game birds by federal and state laws, but most can be hunted during the fall and winter. Hunting dramatically increases the effectiveness of hazing techniques. Permits are needed to take waterfowl, but hunters with the appropriate licensing can take waterfowl during open seasons. The Whooping Crane is federally listed as endangered with a small population that migrates from Wood Buffalo National Park in Canada through the Central Plains States east of Colorado to Aransas National Wildlife Refuge in Texas and rarely ever show up in Colorado; this species in particular is avoided, but could potentially be hazed from an airport with the appropriate permit (this would be beneficial for the cranes because they could be struck by aircraft). One other species, the greater subspecies of Sandhill Crane is a state listed species of concern.

Corvids. Corvids are well-known, boisterous birds and include crows, jays, magpies, and ravens. Crows and ravens are black, medium sized birds that are slightly iridescent in sunlight. Magpies are black and white birds that appear medium-sized because of their relatively long tail. Jays, with the exception of the Gray Jay, have blue in varying amounts contrasted with gray, black, or white. Clark's Nutcrackers and Gray Jays are white, black, and gray. Ravens, crows, magpies and Western Scrub-Jays are common in open areas close to dense or scattered trees, or brushy or riparian habitats. The other jays are more common in coniferous or deciduous forests with some open areas. Corvids are opportunistic feeders and will feed on a wide variety of food including fruits, nuts, small animals, insects, refuse, and carrion. Activities such as plowing are very attractive to ravens, crows, and magpies because of the food that becomes exposed. Most corvids are flocking during the winter and can cause problems. The winter roosts of magpies and crows can be a noise nuisance and potential health hazard from accumulated fecal material. Non-breeding ravens are also flocking and are often the ravens implicated in damage to livestock. All of these species, but especially flocking birds, can cause damage to crops such as pecans and corn. Ravens and magpies will kill livestock, primarily those that are somewhat incapacitated such as newborns or cows calving. Crows and ravens are medium size and can inflict severe damage to airplanes, especially where they are hunting insects in the airfield. Crows are the most commonly struck corvids at airports (258 of the 296 corvid strikes at airports in the United States) with 4 strikes in Colorado from FY02 to FY11 (Appendix D: Table D1). Corvids are migratory nongame birds, but the crow is hunted in many states including Colorado. Crows and magpies can be taken without a permit when found doing damage, but USFWS permits are required to take the other species.

Corvids are represented by 10 species that breed in Colorado, and are regular occurring species. The most abundant species are the Pinyon Jay with 300,000, Black-billed Magpie with 230,000, Clarke's Nutcracker with 200,000, and Steller's Jay with 190,000 (RMBO 2007). Less abundant species include the American Crow with a breeding population of 120,000, the Western Scrub-Jay (80,000), Gray Jay (30,000), Common Raven (24,000), Blue Jay (13,000) on the western part of its range, and Chihuahuan Raven (7,000) on the northern part of its range. Of the species in Colorado, the Common Raven, American Crow, and Black-billed Magpie were the only corvids associated with work tasks from FY06 to FY10, annually averaging 73 with 51 of these for the Common Raven. The ravens were associated with livestock and wildlife depredations, typically pecking the eyes or other soft tissue of newborn livestock causing them to die or potentially depredating eggs and nestlings of the Gunnison Sage-Grouse. Corvid damage in Colorado from FY06 to FY10 averaged 98 work tasks and $9,500 damage annually. All are protected species, with the exception that magpies and crows can be taken under a USFWS Depredation Order when found or about to commit damage or are a safety concern, and can be hunted in some states during established seasons.

Corvid populations have been negatively and positively affected by habitat changes depending on the species, and possibly West Nile virus which affected this group more than other species of birds. Of the 10 species (Appendix C: Table C1), the Black-billed Magpie has decreased significantly ($P<0.05$) survey-wide and in Colorado at -0.7%/year and 1.2%/year. BBS survey-wide, the Blue Jay and Pinyon Jay are also significantly ($P<0.05$) at -0.7%/year and -3.7%/year from 1966 to 2009 (Sauer et al. 2011). The Steller's Jay and Western Scrub-Jay in Colorado and BBS survey-wide, the Pinyon Jay in Colorado, and the Gray Jay survey-wide show nonsignificant ($P>0.05$) decreasing populations(Sauer et al. 2011). On the other hand, the American Crow and Common Raven show significant increases ($P<0.05$) of 0.3%/year and 2.6%/year survey-wide and of 1.7% and 2.7%/year in Colorado from 1966 to 2009 (Sauer et al. 2011). These increases in populations are believed to have been partly attributed to the availability of anthropogenic year-round food sources such as at landfills, in urban areas, and in agricultural production areas. Additionally, the Chihuahuan Raven and Clark's Nutcracker BBS survey-wide and in Colorado, and the Blue Jay and Gray in Colorado show nonsignificant (P>0.05%) increases from 1966 to 2009 (Sauer et al. 2011). Of these species, WS has the highest impact on the Common Raven and American Crow (discussed in Chapter 4), species increasing despite control efforts. Several BDM methods are used to manage damage caused by corvids (see Section 3.3.1.3) and are specifically discussed for American Crows (Johnson 1994), magpies (Hall 1994), and Western Scrub-Jays (Clark and Hygnstrom 1994d). Several corvids flock from late summer through winter causing associated damage problems and BDM efforts can be focused on dispersing these birds from damage situations such as crop fields and airports (Booth 1994, Godin 1994).

Raptors. Raptors include vultures, eagles, hawks (Osprey, kites, harriers, accipiters, buteos, and falcons), and owls. Shrikes are also included in this category because of behavioral similarities. Raptors are predatory birds or scavengers that possess hooked beaks and talons to capture and feed on prey. Shrikes do not have talons; they impale their prey on thorns or barbed-wire to feed on them. Raptors range in size from small species such as the Elf Owl and American Kestrel to the larger ones such as the Golden Eagle and Turkey Vulture. Most species have typical hunting styles including soaring (vultures, eagles, Red-tailed Hawks), low-flying ambush (harriers), dense forest ambush (accipiters), hovering (kestrel, Rough-legged Hawk), or watching from perches (buteos or *broad-winged hawks*, owls). Most are solitary hunters. Most owls are nocturnal and hunt at night. The combination of abundant small mammal populations, open spaces, and roosting and perching structures provides ideal habitat for most raptors. Most raptors do not cause significant problems, except potentially at airports. Black Vultures, eagles, Red-tailed Hawks, Great Horned Owls, and, to a lesser extent, other raptors will take livestock and poultry. Turkey Vultures will roost sometimes in large flocks and can be an odor nuisance in and around residences or cause property damage to structures. Cooper's Hawks sometimes chase prey, birds, into warehouses where, often, they cannot find their way out. Kites are very aggressive nest defenders and will occasionally strike people that near their nest, often drawing blood from the victim in the attack. Most raptors represent a significant hazard to aircraft due to their larger sizes and hunting over open spaces such as airfields.

Colorado has 1 species of vulture, 2 eagles, 14 hawks, 5 owls, and 2 shrikes that regularly occur with the potential to be involved in BDM projects. In addition, 7 species of owls are found regularly in Colorado that will not likely be the focus of BDM because these are found in habitats not conducive to causing damage, including airports. Lastly, 10 species of raptors, 8 hawks and 2 owls, have been found in Colorado only rarely and, as a result, are not likely to be the focus of a BDM project. From FY06 to FY10, raptors were associated with an annual average of 1,280 work tasks valued at $75,500. One incident caused the majority of this damage when a Red-tailed Hawk collided with an airplane causing $350,000 damage or $65,000 of the average value (Table 1 and Table 3). Red-tailed Hawks accounted for the majority of damage and work tasks from FY06 to FY10 (Table 1). Average annual work tasks associated with raptors included 409 for Red-tailed Hawks, 189 for Northern Harriers, 157 for Swainson's Hawks, 135 for Ferruginous Hawks, 90 for American Kestrels, 86 for Turkey Vultures, 70 for Rough-legged Hawks, 65 for Bald Eagles, 62 for Great Horned Owls, and 46 for Golden Eagles (these ten species were responsible for 95% of the work tasks). Additionally, 70 work tasks were associated with 10 other species. Almost all work tasks associated with raptors were worked at airports and most of these were conducted at airports. Raptors in Colorado caused an average of 23 strikes/year (16 hawks and 7 owls) at Colorado airports and airbases from 2001 to 2010 (Appendix D). Several BDM methods are used to manage damage caused by raptors (see Section 3.3.1.3) and can be focused on hawks and owls (Hygnstrom and Craven 1994), eagles (O'Gara 1994), and Mississippi Kites (Andelt 1994). Several species of raptors are significant problems at airports, and are often hazed or trapped (Godin 1994), but hazing efforts usually are not as effective for them.

Raptors are protected as migratory birds. Eagles are specifically protected under their own Act and a permit is required to harass or take them. Wildlife control personnel avoid harassing eagles, but would if it became necessary at an airport or livestock facility where they were a potential threat to aircraft or where they were killing livestock. None of the raptors are federally listed T&E species, but the Bald and Golden Eagles, Swainson's and Ferruginous Hawks, Peregrine and Prairie Falcons, and Burrowing and Short-eared Owls are birds of conservation concern (USFWS 2008a) and considered accordingly.

Larids. Larids are gulls, terns, jaegers, and skimmers. Gulls are familiar birds. They are robust birds with webbed feet, long pointed wings, a stout slightly-hooked bill, and, typically, a square tail. Most gulls are white with gray backs and black wing tips and, sometimes, heads. Gulls are attracted to water or food including refuse from dumpsters and landfills, earthworms, insects, and carrion. They are also attracted to lakes, sandy beaches, flat-roofed buildings, parking lots, and airports because they often provide ideal loafing sites. Terns are typically similar to gulls, except that they are smaller and slimmer with long narrow wings, forked tails, and pointed beaks. Terns are piscivorous (eat fish), diving into water after their prey. The jaegers and skimmers are rarities in Colorado, typically associated with coastal areas.

All of these species represent a significant strike hazards at airports. Gulls are considered a primary hazard at airports because of their size, abundance, wide and expanding distribution, flocking behavior, and general tendency to concentrate at airports. As a group, gulls caused 27% of the strikes at civil airports in the United States from 1990 to 2004 where the species was identified (4,582 out of 16, 727) with most strikes (89% occurred at less than 500 feet above ground) occurring at or near the airport (Dolbeer 2006). However, relatively few gulls are struck in Colorado averaging 0.5/year from 2001 to 2010 (FAA 2011a). Gulls are also a problem at landfills where they may carry off refuse, potentially hazardous waste, to nearby residential areas (landfills are often cited by the Health Department for not having adequate bird control programs). Finally, gull fecal material, such as on a rooftop, can build-up to the point of causing damage. Gulls occasionally will also damage agricultural crops. Terns and gulls can cause problems at aquaculture facilities. Colorado has only a few breeding gull populations, but has gulls year-round (many juveniles and nonbreeders may stay during the nesting season). Most gulls are in the State during migration and sometimes through winter depending on the temperature (*e.g.*, in colder winters many migrate further south). BDM methods for gulls are discussed in Solman (1994) and Section 3.3.1.3. BDM methods to protect aquaculture facilities from fish-eating birds including Larids are discussed in Gorenzel et al. (1994) and Section 3.1.3.3; several of these methods generally apply to protection of other resources.

Five species of gulls and 5 terns can be found in Colorado regularly (Appendix C: Table C1) with the Ring-billed and California Gulls being most numerous typically. The Franklin's and Bonaparte's Gulls can be numerous during migration. In addition, 23 other species of larids, including 16 gulls, 3 terns, 3 jaegers, and the Black Skimmer have been recorded in Colorado (Appendix C: Table C3) some with more frequent occurrence such as the Lesser Black-backed Gull which is expanding its range. Larids are protected as migratory birds under the Migratory Bird Treaty Act by USFWS, and are classified as migratory nongame birds by CPW. The Least Tern is a federally listed endangered species. Of the species that breed in the BBS survey area (9 of the 10 found in Colorado), the Franklin's Gull is the only one with a significant downward trend from 1966 to 2009, decreasing at rates of 5.0%/year (Sauer et al. 2011). On the other hand, the Ring-billed Gull has significantly increased at 3.3%/year from 1966 to 2009.

Shorebirds. Colorado regularly hosts 34 species of shorebirds including avocets, stilts, plovers, sandpipers, and phalaropes (Appendix C: Table C1) with an additional 8 species being documented once or infrequently (Appendix C: Table C3). Most only migrate through Colorado with only 6 species being seen regularly on BBS routes from 2006 to 2010 (USGS 2012). Additionally, 7 species of shorebirds, and possibly one thought to be extinct, are accidental in Colorado. Avocets and stilts are sleek and graceful waders with long slender beaks, and spindly legs. Plovers are compact birds with short beaks; they dart across mudflats, will stop abruptly, and race off again. Sandpipers vary much more, but typically have medium to long legs and beaks, and flocks fly seemingly erratic, but in unison. Phalaropes are similar to plovers with semi-webbed feet, but spin like tops in the water when they are feeding; phalaropes are somewhat unique in that the female is the more colorful and larger than the male. Most shorebirds are attracted to open, shallow water and mudflats. A few can be seen around agricultural fields and airport operating areas, especially fallow or short grass fields, after rains. They feed on invertebrates, typically probing mudflats with their beaks. Shorebirds are commonly hit by aircraft on or around airports where they are abundant (Dolbeer 2006). A few shorebirds are medium in size and most flock presenting their biggest threat to aviation. Aviation safety is again the primary concern with these species and BDM methods used to reduce their hazards at airports are discussed in Godin (1994), Booth (1994), and Section 3.3.1.3. Much involvement by WS with shorebirds, though, has been for disease monitoring.

Shorebirds are protected as migratory nongame birds. The Eskimo Curlew, which migrated through the Plains States from arctic breeding grounds was listed as endangered, but is likely extinct. The Piping Plover, listed as threatened, has mostly been known to migrate through Colorado; recently, Piping Plovers have begun breeding in the Arkansas River Basin. The Mountain Plover is a proposed threatened species. Additionally, USFWS (2008a) lists the Snowy Plover, Upland Sandpiper, and Long-billed Curlew as birds of conservation concern and Audubon's Watchlist (NAS 2007) also lists the American Golden-Plover, Marbled Godwit, Sanderling, Semipalmated Sandpiper, Western Sandpiper, White-rumped Sandpiper, Stilt Sandpiper, Buff-breasted Sandpiper, Hudsonian Godwit, and Red Knot. Shorebirds mostly pose threats to aircraft. BDM methods used to haze birds from airports are discussed in (Booth 1994, Godin 1994) and Section 3.1.3.3. Shorebirds had 36 work tasks associated with them from FY06 to FY10 (Table 1) with no damage value. In addition to conducting BDM at airports, WS in Colorado did collect several species of shorebirds for disease monitoring.

Wading Birds. Waders include herons, egrets, ibis, and bitterns. Wading birds in Colorado include 8 species regularly found (Appendix C: Table C1) and 9 others species that have only been occasionally to accidentally found (Appendix C: Table C3). The largest, the Great Blue Heron, is somewhat common year-round, except in colder winters. The White-faced Ibis, American Bittern, Snowy Egret, Great Egret, and Black-crowned Night-Heron are fairly common during the nesting season. The Cattle Egret and Green Heron are less common and sporadic. Most wading birds are medium-sized and have long legs, beaks, and necks for stalking and hunting foods in shallow waters and open fields. Many are adorned with plumes in the breeding season. Wetlands and open areas with abundant prey such as rodents, amphibians, insects, and crayfish are attractive to most wading birds. Many of these species nest communally in rookeries which can become an odor and noise nuisance in residential areas. Additionally, where these nesting areas are used year after year, the trees often die from fecal contamination. Wading birds can be a significant problem at aquaculture facilities (Dorr and Taylor 2003) and to aircraft because of their size and slower flight speeds (FAA 2011b); the feeding behavior of Great Blue Herons and Great Egrets in open grasslands and the flocking behavior of particularly the Cattle Egret presents hazards to aircraft. Of the damage caused by these species documented by WS, most occurred at aquaculture facilities and airports by Great Blue Herons, Snowy Egrets, Great Egrets, and Black-crowned Night-Herons. WS had an annual average of 38 work tasks associated with wading birds from FY06 to FY10, with an average value of about $5,000. Wading birds are protected as migratory nongame birds. BDM methods for use at aquaculture facilities are discussed in Gorenzel et al. (1994) and, for general use, in Section 3.3.1.3. These species are managed as migratory nongame birds by USFWS and CPW and can only be taken with a USFWS permit. It should be noted that the American Bittern is a bird of conservation concern (USFWS 2008a).

Loons, Grebes, Pelicans, Cormorants, and Kingfishers (Waterbirds). Colorado commonly has one species of loon, pelican, cormorant, and kingfisher, and 5 species of grebes that are regularly found in the State at some time during the year. None of these species is particularly abundant in Colorado, except the Double-crested Cormorant locally. Nine other species have been accidentally found in Colorado, but most well outside their normal range. Loons are large waterbirds with thick bills and necks, and webbed feet; they submerge directly underwater to feed on fish, crustaceans, and aquatic plants. Grebes are smaller with narrow beaks, long thin necks, and lobed toes; they dive forward to submerge under water and feed on fish. Loons and grebes are rarely seen in flight. Loons and grebes live in close association to wetlands with abundant fish, invertebrates, and aquatic vegetation. The pelicans are large, white or brown (as their names imply) waterbirds with a massive bill and throat pouch. pelicans dive from the air to catch fish. Pelicans primarily roost and nest on the ground. Cormorants are large, black birds with set back legs, a hooked bill, and reddish-orange facial skin and throat pouch. Anhingas, only accidentally found in Colorado, are similar to cormorants in appearance, except that have a heron-like neck and beak. Cormorants and the Anhinga dive from the water's surface to catch fish. Cormorants nest in colonies in trees that are submerged in water. Kingfishers are smaller stocky birds with slate blue or green backs and often have breast bands. Kingfishers dive from the air to ambush fish or invertebrates just under the surface and typically nest in banks. These species are attracted to open waters with a good fishery. Kingfishers are usually associated with wooded streams and lakes where they hunt fish and aquatic invertebrates from trees, wires, or other perches. Many of these species, especially cormorants and pelicans, depredate fish at aquaculture facilities and can reduce native fisheries where their populations are abundant; applicable BDM methods used to protect aquaculture are discussed in Gorenzel et al. (1994) and Section 3.3.1.3. Kingfishers are often controlled at fish hatcheries where they cause minor problems (Kelly et al. 2009); in fact, USFWS permitted the take of several for hatcheries (Table 9). Most of these species do not represent a significant hazard to aircraft because they are mostly solitary and stay close to water. Pelicans and cormorants, though, can be extremely hazardous, because of their large size, slow flight, and flocking. Loons, pelicans, and cormorants have been struck by aircraft, though infrequently, and have the potential to cause severe damage. These species are migratory nongame birds and managed by the USFWS and CPW.

The Belted Kingfisher, the only "landbird" in this group, has small breeding populations in Colorado. RMBO (2007) using BBS data determined that its breeding population is 12,000 in Colorado. BBS data from 2006 to 2010 (USGS 2012) suggest that the most abundant breeding waterbirds in Colorado are the American White Pelican and Double-crested Cormorant, followed at much lower levels Eared Grebes, Pied-billed Grebes, Western Grebes, and Belted Kingfishers. All breeding species in Colorado, except the kingfisher, show nonsignificant increasing trends; the kingfisher shows a nonsignificant declining trend from 1966 to 2009 (Sauer et al. 2011). Survey-wide, the Horned Grebe and Belted Kingfishers show significant declining trends of -2.7%/year and -1.5%/year from 1966 to 2009 with the Double-crested Cormorant showing the only significant increasing trend of 4.7%/year (Sauer et al. 2011). From FY06 to FY10, these species annually averaged 35 work tasks with an average value of just over $6,000.

Woodpeckers. Nine species of woodpeckers regularly occur in Colorado. An additional 3 species have also been documented in the State. Woodpeckers are familiar birds because of their drumming and cavity building behavior. They are relatively small birds with short legs, two forward - two back, sharp clawed toes for climbing trees, stiff tail feathers for support, and a sharp, stout beak for drilling. These characteristics enable them to climb trees while probing for insects or making cavities. Woodpeckers are found near or in wooded areas. Their undulating flight is a characteristic trait. They are territorial and usually found alone or in pairs. Woodpeckers are primarily attracted to areas with trees, space, water, and a good food supply. Woodpeckers are primarily insectivorous, though they also eat fruits and nuts (sap for sapsuckers). Woodpeckers can damage structures such as buildings and telephone poles. They can also damage crops such as pecans. Since woodpeckers are fairly territorial damage is typically at low levels to orchard crops and uniform throughout orchards rather than focused in a particular area. Woodpeckers are protected as migratory nongame birds. Of the species that regularly occur in Colorado, the Lewis's Woodpecker is a bird of conservation concern (USFWS 2008a) and the Red-headed Woodpecker and Williamson's Sapsucker are on the Audubon Watchlist (NAS 2007). The species that causes the most damage in Colorado has been the Northern Flicker with Hairy and Downy Woodpeckers combined a distant second. Their breeding populations in Colorado were estimated to be 300,000, 74,000, and 30,000 by RMBO (2010). From FY06 to FY10, WS annually averaged 73 work tasks associated with woodpeckers (71 for flickers) with a damage value of almost $210,000 (Table 1). BDM methods for woodpeckers are discussed in Marsh (1994) and Section 3.3.1.3.

Gallinaceous Birds. Colorado has 13 species of gallinaceous birds with the most abundant and likely to be involved in BDM the Ring-necked pheasant (230,000), Scaled Quail (30,000), Northern Bobwhite (14,000), and Wild Turkey (14,000) (population numbers from RMBO (2007)). Gallinaceous birds are primarily ground-dwellers with short, rounded wings and short strong bills. Flight is usually very brief for these species, as they prefer to walk. Males are typically very colorful and perform elaborate courting displays. Pheasants and quail can be found in several habitats ranging from riparian woodlands to agricultural fields, but primarily open areas with brushy cover. Quail are normally found close to permanent water. Turkeys are found in close association with wooded regions. The prairie-chickens are found in short- and long-grass prairies with interspersed agricultural areas. All are primarily grain and seed eaters. Of these, the Scaled Quail was the only one to be involved in BDM from FY06 to FY10 (Table 1); they were hazed from an air operating area several times at an airport. These species are hazardous to aircraft when found on or around airports. Gallinaceous birds are protected as resident game birds by CPW and most have hunting seasons. These birds are non-migratory and not protected by federal laws, except the Gunnison's and Greater Sage-Grouse and Lesser Prairie-Chicken are listed as federal candidates. The two populations of Sharp-tailed grouse are listed as State endangered and a species of concern and Scaled Quail are listed on the Audubon Watchlist (NAS 2007). BDM methods for gallinaceous birds are discussed in Section 3.3.1.3.

Frugivorous Birds. Several fruit and seed eating birds are found in Colorado that can cause damage. The most notable of these, other than those discussed above such as starlings, are the American Robin, Northern Mockingbird, Cedar Waxwing, Northern Cardinal, and House, Purple and Cassin's Finches. These birds are all mid-sized small birds, often forming large flocks. The robin is well-known with its red-breast and slate-black or grayish back. The Northern Mockingbird is gray and white with flashes of white in their wings; they are highly territorial and do not form flocks. Waxwings are brownish and have crests, black masks, short tails with yellow tips; they get their name from wax-like red tips on the wing feathers of adults. The finches are small brownish sparrow-sized birds; males have a bright red forehead, breast, and rump. These species are attracted to trees that have fruits or nuts, grains, and areas with an abundance of insects. Earthworms are a major attractant for robins. Most prefer brushy to open areas with scattered trees, and sometimes dense forests. Robins use dense trees or thickets for roosting. Grapes and other fruits can be significantly damaged by these species. Other than agricultural damage, robins and House Finches can form nightly roosts in residential areas causing some nuisance problems. Northern Cardinals often see their reflection in windows and incessantly attack the window, becoming a nuisance or sometimes damaging screens. The Northern Mockingbird is a very aggressive nester, often attacking people that come near the nest. House Finches can build nests in structures and droppings become a problem. These two species are especially a problem at the entrance to residences and businesses. American Robins and a few other species can be a problem at airports during migration, especially when they are flocks, though often they are loose-knit. These species are migratory nongame birds and protected by USFWS and CPW. BDM methods for frugivorous birds are discussed in Section 3.3.1.3. Clark and Hygnstrom (1994c) discuss methods specifically to address House Finch damages. These species generally are not a significant problem in Colorado, generating only an annual average of 12 work tasks from FY06 to FY10, with most all associated with American Robins at airports (Table 1). The only species of concern among this group is the Cassin's Finch which is listed as a bird of conservation concern (USFWS 2008a).

Other Birds. A few other birds (Appendix C: Table C1) in Colorado infrequently cause damage, or have the potential. Greater Roadrunners are somewhat common in far southeast and prey on lizards and the eggs and nestlings of birds. These species did not have any work tasks associated with them from FY06 to FY10. Finally, a few other bird species could possibly be a problem at airports (grosbeaks) or other resources (White-breasted Nuthatches have been found to nest in cavities likely drilled by woodpeckers in the sides of structures, but abandoned quickly and then widened and used by the nuthatches), though it is anticipated that this will be infrequent. Several other birds are commonly found in Colorado (Appendix C: Table C2), but few will ever cause damage, though they may be responsible for a request for assistance (*e.g.,* injured bird picked up to be taken to a rehabilitator).

2.1.1.2 Bird Population Estimates. To determine impacts from WS lethal BDM activities, a reasonable quantitative estimate of a bird population provides the best reference for impacts from WS and others (Table 4). Bird populations generally are quite mobile and wide-ranging. Thus, a population estimate should be somewhat specific to the population potentially affected, but include all areas where the species may reside, even if for just a short duration in Colorado. For example, WS conducts BDM year-round in Colorado and can involve resident birds and migratory birds during winter that come into Colorado from northern breeding grounds such as the Red-winged Blackbird; thus, birds likely come from a larger area and impacts need to be considered for the overall population and not just for Colorado. For migratory birds, it is important to know when birds are present that cause damage and when the BDM projects will be conducted. It is especially important to have population numbers for those species that more than several individuals will be lethally taken. Those species lethally taken by WS with an average of 100 or more includes two invasive species, the European Starlings and feral pigeons, and Mourning Doves, Red-winged Blackbirds, Cliff Swallows, Western Meadowlarks, Canada Geese, and Western Kingbirds. In some years, more than 100 Lark Buntings, Common Ravens, Mallards, and Red-tailed Hawks have been taken, but their average was less 100. The analysis in Chapter 4 will primarily key on these species, but all species that are taken or possibly be taken by WS will be considered. Other species that have been killed in limited numbers include other corvids, other raptors, other herons, egrets, vultures, hawks, crows, shorebirds, waterfowl, and swallows. Also, there may be concerns about potential adverse impacts from WS's harassment of nesting birds during spring. This analysis will address those impacts as well.

Bird populations that are affected by BDM are either migratory or resident with some bird species having populations that are both (*e.g.*, Red-winged Blackbird). Some WS BDM projects involve resident species which primarily include many of the invasive species (*e.g.*, Rock Pigeons) and gallinaceous birds (*e.g.*, Wild Turkey). Several migratory species are found in Colorado year round, but the population may actually shift during the year (*e.g.*, Mallards). Additional birds may come into Colorado for the winter while some that summer in Colorado may leave. Canada Geese have a "resident" population (transplanted, especially in urban areas) in Colorado and more that migrate through or winter from northern breeding grounds. Some species only nest in Colorado during the summer and migrate out of the State from fall through spring (*e.g.*, Cliff Swallow), though a few may linger in the area during winter months. Some only migrate through the State from northern breeding areas to southern wintering grounds (*e.g.*, Franklin's Gull) and return passing through in spring. And finally, some species of migratory birds targeted in BDM may only winter in Colorado (*e.g.*, Rough-legged Hawk). Colorado WS BDM involves species from all of these groups. Because birds can be involved in BDM from more than just Colorado, bird populations are looked at over a broader area.

Current bird population estimates are unavailable for most species of birds and are estimated from the best available information for impacts analyses. The best information available for monitoring most bird populations, primarily land birds and not colonial water birds, is trend data from the Breeding Bird Survey (BBS). The BBS is a long-term (1966-2007), large-scale inventory of North American birds, coordinated by the U.S. Geological Survey, Patuxent Wildlife Research Center, which combines a set of over 3,500 roadside survey routes primarily covering the continental United States and southern Canada (Sauer et al. 2011). BBS routes are surveyed each May and June by experienced birders. The stated primary objective of the BBS has been to generate an estimate of population change, or index, for songbirds. Estimates of population trends from BBS data are derived primarily from route-regression analysis (Geissler and Sauer 1990) and are dependent upon a variety of assumptions (Link and Sauer 1998). The statistical significance of a trend for a given species is reflected in the calculated *P*-value (i.e., the probability of obtaining the observed data or more extreme data given that a hypothesis of no change is true) for a particular geographic area and is best calculated over a number of years and larger geographic areas. BBS trends are available for 1966 to 2009 and 1999 to 2009, or can be analyzed for any set of years desired (Sauer et al. 2011). Older BBS data (*e.g.*, Sauer et al. 2008) gave the level of significance of a trend estimate. The new BBS data does not give the exact level of significance for a trend rather whether the level of significance is $P<0.05$ or $P>0.05$. Sauer et al. (2011) note the trends that are significant. BBS data can be summarized for Colorado, the Central or Pacific Flyways (the northern limit of the BBS is in central Alberta, British Columbia, and Saskatchewan, and southern limit Mexico), or survey-wide for species breeding in the BBS survey area.

BBS data are intended for use in monitoring bird population trends, but has the potential for providing a general estimate of the size of bird populations from the average birds seen/survey route (Rich et al. 2004, RMBO 2007). The raw data is available from counts for individual routes, all routes combined in a particular geographic area such as a state, or all routes by a single year or multiple years (USGS 2012). If a population has been increasing or declining in the last 20 years, the best estimate of a population would come from recent data. The population estimates for land birds from RMBO (2007) were derived using BBS data from the 1990s and sometimes other bird population data, especially in areas with few or no BBS counts and for nocturnal or secretive species, to derive population estimates. RMBO (2007) looked at several factors to estimate bird populations.

However, some populations have changed since the 1990s (Table 4), the data used for RMBO (2007). Thus, a new estimate using current BBS data would provide a better impact analysis. For this EA, it was decided that populations would be estimated from BBS raw data for different geographic areas averaged for the last 5 years for the geographic area of the majority of bird population involved in BDM (2006 to 2010) because 5 FYs are used to look at impacts (FY06 to FY10). This estimate would lack some of the complicated formulas RMBO (2007) used to make their estimate. A population estimate will be calculated for the analysis using 2006-2010 data, but mostly presented with the RMBO (2007) estimate because they also calculated other factors into the population estimate. The estimate made will focus on the population likely impacted from BDM. For example, feral pigeons, starlings, ravens, and species with minimal take are estimated at the statewide level since most lethal BDM projects in Colorado involve only the resident birds. For most other species, except for waterbirds and those that do not nest within the BBS survey area, populations will be estimated for the Rocky Mountain States (RMS) since most birds in Colorado will come from this area and the most likely to be affected by BDM in Colorado (Figure 8). However, the BBS physiographic areas shaded in Figure 8 would likely provide a better estimate for the population of migratory birds affected by BDM in Colorado; the raw data, though, is available by states and provinces, and not the BBS physiographic regions. Additionally, impacts to the populations are known for WS, but less so by others, especially in Canada. Thus, only the RMS area will be used.

WS will use BBS data, averaging the relative abundance for geographic areas from 2006 to 2010, to estimate populations that are impacted lethally by WS BDM (Table 4). WS conducts BDM for most all species that are either residents in Colorado or primarily come from the west Central and east Pacific Flyways which, for the purposes of this EA, include the BBS physiographic regions: 34, 36, 37, 38, 39, 54, 55, 56, 61, 62, 63, 64, 65, 80, 81, 82, 83, 84, 86, 87, 88, 89 and that portion of region 30 in Canada except Manitoba in the states and Canadian provinces of: southern Alberta, British Columbia, and Saskatchewan; eastern California, Oregon, and Washington; western Nebraska, North Dakota, Oklahoma, South Dakota, and Texas; and the entire states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming (Figure 8). Additionally, some birds come from areas further north (primarily area 29) in Canada from the Central Flyway or, to a lesser extent, the far western portion of the Pacific Flyway, the far eastern portion of the Central Flyway, the Mississippi Flyway, or the Atlantic Flyways. However, for the EA, the migratory bird populations in the core area of this region will be estimated from the Rocky Mountain States of Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming, the RMS region determined to likely produce birds that could potentially be taken by BDM in Colorado.

Using methods adopted by Partners in Flight (PIF) to estimate population size with BBS data (Rich et al. 2004, RMBO 2007), the numbers of birds seen per route can be used to extrapolate a population estimate. The PIF system involves extrapolating the number of birds in the 50 quarter-mile circles (total area/route = 9.82 mi^2). It also makes assumptions on the detectability of birds, which *varies* for each species. For example, some species that are large such as ravens and vultures or vocalize frequently such as Mourning Doves and American Crows are much more easily detected during bird surveys than species that are small and inconspicuous such as owls and Horned Larks, or do not vocalize that often or loudly during surveys such as herons and shorebirds. Additionally, breeding males are often the most visible during surveys while females may be in cover or on a nest and not detected such as Red-winged Blackbirds. Given an idea about the detectability of a bird species, a population estimate can be obtained from the equation - #

of birds/route seen/9.8 mi^2 x area of concern x detection parameters (distance, pair, and time). RMBO (2007) discusses the detectability parameters in detail. Detectability parameters were not made for colonial waterbirds because it has been determined that the BBS data has limitations for estimating their populations.

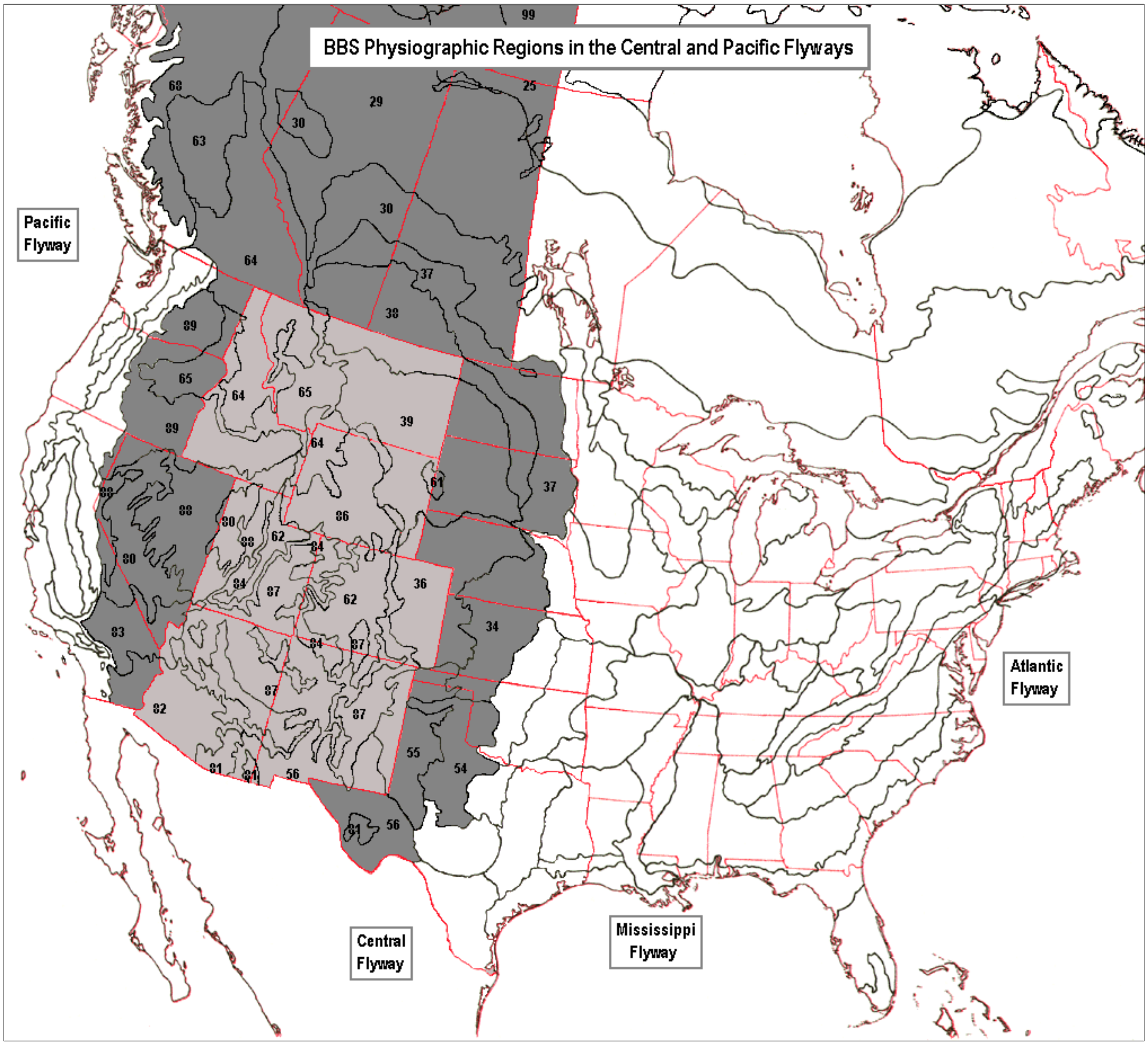

Figure 8. BBS physiographic regions in the Central and Pacific Flyways (shaded light gray) that encompass the population of birds that could be impacted by BDM in Colorado, especially those during migration and winter. The shaded area includes BBS regions 34, 36, 37, 38, 39, 54, 55, 56, 61, 62, 63, 64, 65, 80, 81, 82, 83, 84, 86, 87, 88, 89 and that portion of region 30 in Canada excluding Manitoba. This area excludes the eastern portion of the Central Flyway (eastern Great Plains), western portion of the Pacific Flyway (coast and coastal mountains), and birds from the Canadian boreal forest and Arctic tundra (BBS regions 25, 29, 68, and 99) which are mostly north of the BBS boundary limit. Migratory bird population estimates for the EA will be derived from the light gray shaded area or the Rocky Mountain States (RMS) of Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming using BBS raw data for those states.

Table 4. Population estimates for those species that WS takes the most in BDM in Colorado from BBS (USGS 2012) raw data (see Appendix A for details). Population estimates for Colorado are included for land birds in the 1990s (RMBO 2007) and for waterbirds (NAS 2012c).

Species	Detectability Parameter Factors			RMBO Pop. Estimate 1990-1999 ^	Ave. Colo. BBS Birds/Count 2006-2010^^	Colorado Pop. Estimate 2006-2010 ^^	Colorado Pop. Est. 1990-1999^
	Dist.	Pair	Time				
Population Estimates for the Less Migratory/"Resident"/Local Species in Colorado							
Canada Goose*	x	x	x	5,300,000	4.059	43,000	na
Feral Rock Pigeon	4	2	1.19	26,000,000	2.364	320,000	500,000
European Starling	4	2	1.06	120,000,000	16.083	1,600,000	1,700,000
House Sparrow	4	2	1.06	82,000,000	14.485	1,600,000	1,700,000
Population Estimates of Migratory Birds in Colorado with Little Take in BDM by WS							
Mallard	x	x	x	23,000,000	3.489	37,000	na
Great Blue Heron	x	x	x	120,000	0.597	6,300	na
Turkey Vulture**	0.5	2	2.61	1,300,000	0.717	9,900	7,000
Northern Harrier	1	2	1.29	400,000	0.324	8,800	9,900
Swainson's Hawk	1	2	1.26	460,000	2.075	55,000	48,000
Red-tailed Hawk	1	2	1.61	2,000,000	1.645	56,000	39,000
Ferruginous Hawk	0.5	2	1.33	20,000	0.3444	4,800	2,600
Rough-legged Hawk+	0.5	2	1.62	8,000	nb	nb	nb
American Kestrel	4	2	1.2	4,300,000	1.127	110,000	130,000
Killdeer	x	x	x	1,400,000	3.528	37,000	na
California Gull	x	x	x	410,000	1.768	19,000	nb
Ringed-billed Gull	x	x	x	1,700,000	0.075	800	nb
Eurasian Collared-Dove	4	2	1.32	400,000	1.075	120,000	Not here
Mourning Dove	4	2	1.31	110,000,000	36.649	4,100,000	4,500,000
Barn Owl	10.2	2	7.32	300,000	0.009	15,000	10,000
Great Horned Owl	1	2	11	2,000,000	0.237	55,000	70,000
Western Kingbird	4	2	1.55	18,000,000	12.998	1,700,000	1,500,000
Black-billed Magpie	1	2	1.23	3,400,000	7.347	190,000	230,000
American Crow	1	2	1.55	31,000,000	4.739	160,000	120,000
Common Raven**	0.5	2	1.3	2,000,000	5.173	71,000	24,000
Horned Lark	4	2	1.35	81,000,000	59.836	6,800,000	9,200,000
Cliff Swallow	4	2	1.31	80,000,000	19.928	2,200,000	2,600,000
Barn Swallow	4	2	1.19	51,000,000	7.134	720,000	60,000
Lark Bunting	4	2	1.09	27,000,000	22.631	2,100,000	5,100,000
Red-winged Blackbird	4	2	1.13	190,000,000	30.36	2,900,000	3,500,000
Western Meadowlark	1	2	1.13	30,000,000	72.465	1,900,000	2,400,000
Brewer's Blackbird	4	2	1.39	35,000,000	11.7	1,200,000	1,300,000
Common Grackle	4	2	1.23	97,000,000	11.059	1,300,000	3,000,000
Great-tailed Grackle	4	2	1.32	7,800,000	0.603	67,000	30,000
Brown-headed Cowbird	4	2	1.45	51,000,000	5.818	580,000	620,000

***** PIF (Rich et al. 2003, RMBO 2007) provided estimates for landbirds and NAS (2011c) for waterbirds. BBS data do not generally provide sufficient information to estimate waterbird populations; the estimate is provided using no corrective factors (i.e., a corrective factor of 1).

****** Distance detectability parameter was adjusted for these species because we believe the PIF parameters (Rich et al. 2003 and RMBO 2007) are overly conservative. PIF has twice the distance counted in the BBS point counts (800 meter radius instead of 400 meter radius set as BBS observer limit for counting) because these species may cover large distances flying during the 3 minute count or can be heard calling from long-range. However, this effectively increases the area counted or decreases the population estimated four-fold. While there is no doubt that some birds are detected from an area greater than quarter mile radius in the BBS point counts, the assumption that all birds of these species are counted in an area 4 times the size of the point count (after accounting for time and pair detectability parameters) would be an underestimate. In fact, limitations at survey stops that restrict vision such as trees, structures, and hills reduce the area surveyed at many point counts already, especially for species that are relatively quiet such as the Turkey Vulture, and many birds are not counted as a result. Therefore, we believe a more appropriate estimate, yet still believed to be conservative, would be acquired by using twice the size of the count area rather than 4 times which equates to a distance parameter of 0.5. We believe that the actual distance parameter for these species should be even closer to 1.

^ Estimates using BBS data from 1990-1999 (Rich et al. 2003 and RMBO 2007) for the United States and Canada.

^^ Estimates from 2006-2010 BBS raw data (USGS 2012) with point counts covering 9.82 mi^2 (the Canada Goose population will not be used for analysis).

+ Does not breed in the RMS area, but the northern boreal forests of Canada, mostly north of the BBS limits.

++ Spring 1999 population estimate from Resident Canada Goose EIS (USFWS 2011a)

To determine impacts, all known take in the area used to estimate the population is analyzed in Section 4.1.1.1. WS records or estimates take of species killed in BDM. Estimates of other take are made for species hunted or those species that are permitted to be taken under permits issued by USFWS to resolve depredations. In many cases, undocumented take can occur for species that are not protected (starling, feral pigeon, and House Sparrow) or have a USFWS depredation order (blackbirds, magpies, and crows) which allows take without a permit. For these species, an estimate of other take can be made, but should only be considered a guess; to be conservative we believe we have greatly overestimated this take.

Many of the requests for assistance that WS receives occur during winter when migratory birds have come into Colorado, thus changing bird population numbers. Birds from a larger geographic area are often involved in depredations, namely those that reside in the state and those that migrate into the state, mostly from northern areas. NAS conducts nationwide bird surveys within a few weeks of December 25th, the NAS Christmas Bird Counts (CBC). The CBC (NAS 2011b) reflects the number of birds in Colorado during early winter that would occur after migrations are completed. The Christmas Counts are a volunteer effort conducted by all levels of birders and only provides the number seen in a 15 mile diameter circle (177 mi^2). The CBC data does not provide a population estimate (numbers can be extrapolated for the area of coverage giving a very rough population estimate over a larger area), but can be used as an indicator of trend in the population, used to determine winter species composition, or compared with other populations. CBC data often varies much more than BBS data due to variations in winter climate and observer ability.

2.1.1.3 BDM for T&E, and Sensitive Species. Of most concern to WS and others are BDM activities that need to be directed at T&E, and sensitive bird species which have limited populations. Colorado has 20 bird species or subspecies considered T&E, or sensitive (Table 5). Some federal and state listed species have the potential of being the target of a BDM project. Any activity involving a listed species would require a Section 10 or State permit under ESA, Colorado laws, or other allowance to conduct that activity. Additionally, the species being targeted, its status throughout its range, and available techniques would be considered. In most all situations, nonlethal techniques would likely be used including trapping and relocation. In addition, Colorado has documented 79 species considered sensitive species by USFWS (2008a) and NAS (2007) which are not federally or state listed species (Appendix C).

Table 5. Federal and State listed avian T&E and candidate species in Colorado and potential of them to be targeted in BDM or the potential impact as a nontarget species in BDM.

Species	*Scientific Name*	Status	Locale	BDM Target	Protected by BDM	BDM Nontarget
Lesser Prairie-Chicken	*Tympanuchus pallidicinctus*	FC ST	Southeast	A/S	N P	F
Plains Sharp-tailed Grouse	*Tympanuchus phasianellus jamesii*	SE	Far East	A/S	N P	F
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	SC	Northwest	A/S	N P	F
Greater Sage-Grouse	*Centrocercus canadensis tabida*	FC SC	Northwest	A/S	N P	F
Gunnison's Sage-Grouse	*Centrocercus minimus*	FC SC	Southwest	A/S	N P	F
Bald Eagle	*Haliaeetus leucocephalus*	SC	Statewide	A/S Aq L	0	F R
Ferruginous Hawk	*Buteo regalis*	SC	Statewide	A	0	F R
American Peregrine Falcon	*Falco peregrinus anatum*	SC	Statewide	A L	0	F
Whooping Crane	*Grus americana*	FE SE	Far East	A/S Aq	0	FT
Greater Sandhill Crane	*Grus canadensis tabida*	SC	West	A/S Aq	N	F
Western Snowy Plover	*Charadrius alexandrinus*	SC	Statewide	A/S	N	F M
Piping Plover	*Charadrius melodus*	FT ST	Statewide	A/S	N	F M
Mountain Plover	*Charadrius montanus*	SC	Statewide	A/S	N	F M
Long-billed Curlew	*Numenius americanus*	SC	Statewide	A/S	0	F
Least Tern	*Sterna antillarum*	FE SE	East	A/S Aq	N	F M
Western Yellow-billed Cuckoo	*Coccyzus americanus*	FC SC	West	0	0	0
Burrowing Owl	*Athene cunicularia*	ST	Statewide	A	0	F
Mexican Spotted Owl	*Strix occidentalis lucida*	FT ST	South	0	0	0
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE SE	Southwest	0	C	0
Sprague's Pipit	*Anthus spragueii*	FC	Statewide	A/S	0	F

STATUS	BDM Target	BDM to Protect	BDM - Nontarget
F - Federal	**A** – Airport	**C** – Cowbird Nest Parasitism	**F** –Frightening Devices
S - State	**Aq** – Aquaculture	**N** – Egg/Nestling Depredation	**M** – Mist Nets
E - Endangered	**L** – Livestock/Poultry	**P** – Predation Adults	**R** – Raptor Traps
T - Threatened	**S** – Toxic Spill (*e.g.*, oil)	**0** - none	**T** – Toxicants
C – Candidate/Concern	**0** – Not Targeted		**0** – No Impact
P – Proposed			

Of the 20 listed avian species in Colorado, 17 have the potential of being targeted by BDM (Table 5). Most of these species would potentially be targeted at airports where they were deemed a strike hazard. Most would be frightened with hazing devices such as pyrotechnics and propane cannons. Some of the raptors such as the Ferruginous Hawk are not easily frightened with hazing techniques, but could be trapped with raptor traps and relocated (see Section 3.1.3.3). This may seem to be a negative interaction with a listed species, but it would actually be beneficial because the species would be hazed or relocated from the aircraft operating area, reducing the possibility of it being killed or injured by aircraft. Of the 17 species listed that could be involved in BDM at airports, 4 of these will likely never be involved in Colorado including the Lesser Prairie-Chicken, Sharp-tailed Grouse (2), and Gunnison's Sage-Grouse. Additionally, it is unlikely that the Whooping Crane will be either because of its rarity migrating through Colorado.

Similarly, 14 species could be hazed from an area with toxic waste such as sludge ponds, oil pits, gold and copper mining cyanide ponds from heap leach mining, and accidental spills to reduce the potential for them to be killed. Many of these sites have been found in Colorado, but the industries involved have improved compliance with preventing migratory bird use (USFWS 1996). This, again, would be a beneficial impact on the species because hazing activities at a toxic site would reduce the likelihood of deaths.

WS personnel may work to protect resources from T&E or sensitive species (Table 5). Aquaculture facilities could be impacted by 4 species. The Whooping Crane and Least Tern would require a Section 10 permit to haze being a federally listed species. Finally, Bald Eagles kill livestock such as lambs and Peregrine Falcons kill poultry such as show pigeons and may need to be hazed or relocated from the damage area.

From FY06 to FY10, of the 20 listed T&E or sensitive avian species in Colorado, 1 State listed threatened species (the Burrowing Owl) and 4 State listed sensitive species (Bald Eagle, Ferruginous Hawk, Peregrine Falcon, and Long-billed Curlew) were involved in BDM projects at airports with 206 work tasks associated with them (200 for the eagle and hawk alone). During this time, WS lethally took an average of 14 Ferruginous Hawks and 0.2 Peregrine Falcons lethally and hazed or trapped and relocated an average of 361 Ferruginous Hawks, 72 Bald Eagles, 3 Long-billed Curlews, and 1 Peregrine Falcon (all at airports). From FY95 to FY05, WS did not receive other requests for any other T&E species. Thus, in 16 years, WS has only documented working with 5 T&E or state sensitive species, showing the minimal potential for damage that these species actually represent.

On the other hand, WS could conduct BDM to protect T&E or sensitive species. WS has conducted BDM to protect some avian species as well as other listed species from depredating bird species. WS has conducted avian predator control to reduce predation of Gunnison's Sage-Grouse nests and young from Common Ravens where a landfill had artificially supported a high raven population density. Additionally, WS in coordination with the Corps of Engineers and USFWS may provide protection to nesting T&E Least Terns and Piping Plovers from avian predators. Some BDM in other States has been conducted to alleviate nestling/egg depredation for other T&E species or nest parasitism (cowbirds on flycatcher, vireo, and warbler nests). Additionally, other T&E species could be depredated by birds and may need BDM to protect them. Where a bird(s) has been identified as a limiting factor for T&E or other sensitive species' population, BDM could be conducted to protect them, thus providing a beneficial impact on the T&E or sensitive species.

Similar to federal and state listed T&E species, some sensitive species could also be the focus of BDM projects. The USFWS (2008a) and the National Audubon Society (NAS 2007) list species of management concern (SMC: USFWS lists "Birds of Conservation Concern" and NAS has a "Watch List") (Appendix C: Tables C1, C2, and C3 denote these species). These are species of birds considered sensitive because their populations have declined over the past several years, but not serious enough to be considered T&E species (NAS lists T&E species as well in "Watch List" (NAS 2007)). Most population declines have been attributed to habitat loss, but predation or other negative wildlife interactions have been noted as a contributing factor in the decline of some species. USFWS (2008a) and NAS (2007) list 79 bird species documented to be in Colorado (Appendix C) that are not listed as federal or state T&E, or candidate species (Table 5). Of these, 26 are regularly occurring species in Colorado that could be the focus of a BDM project (Appendix C: Table C1), 15 are species that will not likely be involved in BDM (Table C2); and 38 are accidental species (16 that could be involved in BDM). Most SMC species would only be hazed from the resource being protected. The SMC species lethally taken by WS from FY06 to FY10 included the Semipalmated Sandpiper (for disease surveillance) and Lark Bunting (for airport). The take of these species will be analyzed in Section 4.1.1.1.

2.1.2 Effects of BDM on Nontarget Species Populations, Including T&E Species

A common concern among members of the public and wildlife professionals, including WS personnel, is the potential impacts of damage control methods and activities on nontarget species, particularly T&E species. WS's SOPs include measures intended to reduce the effects of BDM activities on nontarget species populations and are presented in Chapter 3. From FY06 to FY10, WS accidentally killed 1 Killdeer, 1 Semipalmated Sandpiper, and 1 Least Sandpiper during disease surveillance in mist nets where they were targeted, but intended to be set free. Other than that, WS freed an average of 18 Scaled Quail, 3 Mourning Doves, 1 Great-tailed Grackle, and 0.2 Northern Flickers from cage traps, and 0.2 Franklin’s Gulls in cannon nets from FY06 to FY10. No other nontargets were taken during this time. From FY95-FY05, WS did not lethally take any nontarget species. Thus, WS has had a negligible impact on nontarget species during BDM because most birds have been released.

In contrast to adverse impacts on nontarget animals from direct take by BDM methods, some nontarget species may actually benefit from BDM, though this benefit would be unintentional unless it was the focus of the BDM project. Prime examples are the benefit to native cavity nesting bird species such as the bluebird that results from any reduction in starling populations. A number of other bird species, including some T&E species, could benefit from reductions in populations of Brown-headed Cowbirds which parasitize nests of other birds. Section 4.1.2.1 discusses this further.

2.1.2.1 Federally Listed T&E Species. Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects on them and the establishment of special restrictions or mitigation measures to reduce the potential. A current list of threatened and endangered (T&E), and candidate species was obtained from USFWS for Colorado in March 2011 which includes 9 mammals, 11 birds, no reptiles or amphibians, 8 fish, 2 invertebrates, and 20 plants. Of the species and subspecies currently listed in Colorado under provisions of the ESA, excluding those listed but not in Colorado (*e.g.*, grizzly bear (*Ursus arctos horribilis*), 16 species are endangered (10 animals and 6 plants), 13 species are threatened (6 animals and 7 plants), and 3 are proposed species (1 endangered and 2 threatened, 1 bird and 2 plants). Four species/subspecies have nonessential, experimental populations (NEPs), 1 in Colorado and 3 in surrounding states (including the Mexican wolf (*C. l. baylei*) as a separate subspecies). An additional 15 species have no federal listing, but are candidate species for the list. Combining information for species and subspecies from all lists excluding the black-footed ferret NEP because it was already listed in Colorado as an endangered species resulted in a list of 6 mammals (excludes grizzly bear), 11 birds, 7 fishes, 2 invertebrates, 18 plants, and no reptiles or amphibians. WS BDM will have no effect on listed reptiles, amphibians, fish, invertebrates, plants, and little potential to adversely affect T&E mammals or birds. Tables 5 and 6 list the federally listed birds and mammals and the potential for BDM to have an impact on them. In all, BDM has the potential to have a slight adverse impact on 8 federally listed avian species (Table 5) and 1 federally listed mammalian species (Table 6). The Tables denote where a problem could occur, but the likelihood of occurrence would be nullified if the species distribution is outside areas where BDM is conducted. WS conducted a national Section 7 consultation with USFWS in 1992 on the potential for WDM, in general and including most BDM methods currently used, to impact the species listed nationwide. WS received a Programmatic BO in 1992 (USDA 1997, Appendix F) from USFWS on the species that WS had the likelihood to adversely affect. However, USFWS concluded that WS would have no adverse effects on listed species (USDA 1997, Appendix F) following the Reasonable and Prudent Measures and Alternatives and Terms and Conditions of the BO. The Colorado WS Program completed a new statewide biological assessment (WS

2011) and initiated consultation with USFWS in May 2011. USFWS issued a letter of concurrence on WS's findings (USFWS 2011a) and the Reasonable and Prudent Measures and Alternatives and Terms and Conditions of the new consultation will be incorporated into SOPs which will be discussed in Section 3.5.

USFWS had no concerns with BDM and the listed species of Colorado in their 1992 BO (USDA 1997), except for the Whooping Crane with toxicants. WS agreed not to use DRC-1339 and Avitrol in areas inhabited by the cranes and has never taken a crane. WS has not conducted starling and blackbird projects in the vicinity of locations where Whooping Cranes have been found in eastern Colorado and believes it will have no effect on them with DRC-1339, the only avian toxicant used in Colorado. No species listed since that decision would be similarly affected. In the new Biological Assessment (WS 2011), WS identified potential threats to listed species. The only potential for take included the use of frightening devices and mist nets/noose mats. Frightening devices were anticipated to have the potential to inadvertently harass 6 species and mist nets have the potential to take 3 species. WS will follow SOPs given in Section 3.5 to reduce the potential to take these species. However, the potential was deemed very slight. The Piping and Mountain Plovers, and Least Tern could be accidentally caught in mist nets or noose mats used to capture shorebirds for disease monitoring. These devices are monitored closely and species taken in them are released unharmed. Where these methods are used with a potential to take T&E species, WS has consulted nationally with USFWS under Section 7 of the ESA. WS has developed SOPs to avoid impacts which include ensuring WS Specialists are trained in T&E species identification, not working in areas known to be inhabited by T&E species, monitoring mist nets and traps frequently, and pulling equipment if a T&E species is seen in the vicinity of the trapping operations. These SOPs ensure that T&E species are not likely to adversely be affected.

Table 6. Federal and stated listed mammalian T&E and candidate species in Colorado and the potential impact as a nontarget species from WS BDM.

Species	***Scientific Name***	**Status**	**Locale**	**BDM Impact**
Gunnison's Prairie Dog	*Cynomys gunnisoni*	FC	South Central	F
Black-tailed Prairie Dog	*Cynomys ludovicianus*	SC	East	F
Botta's Pocket Gopher	*Thomomys bottae rubidus*	SC	Freemont	0
Northern Pocket Gopher	*Thomomys talpoides macrotis*	SC	Arapahoe, Douglas, Elbert	0
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	FT ST	North Central	0
New Mexico Jumping Mouse	*Zapus hudsonius luteus*	FC	South	0
Townsend's Big-eared Bat	*Corynorhinus townsendii pallescens*	SC	West	M
Canada Lynx	*Lynx canadensis*	FT SE	West	0
Gray Wolf*	*Canis lupus*	FE SE	Northwest**	F
Kit Fox	*Vulpes macrotis*	SE	Far West	F
Swift Fox	*Vulpes velox*	SC	East	F
Wolverine*	*Gulo gulo*	SE FC	Northwest**	0
River Otter	*Lontra canadensis*	ST	West	F
Black-footed Ferret*#	*Mustela nigripes*	FE SE	Northwest#	0

STATUS
F - Federal
S - State
E - Endangered
T - Threatened
C – Candidate

BDM Nontarget Impact
F –Frightening Devices
M – Mist Nets
0 – No Impact

***** Believed extirpated ******Have come into state from northern populations
Nonessential/experimental pop.

Of the federally listed mammalian species, the gray wolf and Gunnison prairie dog could potentially be affected by BDM where noise harassment was used to protect human health and safety (*e.g.*, at airports), property such as aircraft and residences, livestock, crops, or aquaculture facilities from birds. This species could unintentionally be harassed by frightening devices used in the vicinity of them. This would be inconsequential to either species and typically go unnoticed by those implementing a BDM action near them. As an example, a gray wolf could be in an area adjacent to a crop where birds were being hazed to reduce crop damage. The gray wolf could leave the area because of the noise from pyrotechnics and propane cannons. This would not cause harm to the species. USFWS (USDA 1997) determined that this would have no more than a temporary effect and did not consider this further. It should be noted that of the above species, WS anticipates that this would only have the potential of occurring with the Greater Sage-Grouse, plovers, tern, and pipit. The Lesser Prairie Chicken and other grouse listed in Table 4 are in areas of the state where they are not likely to be encountered during BDM, except at toxic spills sites. WS will be cognizant of these species when conducting a frightening program.

On the other hand, some T&E species could unintentionally benefit from BDM. The Southwestern Willow Flycatcher could benefit from Brown-headed Cowbird control where their nests were significantly parasitized by the cowbirds. The Interior Least Tern would benefit from the control of predatory and scavenging birds such as gulls if they were nesting near an airport where gulls were being controlled. Additionally, if a species were accidentally hazed from an air operating area or a toxic spill such as oil where they could potentially be struck by aircraft or succumb to the effects of a toxic spill, they would benefit by moving away from that site. However, WS would consult with USFWS if it was known that there was a potential to impact a T&E species, even if the species would benefit from the activity.

2.1.2.2 State Listed T&E Species. CPW lists animals that are considered T&E or sensitive species in Colorado. This list contains most federally listed species. It also lists additional species considered threatened or endangered in Colorado, but not their entire range as these are not listed federally. CPW list has, in addition to the federal list, 7 mammals, 9 birds, 10 reptiles, 7 amphibians, 15 fish, and 2 invertebrates. As the same for federally listed species, BDM will have no effect on listed reptiles, amphibians, fish, and invertebrates. Of the 7 additional mammals (Table 6), the bat could potentially be impacted with the use of mist nets. Mist nets used after dusk and before dawn during BDM in the range of the species have the potential to capture a bat. However, WS has not used mist nets in the range of the bat, uses them minimally, puts them up after dawn, and removes them before dusk. Thus, WS anticipates that this species will not be taken. Other mammals listed by the state such as the swift and kit foxes could be temporarily frightened by hazing devices. However, per state law, this is not considered take as it is under ESA. Frightening devices intended for use birds to protect several different resources could temporarily frighten several species. However, the impact would be minimal and not be expected to disrupt their behavior except temporarily. Thus, WS does not believe it will impact any of the mammal species listed in Colorado.

Of the additional 9 species of birds not on the federal list (Table 5), all could be inadvertently frightened by hazing devices, though some most of the gallinaceous birds are in isolated areas where these techniques would not likely be used. However, per state law, frightening devices would not be considered take. Raptor traps are used primarily at airports and could take Bald Eagles and Ferruginous Hawks, but these could be released unharmed. However, if one were taken accidentally, it would more likely be relocated, which as discussed would be to their benefit to reduce the likelihood of them being struck by aircraft. Finally, mist nets could take a Snowy Plover, but as with federally listed plovers, these would be released. The areas where these techniques would be used most are at airports where more than likely these species would be targeted. Thus, WS believes that at most, any impact to Colorado listed T&E species would be minimal and temporary.

2.1.2.3 Sensitive Species. WS also monitors potential impact to USFWS (2008a) and NAS (2007) species of management concern (see Appendix C for list). Of the 79 additional species listed, some could have the potential of being taken lethally where they were nontargets. These species will be analyzed to determine the potential for impact on them in Section 4.1.3. However, most of these species, if not targeted, have minimal chance to be taken lethally.

2.1.3 Effects of BDM on Public and Pet Safety and the Environment

WS uses a variety of methods in BDM, but includes SOPs to reduce potential safety impacts to the public and the environment. WS relies on its Specialists to use their professional judgment to determine the most effective methods to use in a given bird damage situation, while having minimal, if any, impact to people, pets, and the environment. WS Specialists are professionally trained to use BDM techniques, especially with those techniques that have the potential to impact themselves, the public, and the environment. Several BDM methods have the potential to be hazardous including firearms, pyrotechnics, and avicides. Chapter 3 lists measures that WS implements to reduce potential problems.

Some individuals have expressed concerns that they believe that chemical BDM methods and pyrotechnics could adversely affect people and pets from direct exposure or indirectly from birds that have died from chemical use. Under the proposed alternatives in this EA, the avicides that WS could use are DRC-1339, an avicide used to remove damaging feral pigeons, starlings, crows, blackbirds, and gulls, and Avitrol for House Sparrows, blackbirds, and feral pigeons. Chemical repellents that could be used under the proposed action include methyl-anthranilate (MA), an artificial grape flavoring used in the food industry that repels many bird species, methiocarb (Mesurol® - Gowan Co., Yuma, AZ) used in eggs to repel corvids from raiding nests of other birds, and polybutene products which are bird repellents that have a tactile, sticky consistency to touch and are applied directly to problem locations to prevent birds such as feral pigeons from perching. Avicides and chemical repellents are regulated under FIFRA and Colorado pesticide laws by EPA and CDA, and applied by WS under their management and in accordance with labeling and WS Directives. WS applicators are certified by the State and must complete a written examination and undergo recurrent training. Other chemical methods that could be used are the tranquilizer A-C, used to capture waterfowl and a wide variety of other species, and euthanizing drugs such as Fatal Plus®. These drugs are regulated by FDA under the Food, Drug, and Cosmetic Act and WS policy. WS would also use pyrotechnic cartridges fired from 15mm pistols and 12 gauge shotguns. WS used an annual average of about 0.03 ounces of A-C, 1.9 pounds of DRC-1339, and no other chemicals, and fired an average of 1,187 pyrotechnics from FY06 to FY10 (Table 7). This is a minimal use of chemicals and pyrotechnics. A formal risk assessment of WS methods concluded low risks to humans (USDA 1997, Appendix P) including BDM methods used by WS such as toxicants, repellents, immobilization drugs, firearms, pyrotechnics, and traps.

Table 7. Chemicals and pyrotechnics used by WS in BDM from FY06 to FY10. Minimal alpha-chloralose, an immobilization drug, was used and is regulated by FDA. DRC-1339 and Avitrol, two avian toxicants, are registered for use in Colorado by EPA and CDA, could have been used by WS, but only DRC-1339 was from FY06 to FY10. WS used pyrotechnics, an "explosive," to mostly haze birds from airfields. WS did not use any chemical repellents from FY06 to FY10.

Chemical/Pyrotechnics	FY06	FY07	FY08	FY09	FY10	Ave.
DRC-1339 (g)	16	43	1262	1846	1060	845.4
Alpha Chloralose (g)	0	0	0	0	4	0.8
Pyrotechnics	353	251	1128	2309	1892	1186.6

Some people may be concerned that WS's use of firearms and pyrotechnic bird scaring devices could cause injuries to people. WS personnel occasionally use small caliber firearms or air rifles and shotguns to remove feral domestic pigeons and other birds that are causing damage, and would continue to use such firearms in bird damage situations. WS policy has requirements for training, safe use, storage and transportation of firearms as prescribed by the WS Firearms Safety Training Manual (WS Directive 2.615). The required firearms training is conducted biennially by certified instructors. Hands-on firearms proficiency is evaluated in the field and candidates must pass a written exam. Therefore, firearms are handled in a safe manner with consideration given to the proper firearm to be utilized, the target density, backstop, and unique field conditions. Pyrotechnics often emit sparks when launched, creating some potential fire hazard to private property from field use. Prior to the implementation of formalized training standards, other states reported incidents where small fires were started from the use of pyrotechnics in the field. Pyrotechnics storage, transportation, and use are regulated by the Alcohol, Tobacco and Firearms Bureau, Department of Transportation, and WS policy respectively. WS requires adherence to all federal, state, and local laws. Pyrotechnics on-hand are less than 50 lbs. in total weight; that, along with industry approved packaging of the materials allow WS's pyrotechnics to be classified as Division 1.4 (formally known as Class C), the lowest classification of explosive materials as defined by the Alcohol, Tobacco and Firearms Bureau. Pyrotechnics are stored and transported in approved metal boxes. Training for pyrotechnics field use is also conducted and maintained under the WS Firearms Safety Training Manual guidelines.

On the other hand, public health and safety may be jeopardized by not having a full array of BDM methods for responding to complaints involving threats to human health and safety such as bird airstrike hazards and a disease outbreak. Many bird species such as raptors, gulls, and starlings represent a significant strike risk for aircraft at airports and are commonly struck (Dolbeer 2006). This can result in damage and injuries to people. Additionally disease, especially the potential for HP H5N1 AI, could be a significant threat to humans. Surveillance of this disease is being conducted in much of the United States in migratory birds to monitor for its presence. WS often uses several BDM methods to capture target animals, depending on the specifics of these types of situation. Firearms, traps, mist nets, chemical immobilization, or toxicants may be used to take a target bird. BDM methods that may pose a slight public safety risk may be used safely and effectively to eliminate or monitor for a recognized public safety risk.

One peripheral factor pertinent to assessing the risk of adverse effects of WS BDM activities is the potential for adverse effects from not having professional assistance from programs like WS available to private entities that express needs for such services. WS operates to assist individuals with damage from birds where a need exists. In the absence of a federal BDM program, or where restrictions prohibit the delivery of an effective program, it is most likely that BDM would be conducted by other entities such as private individuals. Private BDM activities are less likely to be as selective for target species, and less likely to be accountable. Additionally, private activities may include the use of unwise or illegal methods to control birds. For example, Great-tailed Grackles were illegally poisoned in Texas with dicrotophos (Mitchell et al. 1984) and a corporation in Kentucky was fined for illegally using carbofuran to destroy unwanted predators including raptors at a private hunting club (Porter 2004). Similarly, on a Georgia quail plantation, predatory birds were being killed by eggs that had been injected with carbofuran (the Federal Wildlife Officer 2000); in Oklahoma, Federal agents charged 31 individuals with illegally trapping and killing hawks and owls to protect fighting chickens (USFWS 2003b). The Texas Department of Agriculture (2009) has a website and brochure devoted solely to preventing pesticide misuse in controlling agricultural pests. Similarly, the Department for Environment, Food and Rural Affairs (2004) in Britain has a "Campaign against Illegally Poisoning of Animals." Therefore, WS believes that it is in the best interest of the public, pets, and the environment that a professional BDM program be available because private resource owners could elect to conduct their own control rather than use government services and simply out of frustration resort to inadvisable techniques (Treves and Naughton–Treves 2005).

2.1.4 Effects of BDM on Aesthetics

Some individual members or groups of wild and feral domestic bird species habituate and learn to live in close proximity to humans. Some people in these situations feed such birds or otherwise develop emotional attitudes toward such animals that result in aesthetic enjoyment. In addition, some people consider individual wild birds as "pets," or exhibit affection toward these animals. Examples would be people who visit a city park to feed waterfowl or pigeons and homeowners who have bird feeders or bird houses. Other people do not develop emotional bonds with individual wild animals, but experience aesthetic enjoyment from observing them. Public reaction to BDM actions is variable because individual members of the public can have widely different attitudes toward wildlife. Some individuals that are negatively affected by wildlife support the removal or relocation of damaging wildlife. Other individuals affected by the same wildlife may oppose removal or relocation. Individuals unaffected by wildlife damage may be supportive, neutral, or opposed to wildlife removal depending on their individual personal views and attitudes.

Some people do not believe that birds such as nesting Canada Geese or nuisance egret, blackbird, or starling roosts should even be harassed to stop or reduce damage problems. They are concerned that their ability to view migratory birds is lessened by WS nonlethal harassment or relocation activities and lethal control projects. The public's ability to view wild birds in a particular area would be more limited if the wildlife are removed or relocated. However, immigration of wildlife from other areas often replace the animals removed or relocated during (negating the effectiveness of the action) or following a damage management action. Thus, viewing would still be an opportunity. However, if the program is successful and birds can no longer be found at a project site, the opportunity to view or feed wildlife is often available at other parks or areas with adequate habitat and local populations of the species of interest.

Property owners that have pigeons roosting or nesting on their buildings or waterfowl grazing on turf areas are generally concerned about the negative aesthetic appearance of bird droppings and the damage to their buildings, turf, or other property. Business owners generally are particularly concerned because negative aesthetics can result in lost business. Costs associated with property damage include labor and disinfectants to clean and sanitize fecal droppings, implementation of nonlethal wildlife management methods, loss of property use, loss of aesthetic value of flowers, gardens, and lawns consumed by birds such as geese, loss of customers or visitors irritated by the odor of or having to walk on fecal droppings, repair of golf greens, replacing grazed turf, and loss of time contacting local health departments and wildlife management agencies on health and safety issues.

Wildlife biologists often find that domestic waterfowl will hybridize with wild waterfowl, thereby, diluting the wild strain genes. The hybrids are often looked at by wildlife biologists and others as aesthetically displeasing because they are not the wild form. Thus, they find that these hybrids are aesthetically and biologically displeasing.

Thus, aesthetics is an issue that has very opposing views. The alternative selected must be able to accommodate the widest array of these views.

2.1.5 Issues that Were Analyzed in Prior WS EAs (WS 1998, 1999, 2001) that Will Not Receive Detailed Analysis under the Alternatives in This EA, but Some Background Information Will Be Discussed

In addition to the above issues, several other issues have been identified and analyzed thoroughly in the previous WS EAs (*e.g.,* WS 1996, 1998, 1999, and 2001) and USDA (1997), and their analyses would be almost identical in this EA. These will not be considered further. The environmental consequences of these issues were found to have the least impacts under the current program alternative, the same in this EA except this EA is being considered at the statewide level for all bird species found in Colorado. Even though these issues are not analyzed in this EA, the issue of humaneness will still be considered in determining SOPs to minimize potential impacts. Following are two issues that will not receive detailed analysis, except in the development of SOPs.

2.1.5.1 Selectivity and Humaneness of BDM Methods. Selectivity of BDM methods is related to the issue of humaneness in that greater selectivity results in less perceived suffering of nontarget animals. The selectivity of each method is based, in part, on the skill and discretion of the WS Specialist in applying such methods and on specific measures and modifications designed to reduce or minimize nontarget captures. The humaneness of a given BDM method is based on the human perception of the pain or anxiety caused to the animal by the method. How each method is perceived often differs, depending on the person's familiarity and perception of the issue as discussed in Section 2.3.5. The selectivity and humaneness of each alternative are based on the methods employed and who employs them under the different alternatives. Schmidt and Brunson (1995) conducted a public attitude survey in which respondents were asked to rate a variety of WDM methods on humaneness (1=not humane, 5= humane) based on their individual perceptions of the methods. Their survey found that the public believes that nonlethal methods such as animal husbandry, fences, and scare devices were the most humane and the use of traps, snares, and aerial hunting was the least humane. Many other WS EAs (WS 1999, 2001, 2006, 2008) have discussed how selective each of the methods used in Colorado to take target animals was and information on their humaneness.

In comparison, under the No Federal Program Alternative, the federal portion of WS would not employ methods viewed by some as inhumane and, thus, have no program effect on humaneness. CPW, CDA, or other agency would probably still provide some level of hands on professional BDM assistance, but without federal supervision. They would continue to use the BDM methods considered inhumane by some, but likely at lower levels. The state personnel would not receive training from federal sources nor would the program benefit from federal research focused on improved humaneness, selectivity, and nonlethal methods. Private individuals that have experienced resource losses, but are no longer provided professional assistance from WS, could conduct lethal BDM on their own. Use of Avitrol, traps, and shooting by private individuals would probably increase. This could result in less experienced persons implementing BDM methods such as traps without appropriate modifications to reduce stress of the target animal and take of nontarget animals. Greater take or suffering of both nontarget and target wildlife would likely be the result. Therefore, it was concluded that the No Federal Program Alternative would result in the highest potential for negative effects from BDM (USDA 1997, WS 1996, 1998, 1999, 2001). Additionally, it is hypothetically possible that frustration caused by the inability of resource owners to reduce losses could lead to the illegal use of chemical toxicants. The illegal use of toxicants could also result in increased animal suffering.

BDM conducted by private individuals would probably be less humane than BDM conducted under the auspices of a federal BDM program. WS is accountable to public input and humane interest groups that often focus their attention and opposition on BDM activities employed by WS. BDM methods used by private individuals may be more clandestine, and in particular, those that are used illegally. Members of the public that perceive some BDM methods as inhumane would be less aware of BDM activities being conducted by private individuals because private individuals would not be required to provide information under mandatory policies or regulations similar to those applied to WS. Thus, the perception of inhumane activities could be reduced, although the actual occurrence of BDM and associated inhumane activities may increase.

The No Federal Program Alternative would likely result in more negative impacts with regard to humaneness than the current program. The other alternatives analyzed in this EA were also analyzed in prior WS environmental documents (USDA 1997, WS 1996, 1998, 1999, 2001) and found to lie between the Current Program and No Federal Program Alternatives. These will not be discussed further. However, humaneness is a concern of WS and is a criteria used to help determine the appropriate SOPs to maximize method selectivity and humaneness. The current program conducted by WS has taken minimal numbers of nontarget species from FY06 to FY10, with most of these being targeted, but unintentionally killed during the project (they were to be relocated). Thus, WS's SOPs have been very effective at minimizing the take of nontargets.

2.1.5.2 Effects of BDM on Water Quality and Wetlands. Two issues arose regarding water quality and wetlands in WS EAs (WS 1999, 2001) that were believed to be impacted by BDM targeting blackbirds at feedlots and other locations with avicides. Some discussion is provided here to ensure the reader that these issues have been considered.

Potential for BDM Chemicals to Runoff site and Affect Aquatic Organisms. An issue that was raised during interagency discussions while working on previous WS EAs (WS 1999, 2001) that WS has the potential to affect water quality to the point that adverse effects on humans or aquatic organisms could occur from the use of DRC-1339. This issue overlaps with "effects on human health" identified in section 2.1.3. Under the current WS BDM program, WS would use DRC-1339 in accordance with EPA-approved label directions. USDA (1997, Appendix P) contains information pertinent for analyzing the potential for effects on water quality from use of this chemical and is incorporated by reference. This chemical is very soluble in water (one liter can dissolve 91 grams). Based on its solubility, the appearance is such that DRC-1339 has a high potential to be transported from sites where it is used. However, DRC-1339 degrades rapidly under both aerobic and anaerobic conditions in soils with a half-life of less than two days. This degradation process diminishes concentrations before the chemical migrates to groundwater or off-site surface water areas. Continued degradation would be more than 90% degraded within about one week based on a half-life of two days.

Available information suggests DRC-1339 has low potential for aquatic and invertebrate toxicity (USDA 1997). Aquatic toxicity of DRC-1339 to water fleas occurred at 1.6 mg/L (Marking and Chandler 1981, Blasberg and Herzog 1991). The majority of LC_{50} (lethal concentration of a chemical in water in mg/L that is expected to kill 50 percent of the test subjects of a given species) values ranged from 6 to 18 mg/L for such species as glass shrimp, snails, crayfish, and Asiatic clams (Marking and Chandler 1981). LC_{50} values for bluegill and catfish ranged from 21 to 38 mg/L (USDA 1997, Appendix P). The greatest quantity that might ever be used by WS at an individual site at any one time is expected to be much less than one pound (16 ounces, 454 grams). If the chemical was transported off site and made it to surface or ground water, the water supply would have to be no more than 75,000 gallons in size to present a 50% lethal hazard to water fleas, no more than 6,700 to 20,000 gallons in size to present such a hazard to other invertebrates, or no more than 3,200 to 5,700 gallons to present such a hazard to bluegills or catfish. Put in perspective, 75,000 gallons is equivalent to a pond that is about 65 feet across and averages only 3 feet deep. These water volumes are much smaller than are likely to be encountered in streams or lakes in the area, and, undoubtedly, only a tiny fraction of the ground-water supply in the area. Because treated bait material is not applied unless target birds are already taking a similar amount of untreated bait, it is highly unlikely that much, if any, of the chemical would be left on the ground where it would be subjected to off-site transport by rainfall. The risk is further mitigated by the fact that the chemical degrades rapidly as discussed above. USDA (1997, Appendix P) concluded no probable risk to aquatic organisms. This analysis further indicates that the low quantities used at any one site, rapid degradation, and dilution factors act together to virtually eliminate any potential for hazard to humans or aquatic organisms due to possible run-off or ground water. Therefore, WS concluded in a previous EA (WS 1999, 2001) that the use of DRC-1339 would not cause runoff problems or affect aquatic organisms. From FY06 to FY10, WS used an average of 1.9 lbs. of DRC-1339 statewide which is a low use of the chemical and therefore, WS concludes that the current use of DRC-1339 is minimal and will not cause runoff problems or affect aquatic organisms.

The only other chemical that could be used by WS would be Avitrol, which possibly might be used for House Sparrow control. However, WS did not use the chemical from FY94 to FY10 which indicates the low potential for use in Colorado; it should be noted that the manufacturer of Avitrol Corporation was closed from 10-31-2010 until 11-1-2011 because the owners retired, but the business was bought by another owner, so the product was not used during this time. Avitrol, if it were used, would not cause problems under the current program, especially as it would be used according to label directions. Avitrol is available as a prepared grain bait mixture that is mixed in with clean bait at a no greater than 1:9 treated to untreated mixture of bait kernels or particles. Several factors virtually eliminate health risks to members of the public or to water quality from the use of this product as an avicide:

- It is readily broken down or metabolized into removable compounds that are excreted in urine in the target species (Extension Toxicology Network 1996). Therefore, little of the chemical remains in killed birds to pose contamination risks to water supplies.

- Although Avitrol has not been specifically tested as a cancer-causing agent, the chemical was not found to be mutagenic in bacterial organisms (EPA 2007). Therefore, the best scientific information available indicates it is not a carcinogen. Regardless, however, the controlled and limited circumstances in which Avitrol is used would prevent exposure of members of the public to this chemical or contamination of water supplies.

- Since Avitrol is commercially available, it has already undergone extensive governmental environmental review for potential water quality impacts.

However, this chemical would likely be used much more by private individuals under the other alternatives because it would be the only legal avicide available. Therefore, it can be concluded that the current program would have the least risk. Additionally, WS would use Avitrol according to the label, and therefore, concludes that its use poses no or minimal risks, at most, to aquatic sites and organisms.

Potential to Cause Accelerated Eutrophication of Wetland Areas. This latter concern is based on the possibility that carcasses of birds killed by lethal control with DRC-1339 might significantly increase nutrients in marsh roosting areas, resulting in accelerated eutrophication. Eutrophication is the natural process by which lakes and ponds become more productive in terms of the amount of life (i.e., “biomass’) they can support. If this process is accelerated by man-caused activities that increase nutrients in an aquatic ecosystem, the increased amount of plant material that is produced as a result may lead to increases in decomposition of organic material which can reduce oxygen content in the water and lead to loss of certain species in the area or changes in species composition. Major nutrients that contribute to plant production (and thus, potentially, eutrophication) in freshwater ecosystems are nitrogen, carbon, phosphorus, and potassium (Cole 1975). Thus, the amount of these nutrients was compared under no control with droppings from birds being deposited in the marshes where birds roosted and control with carcasses falling into the marshes. WS (2001) in Kansas analyzed the differences in nutrients for the potential take of up to 3 million starlings and 1 million blackbirds. It was determined that there would be little difference in the amount of nutrient deposited in wetlands from bird droppings under no control to weight of birds with control using DRC-1339, except that nitrogen would likely be much more under no control. WS in Colorado anticipates that up to 1,000,000 starlings and blackbirds could be killed by use of DRC-1339 (currently the average take is less than 100,000). WS (2001) determined that accelerated eutrophication would not be expected to occur from BDM activities at higher than this level. Thus, this issue will not be considered further.

2.2 ISSUES USED TO DEVELOP WS SOPs FOR BDM

2.2.1 Effects on Target Bird Species Populations

WS take is analyzed in Section 4.1.1.1 and would annually monitor target bird take in BDM to determine if take remains within the range analyzed by this EA. All bird species taken in BDM are being considered in this EA and bird populations and abundance can change, and therefore, their populations along with applicable sport harvest, considering cumulative impacts, would be considered and monitored annually. WS SOPs, discussed in Section 3.4, ensure that the take of birds remains below a sustainable harvest, unless the managing agency has different management goals.

2.2.2 Effects on Nontarget Species Populations, Including T&E Species

Special efforts are made to avoid taking nontargets during BDM or jeopardizing T&E species. The selectivity of BDM methods has been improving through the years, and much credit goes to WS' National Wildlife Research Center (NWRC). Improved cage traps, baits, hazing techniques, and other BDM tools and the development of new methods such as lasers have helped WS Specialists be more efficient and effective at focusing efforts on target species while minimizing take of nontarget species. T&E species are avoided by conducting biological evaluations of the potential effects and the establishment of special restrictions or measures to reduce the potential for take, and consultation with USFWS and CPW biologists. WS SOPs include measures intended to reduce the effects of BDM on nontarget species populations, especially T&E species, and are presented in Section 3.4.

2.2.3 Effects on Public and Pet Safety and the Environment

WS Specialists have SOPs to reduce potential safety impacts from BDM to the public, pets, and the environment. WS relies on its Specialists to use their professional judgment to determine the most effective methods to use in a given bird damage situation, while having minimal, if any, impact to people, pets, and the environment. WS Specialists are professionally trained to use BDM techniques, especially those that could have the potential to impact themselves, the public, and the environment. Several BDM methods have the potential to be hazardous including firearms, pyrotechnics, and avicides. Measures to reduce potential problems are given in Chapter 3. WS has not had any known impacts from BDM on the public, pets, or the environment from FY06 to FY10.

As discussed in Section 2.1.3, a peripheral factor pertinent to assessing the risk of adverse effects of WS BDM activities is the potential for adverse effects from not having professional assistance from programs like WS available to private entities that express needs for such services. WS operates to assist individuals with damage from birds where a need exists. In the absence of a program, or where restrictions prohibit the delivery of an effective program, it is most likely that BDM would be conducted by other entities such as State agencies and private individuals. Private BDM activities are less likely to be as selective for target species, and less likely to be accountable. Additionally, private activities may include the use of unwise or illegal methods to control birds. Therefore, WS believes that it is in the best interest of the public, pets, and the environment that a professional BDM program be available because private resource owners could elect to conduct their own control rather than use government services and simply out of frustration resort to inadvisable techniques (Treves and Naughton-Treves 2005).

2.2.4 Effects of BDM on Aesthetics

Under the proposed action, WS would kill what some people would perceive to be a large number of birds. Some people enjoy seeing birds, and, if so, might feel their interests were being harmed. However, the population impacts analysis in Section 4.1.1 indicates the overall populations of birds are not being significantly affected, which means opportunities to view these species would continue to exist.

WS's experience has generally been that, whereas many people perceive some pleasure or enjoyment at seeing relatively small concentrations of birds, most people directly affected by birds, especially large wintering concentrations, perceive them as an annoyance or a health hazard. Reductions in large wintering concentrations of birds such as starlings or local populations of feral pigeons would be viewed by those people as an aesthetic improvement. Concentrations of roosting birds have resulted in calls to the WS office in Colorado concerning nuisance noise, odor, and fecal contamination. Some towns in Colorado have had active harassment programs in order to move birds from urban areas.

It is possible that some birds killed with DRC-1339, due to its slow action, would die in nighttime roost sites in trees or wooded areas near to or in urban or suburban areas. This has been known to happen.

Also, some birds might die en route to nighttime roost sites with DRC-1339 use, despite the tendency for most birds to die at their nighttime roost sites, and be visible to passersby. This would be particularly noticeable if they fall onto snow covered areas where the black bodies would contrast sharply with the white snow. If this occurs, some people might perceive these numbers of dead birds to be aesthetically displeasing. WS would plan to mitigate this effect by retrieving visible dead birds following baiting operations, or by requiring facility managers to provide personnel to pick up visible dead birds as a condition of receiving WS operational service. However, this depends on receiving permission to trespass by property owners.

Measures and policies are in place to help minimize the effects of WS activities on aesthetics as much as possible. WS personnel post signs in prominent places to alert the public that BDM tools are set in an area and this would allow the public offended by BDM activities to avoid these areas. On private lands, the cooperators or landowners are aware that BDM methods are set and can alert guests using the property of their presence. Landowners determine the areas and timing of equipment placement, thereby avoiding conflicts with the public, especially those that would find BDM aesthetically displeasing. For public lands, WS abides by all applicable laws and regulations regarding the use of different BDM methods. WS coordinates with the different land management agencies to determine high-use public areas and times of the year. WS limits conducting BDM in high-use public areas or limits the BDM methods used to minimize potential problems with those people that find BDM aesthetically displeasing.

2.2.5 Humaneness of Methods Used by WS

The issue of humaneness and animal welfare as it relates to killing or capturing wildlife is an important and very complex concept that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate pest damage management for societal benefits could be compatible with animal welfare concerns if ". . . *the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process.*" Suffering is described as a ". . . *highly unpleasant emotional response usually associated with pain and distress.*" However, suffering ". . . *can occur without pain* . . ." and ". . . *pain can occur without suffering* . . ." (American Veterinary Medical Association 1987). Because suffering carries with it the implication of a time frame, a case could be made for ". . . *little or no suffering where death comes immediately* . . ." (California Department of Fish and Game 1991), such as with shooting. Defining pain as a component of humaneness and animal welfare in BDM methods used by WS appears to be a greater challenge than that of suffering. Pain obviously occurs in animals. Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would ". . . *probably be causes for pain in other animals* . . ." (American Veterinary Medical Association 1987). However, pain experienced by individual animals probably ranges from little or no pain to significant pain (California Department of Fish and Game 1991). Pain and suffering, as it relates to damage management methods, has both a professional and lay point of arbitration. Wildlife managers and the public would be better served to recognize the complexity of defining suffering since ". . . *neither medical nor veterinary curricula explicitly address suffering or its relief*" (California Department of Fish and Game 1991).

The American Veterinary Medical Association states, "... *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 accepted methods of euthanasia to be used when killing all animals, including wild and feral animals. The American Veterinary Medical Association states, "*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 use terms such as killing, collecting or harvesting, recognizing that a distress-free death may not be possible.*" (Beaver et al. 2001).

Some individuals and groups are opposed to some management actions of WS. WS personnel are experienced and professional in their use of management methods. This experience and professionalism allows WS personnel to use equipment and techniques that are as humane as possible within the constraints of current technology. Professional BDM activities are often more humane than nature itself (i.e., death from starvation) because these activities can produce quicker deaths that cause less suffering. Research suggests that with some methods, such as restraint in leghold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements indicated similar changes in foxes that had been chased by dogs for about five minutes as those restrained in traps (USDA 1997). However, such research has not yet progressed to the development of objective, quantitative measurements of pain or stress for use in evaluating humaneness. People concerned with animal welfare often express that they would like to see animal suffering minimized as much as possible and that unnecessary suffering be eliminated. The interpretation of what is unnecessary suffering is the point to debate (Schmidt 1989).

Humaneness, as perceived by the livestock industry and pet owners, requires that domestic animals be protected from predatory birds because humans have bred many of the natural defense capabilities out of domestic animals. It has been argued that man has a moral obligation to protect these animals from all predators (USDA 1997). Predators frequently do not kill larger prey animals quickly, and will often begin feeding on them while they are still alive and conscious (Wade and Bowns 1982). The suffering apparently endured by livestock and pets damaged in this manner is unacceptable to many people.

Thus, the decision-making process involves tradeoffs between the above aspects of pain and humaneness. Objective SOPs to minimize impacts from this issue must consider not only the welfare of wild animals, but also the welfare of humans and domestic animals if damage management methods were not used. Therefore, humaneness, in part, appears to be a person's perception of harm or pain inflicted on an animal. People may perceive the humaneness of an action differently. The challenge in coping with this issue is how to achieve the least amount of animal suffering within the constraints imposed by current technology and funding.

WS has improved the selectivity of management devices through research and development for the use of padded jaw pole traps with pan-tension devices and other modifications, lights for deterring birds from airplanes while in flight, immunocontraception drugs to reduce fertility of overabundant species, and chemical immobilization/euthanasia procedures that minimize pain. Research continues to improve selectivity, practicality, and humaneness of management devices (USDA 1997). Until new findings and products are found to be practical, a certain amount of animal suffering will occur if BDM objectives are to be met in those situations where nonlethal BDM methods are ineffective or impractical. Furthermore, if it were possible to quantify suffering, it is possible that the actual net amount of animal suffering would be less under the proposed action (or any other alternative involving the use of lethal methods) than under the No Federal BDM Alternative since suffering experienced by domestic animals preyed upon by predators is reduced if BDM is successful in abating predation. Measures to reduce pain and stress in animals and SOPs used to maximize humaneness are listed in Chapter 3.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

In addition to the above issues, several other issues have been raised that warrant discussion, but not consideration in the analysis. Several of these issues have been discussed in other WS environmental documents (USDA 1997, WS 1996, 1998, 1999, 2001) and found that they would not have an effect on the decision, as rationalized. These issues would have the same discussion in this EA. No new information has arisen that would change the analysis provided in these other EAs or suggest a need for their inclusion here in the issues considered in the comparison of alternatives. Below is a synopsis of issues that have been considered and rationale for why they are not included in the analyses in Chapter 4.

2.3.1 Appropriateness of Preparing an EA (Instead of an EIS) for Such a Large Area.

Some individuals might question whether preparing an EA for an area as large as Colorado would meet the NEPA requirements for site specificity. WS' mission is to manage damage caused by wildlife, not overall wildlife populations. As an agency that exists to manage specific types of damage, WS can predict the types of locations or situations where damage is likely to occur. However, due to any number of variable circumstances, WS has no absolute control over when a request for BDM assistance will be received nor can WS predict specific individual times and locations of most bird damage situations. Therefore, WS must be ready and able to provide assistance on short notice about anywhere in Colorado to protect any resource. The missions of other federal and state wildlife management agencies generally concentrate on management for wildlife abundance and are not equipped or prepared to prevent bird damage problems without resorting to extreme and extensive population management strategies that, in most cases, would be neither prudent nor affordable. Given the numbers of birds, past experiences, and program activity monitoring, WS believes this EA addresses most potential needs and issues associated with providing BDM at any given location in Colorado. It should be noted that MIS data shows that WS works on less than 1% of the analysis area, thus the majority of the state has no BDM. This is reflective of the need and the requests for assistance involving birds, and available manpower to conduct operational BDM.

If a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared. In terms of considering cumulative impacts, one EA analyzing impacts for the entire State may provide a better analysis than multiple EA's covering smaller zones, especially considering the mobility of birds and impacts on their populations.

2.3.2 Effects from the Use of Lead in Ammunition

WS uses nontoxic shot (*e.g.,* steel and bismuth) and lead shot, bullets, and pellets for ground-based shooting. WS uses nontoxic shot for all migratory birds shot under the authority of a permit issued by USFWS and in areas where there is a potential risk to T&E or sensitive species such as Bald Eagles. In general, sport hunting using rifles or shotguns, which would be similar in nature to ground-based shooting by WS with regard to dispersal of lead shot, tends to spread lead over wide areas and at low concentrations (Craig et al. 1999). The primary concerns raised thus far about sport hunting and lead shot contamination have been focused on aquatic areas where waterfowl hunting occurs, and the feeding habits of many species of waterfowl that result in them picking up and ingesting shot from the bottoms of ponds, lakes, and marshes. Shooting of lead shot in dry land upland areas has not raised similar levels of concern except where such activities are more intensively concentrated such as those which can occur with dove hunting at harvested crop fields and with game bird hunting at "shooting preserves" (Kendall et al. 1996). In an ecological risk assessment of lead shot exposure in non-waterfowl bird species, ingestion of lead shot was identified as the exposure mode of concern rather than just contact with lead shot or lead leaching from lead shot distributed in the environment (Kendall et al. 1996). Shots fired during WDM activities in Colorado are scattered in distribution over relatively wide areas in mostly uninhabited locations where contact with humans or ingestion by birds picking up grit to aid in digestion of food are highly unlikely.

The amount of lead deposited on the landscape from the firing of shotguns and rifles during WDM is very small since the amount of land area involved is huge. WS conducted WDM on an annual average of 6.58 million acres from FY06 to FY10 (total acres worked from FY06 to FY10 = 11.2 million acres) which includes all wildlife. WS uses firearms for many WDM activities in Colorado including ground-based, aerial, and harassment shooting, and shooting to euthanize animals caught in traps. WS uses steel shot or pellets to take birds listed on a migratory bird permit from USFWS, but the MIS does not track the type of shot or bullets used, lead or not lead. For the sake of analysis, we will look at the amount of lead from firearms as if all the bullets and shot were lead, even though we know that much of them are not.

Additionally, the MIS does not track the number of shots fired. For the sake of analysis, we will calculate the amount of lead used by assuming that 3 shotgun shells (1.2 oz. lead each) and 3 pellets (0.04 oz. lead ea. – about 16 grain) are used for every bird shot with a firearm and mammal killed in aerial hunting and birds and mammals killed with an air rifle, that 2 bullets (0.25 oz. lead ea. (110 grain bullet ave.)) are fired for every mammal killed by ground-shooting, that one .22 caliber round (0.1 oz.) is shot to euthanize mammals in cage and leghold traps and snares (snares are most often lethal and birds are killed with cervical dislocation in cage traps), and in harassment shooting 5 shotgun shells are fired for every 100 birds and 10 mammals hazed, and 5 pellets are fired for every 10 birds and 1 mammal hazed. From FY 06 to FY10, WS annually averaged 9,336 mammals taken in aerial hunting and birds taken with firearms, 11,470 mammals taken with ground-based shooting, 2,282 animals taken with pneumatics (air rifles), 680 mammals taken in traps and snares, 227,177 birds and 163 mammals hazed with shotguns, and 318 birds and 2 mammals hazed with pneumatics. With the above information, it could be estimated that WS deposits 3,339 pounds of lead annually over 6.58 million acres, but again this is considered conservative for many reasons. WS personnel do not likely shoot as many times as suggested, the bullets used are likely smaller number of grains, nontoxic shot is used for most all bird work (nontoxic shot is used for birds taken under a USFWS permit), and most carcasses shot are retrieved and disposed of according to WS Policy in areas where they are not available for avian scavengers, the species of most concern with lead use. In fact, if the bird take with firearms and animal hazing with firearms at airports were eliminated, 655 pounds would actually be spread over 6.58 million acres, a five-fold decrease. However, considering the most conservative estimate of 3,339 pounds, would still only amount to 5.2 ounces of lead deposited per square mile (1 oz. realistically).

The estimated lead use by WS, 5.2 ounces of lead over one square mile (244 mg/acre), is considered very minimal. WS shooting for all wildlife species taken (including mammals and a few reptiles) or hazed (harassment shooting) in WDM occurs on small proportion of the land area in Colorado. The annual average (FY06-FY10) area worked by WS was about 9.9% of the land area of Colorado. The land area of exposure to shots fired is still relatively large in relation to the amount of shot distributed. Even though this is a small amount, to address even the most extremely unrealistic concerns raised regarding this issue, we have looked at the following detailed scientific facts and data related to any potential exposure of lead resulting from the lead shot used by WS in all WDM activities. It should be noted that hunting is not allowed on much of lands under agreement where WS conducts WDM (*e.g.,* airports and feedlots), thus cumulative impacts on these lands would not include upland game hunting (nontoxic shot is required for waterfowl hunting). In comparison, and cumulatively, CPW estimated that hunters harvested about 80,000 big game (deer, elk, and antelope), 80,000 upland game mammals (coyotes and cottontails) and 290,000 upland game (doves, quail, grouse, and pheasant) in the 2008-2009 season (CPW 2008a and b). Using the same formulas, hunters used 70,000 pounds of lead for the primary game animals in Colorado. This equates to about 11 oz./square mile in Colorado. Adding the WS portion would amount to 11.5 oz./acre in Colorado cumulatively (since WS worked on only 10% of the lands).

The hazard standard set by EPA for lead concentrations in residential soils is 400 ppm (1 part per million is equivalent to 1 mg/kg or 0.0064 oz./lb.) in children's play areas, and 1,200 ppm on average for the rest of a residential yard[8]. We are unaware of any established standards for lead contamination of soil in remote rural areas of the kind where WS conducts much of its WDM activities in Colorado, but it is reasonable to assume the guideline for residential areas would be more stringent than any such standard that might ever be established for rural areas. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil is generally retained within the top 20 cm (about 8 inches). A representative average weight of soil is in the range of 110 lbs. (49.9 kg) per cubic foot (Environmental Working Group 2007). The number of cubic feet of soil

[8] The EPA soil-lead hazard is bare soil on residential real property or on the property of a child occupied facility that contains total lead equal to or exceeding 400 parts per million (mg/g) in a play area or average of 1,200 parts per million of bare soil in the rest of the yard based on soil samples (40 CFR 745.65(c)).

in the top 8 inches of soil in one acre is about 29,000. Therefore, a reasonable estimate of the total weight of the top layer of soil per acre where spent lead shot should remain would be 3.2 million lbs. (110 x 29,000) or 1.5 million kg. If considered over the amount of land area involved in WDM in the State during a typical year, the amount of lead distributed from WS WDM activities would constitute an average of about 1 mg/6,600 kg of soil. This is a small fraction, about 2 million times less than the concentration in the EPA hazard standards for children play area soils shown above. Soil uncontaminated by human activities generally contains lead levels up to about 50 ppm (or 50 mg/kg) (Agency for Toxic Substances and Disease Registry 2012). Assuming that the soils in the areas where WS conducts WDM have the upper limit of this baseline level, it would take an additional 350 mg/kg to reach the EPA hazard standard for children's playgrounds, and 1,150 mg/kg to reach the standard for other residential yard areas. It would take millions of years for enough lead to accumulate from shooting by WS to reach the EPA hazard standard for children's playgrounds. Cumulatively, shooting by hunters and WS equals 73,000 pounds or just over 11 ounces of lead per square mile in Colorado which equates to 0.0003 mg/kg of soil or a million times less the hazard level set for playgrounds. Thus, even cumulatively, the level of lead, assuming all shot and bullets are lead and nontoxic varieties, it would take hundreds of thousands of years of shooting to reach the standard set by EPA for hazardous.

A remaining question is whether lead shot deposited in remote areas by WS might lead to contamination of water, either ground water or surface water via runoff that occurs during or following rainfall or melting snow cover. Stansley et al. (1992) found that lead did not appear to "transport" readily in surface water when soils are neutral or slightly alkaline in pH (i.e., not acidic), but that it will transport more readily under slightly acidic conditions. In their study, they looked at lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Although they detected elevated lead levels in water in a stream and a marsh that were in the shot "fall zones," they did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot where it was believed the lead contamination was due to water runoff from the parking lot, and not from the shooting range areas. Their study indicated that even when lead shot is highly accumulated in areas with permanent water bodies present, the lead does not necessarily cause elevated lead contamination of water further downstream. They also reported that muscle samples from two species of fish collected in the 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 of the impact areas were far below the EPA's "action level" (i.e., requiring action to treat the water to remove lead) of 15 ppb ("parts per billion"). They reported 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 in the impact areas. This means "transport" of lead from bullets or shot distributed across the landscape is reduced once the bullets and shot from these crusty lead oxide deposits on their surfaces, which serves to naturally further reduce the potential for ground or surface water contamination. These studies suggest that, given the very low and highly scattered shot concentrations that occur from WS's WDM shooting activities, as well as most other forms of dry land small game hunting in general, lead contamination of water from such sources would be minimal to nonexistent. Based on the above analysis, we conclude that the amount of lead deposited by WS WDM operations is far below any level that would pose any risk to public health or of significant contamination of water supplies.

In a review of lead toxicity threats to the California Condor, a species not found in Colorado regularly, but highly susceptible to lead poisoning, the Center for Biological Diversity et al. (2004) concluded that lead deposits in soils, including those caused by target shooting by the military at shooting ranges on military reservations used by condors, did not pose significant threats to the condor. The concern was that lead might bio-accumulate in herbivores that fed on plants that might uptake the lead from the soil where the target ranges were located. However, Center for Biological Diversity et al. (2004) reported blood samples from condors that foraged at the military reservation where the target shooting occurred did not show elevated lead levels, and, in fact showed lower lead levels than samples from condors using other areas. Because lead deposited by WS's WDM activities is widely scattered in comparison to military shooting ranges, it is clear that, despite valid concerns about other sources of lead toxicity in the environment, lead deposited onto the landscape by WS should not cause any significant impacts on wildlife, nor should it contribute in any significant way to cumulative impacts from other sources of lead shot deposited by sport hunting. However, there appears to be a growing body of evidence that lead bullets and shot remaining in carcasses of animals that are shot but not removed from the landscape can pose lead toxicity problems for scavenging California Condors (Center for Biological Diversity et al. 2004). These concerns have also arisen regarding lead poisoning from Bald Eagles scavenging predators that have been shot. The WS Program has tried various nontoxic (non-lead) shot loads to reduce the concern of lead poisoning, and continues to move in this direction as new nontoxic ammunition is developed that is effective for WDM. However, some evidence has shown that the threat of lead toxicity to eagles is not as severe as previously thought. Hayes (1993) reviewed literature and analyzed the hazard of lead shot to raptors, in particular eagles from aerial hunting by WS. Key findings of that review were:

- Eagles are known to scavenge on bird and mammal carcasses, particularly when other food sources are scarce or when food demands are increased.

- In studies that documented lead shot consumption by eagles (i.e., based on examining the contents of regurgitated pellets), the shot was associated with waterfowl, upland game bird, or rabbit remains, and was smaller than BB or #4 buckshot used in aerial hunting. Lead levels have been detected in eagle blood samples, but the source of the exposure was unknown. Lead residues have been documented in jackrabbits, voles (*Microtus sp.*), and ground squirrels which can explain how eagles could ingest lead from sources other than lead shot. In one study (Pattee et al. 1981), four of five captive Bald Eagles force fed uncoated lead shot died and the fifth went blind. Frenzel and Anthony (1989) suggested, however, that eagles usually reduce the amount of time that lead shot stays in their digestive systems by casting most of the shot along with other indigestible material. It appears that healthy eagles usually regurgitate lead shot in pellet castings which reduces the potential for lead to be absorbed into the blood stream (Pattee et al. 1981; Frenzel and Anthony 1989).

- WS personnel examined nine coyotes (*Canis latrans*) shot with copper plated BB shot to determine the numbers of shot retained by the carcasses. A total of 59 BBs was recovered, averaging 6.5 pellets per coyote. Of the 59 recovered pellets, 84% was amassed just under the surface of the hide opposite the side of the coyote that the shot entered, many exhibited minute cracks of the copper plating, and two shot pellets were split. The fired shot was weighed, compared with unfired shot, and found to have retained 96% of its original weight. Eagles generally peel back the hide from carcasses to consume muscle tissue. Because most shot retained by coyotes tends to end up just under the hide, it would most likely be discarded with the hide. Any shot consumed would most likely still have the nontoxic copper plating largely intact, reducing the exposure of the lead to the digestive system. These factors combined with the usual behavior of regurgitation of ingested lead shot indicate a low potential for toxic absorption of lead from feeding on coyotes killed by aerial hunting.

The above analysis indicates adverse effects on eagles from scavenging on animals killed in WDM are unlikely. The USFWS did not identify this as a concern in the 1992 BO (USDA 1997, Appendix F) which covered potential adverse effects on Bald Eagles from all WS used WDM methods, including shooting. Bald Eagle populations appear to be increasing in the contiguous 48 states and have met or exceeded recovery goals in several states. Golden Eagle populations appear to be somewhat healthy, but show nonsignificant trends in the BBS (BBS trend estimates for raptors are not as reliable because of small sample sizes). BBS data survey-wide indicate an increasing trend in breeding populations of Golden Eagles (nonsignificant) and Bald Eagles (significant, $P<0.05$) in North America from 1966-2009

(Sauer et al. 2011). However, researchers have suggested that the population of Golden Eagles may be declining in the West (Kochert et al. 2002, Good et al. 2007). Good et al. (2007) estimated the population of Golden Eagles in 4 Bird Conservation Regions from aerial transects at 27,000 and hope to continue the surveys to determine the trend in the population (preliminary estimates suggest a decline). Thus, Bald Eagle populations do not appear to be adversely affected by lead toxicity problems. Some portion of the Golden Eagle population dies from lead poisoning which is believed to occur from eating hunter shot carcasses which were not retrieved. However, one study found that found that eagles were exposed to lead in the environment from unknown sources over extended periods of time (Kochert et al. 2002). To minimize exposure from WDM activities, WS retrieves shot carcasses where practical and disposes of them in areas where eagles and other scavengers such as hawks are not able to scavenge on them. In addition, WS uses nontoxic shot where eagles have been documented recently. In addition, no evidence has been brought forth to indicate that any animals killed during WDM by WS have resulted in any indirect lead poisoning of scavenging eagles or other animals.

2.3.3 Impacts of Hazing Programs on Livestock

Some individuals have raised concerns that noise from pyrotechnics used to harass birds could startle livestock and cause problems such as injuring themselves running through fences. Some dairy operators have voiced concerns that startling effects from sound-scare devices could adversely affect milk production. WS personnel, trained and experienced in using pyrotechnics, have noted that in their experience most animals habituate relatively easily and rapidly to noises from the pyrotechnics. However, personnel avoid shooting pyrotechnics near identified livestock facilities where operators have expressed concerns.

2.3.4 National Historic Preservation Act, American Indian, and Cultural Resource Concerns

NHPA requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and determine whether they have concerns for cultural properties in these areas. In most cases as discussed in Section 1.7.2, WDM activities have little potential to cause adverse effects to sensitive historical and cultural resources. If a BDM activity with the potential to affect historic resources is planned under the selected alternative in the decision for this EA, then an individual site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary. The proposed action would not cause major ground disturbance, does not cause any physical destruction or damage to property, wildlife habitat, or landscapes, and does not involve the sale, lease, or transfer of ownership of any property. In general, the proposed methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Harassment techniques that involve noise-making could have a primary effect that would be beneficial at the damage site. The use of these devices is usually short term and could be discontinued if a conflict arose with the use of historic property. Therefore, the BDM methods that WS would use under the proposed action are not the types of activities that would have the potential to affect historic properties.

The Native American Graves and Repatriation Act of 1990 provides protection of American Indian burial sites and establishes procedures for notifying Tribes of any new discoveries. Senate Bill 61, signed in 1992, sets similar requirements for burial protection and Tribal notification with respect to American Indian burials discovered on state and private lands. If a WS employee locates a burial site, the employee would notify the appropriate Tribe or official. WS only conducts BDM activities at the request of a Tribe or their lessee and therefore, the Tribe should have ample opportunity to discuss cultural and archeological concerns with WS. However, in consideration of Colorado’s Native Americans, WS has included all of the recognized Tribes in Colorado on the mailing list for this EA to solicit their comments.

2.3.5 Concerns that Killing Wildlife Represents "Irreparable Harm"

Public comments have raised the concern that the killing of any wildlife represents irreparable harm. Although an individual bird or multiple birds in a specific area may be killed by WS BDM activities, this does not in any way irreparably harm the continued existence of these species. Wildlife populations experience mortality from a variety of causes, including human harvest and depredation control, and have evolved reproductive capabilities to withstand considerable mortality by replacing lost individuals. Colorado's historic and current populations of big game animals, game birds, furbearers and unprotected birds, which annually sustain harvests of thousands of animals as part of the existing human environment, are obvious testimony to the fact that the killing of wildlife does not cause irreparable harm. Populations of some of these species are in fact much higher today than they were several decades ago (*e.g.*, Snow Geese, Canada Geese), in spite of liberal hunting seasons and the killing of hundreds or thousands of these animals annually. The legislated mission of USFWS and CPW is to preserve, protect, and perpetuate all the wildlife in the United States and Colorado. Therefore, USFWS and CPW would be expected to regulate killing of protected wildlife species in the State to avoid irreparable harm. Our analysis, herein, shows that the native species WS takes in BDM will continue to sustain viable populations. Thus, losses due to human-caused mortality are not "irreparable."

2.3.6 Concerns that the Proposed Action May Be "Highly Controversial" and Its Effects May Be "Highly Uncertain," Both of Which Would Require that an EIS Be Prepared

The failure of any particular special interest group to agree with every act of a Federal agency does not create controversy and NEPA does not require the courts to resolve disagreements among various scientists as to the methodology used by an agency to carry out its mission (*Marsh vs. Oregon Natural Resource Council*, 490 U.S. 360, 378 (1989)[9]). Although there is some opposition to BDM, this action is not highly controversial in terms of size, nature, or effect. If in fact a determination is made through this EA that the proposed action would have a significant environmental impact, then an EIS would be prepared.

2.3.7 Potential for Avian Cholera and Botulism to Result from Killing Starlings and Blackbirds

Concern has been expressed that if WS personnel kill blackbirds with DRC-1339 and the blackbirds subsequently die in wetland roosting areas, there would be an increased risk of avian botulism and avian cholera.

Avian Botulism. Avian botulism is a paralytic disease of birds resulting from ingestion of toxin produced by the bacterium, *Clostridium botulinum* (Rosen 1971, Locke and Friend 1987). Seven distinct types of botulism toxins, designated by the letters A through G, have been identified; waterfowl die-offs from botulism are usually caused by Type C toxin (Locke and Friend 1987). Many species of birds and some mammals are affected by Type C botulism in the wild. Waterfowl, shorebirds and gulls are most commonly affected and songbirds are only infrequently affected (Locke and Friend 1987). However, not enough is known about avian botulism to precisely identify the factors leading to an outbreak (Locke and Friend 1987). Many botulism outbreaks occur on the same wetland year after year, and within a wetland there may be localized "*hot spots*." Also, outbreaks often follow a fairly consistent and predictable time frame (Locke and Friend 1987).

Most outbreaks occur west of the Mississippi River usually during late summer from July through September. The *C. botulinum* bacterium persists in wetlands in a spore form that can persist for many seasons since it is resistant to heat and drying (Locke and Friend 1987). The primary factors that contribute to the onset and maintenance of avian botulism outbreaks include water quality, depth and

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[9] Court cases not cited in Literature Cited section.

fluctuations, rotting vegetation, presence of invertebrate and vertebrate carcasses, high fly populations, and high ambient temperatures (above 77F^{o}) (Rosen 1971, Locke and Friend 1987). Onset usually occurs following fluctuating water levels during the hot summer months which can produce high mortality in the invertebrate fauna and this in turn could initiate rapid bacterial growth and toxin production within the wetland. Once animals begin to die of the toxins, their carcasses are the source of further amplification in fly maggot-bird transmission cycles (Reed and Rocke 1992); a single waterfowl carcass can produce several thousand infected maggots. Consumption of just a few of these maggots can intoxicate a duck. Outbreaks generally occur from July through September. Management of the environmental conditions in the wetlands, especially water levels, and early and continuous clean-up and incineration of botulism-killed waterfowl carcasses are recommended to prevent and/or control avian botulism outbreaks (Locke and Friend 1987). In addition, the occurrence of carcass-maggot cycles of botulism is dependent on a number of factors in addition to the presence of carcasses with botulism spores, including: fly density, and environmental conditions that facilitate fly egg-laying, maggot development, and maggot dispersal from carcasses (Reed and Rocke 1992).

There is little information available on infection or mortality of songbirds, including blackbirds, from avian botulism, but songbirds are generally infrequently affected by this bacterial toxin (Locke and Friend 1987). If numbers of blackbird carcasses were added to a wetland in the winter as a result of BDM activities, it is unlikely that it would result in increased risk of avian botulism to the waterfowl present in the same wetlands in spring and summer. This is mainly because of the cold ambient temperatures and lack of sufficient flies to produce a bird-maggot amplification cycle during winter (Locke and Friend 1987). Most carcasses would be eliminated within a few days through consumption by scavengers or, when temperatures rose above freezing, by decomposition in a few days or a week. This should occur long before summer temperatures rise to levels needed for botulism outbreaks. Also, most of the blackbird carcasses would be located in the dense cattail stands where a nighttime roost is located which means that, even if they were still present by July, they and any associated maggots, would generally not be available to expose feeding waterfowl and contribute to increased botulism risk. There is no evidence to suggest that the blackbird carcasses themselves could initiate rapid bacterial growth and amplification of bird-maggot transmission. Thus, it is unlikely that increased risk of avian botulism would result from any type of BDM activity anticipated to occur at livestock feeding facilities.

Avian Cholera. The following information was provided by R. McLean, Director, National Wildlife Health Center, Madison, WI, and is based on information summarized from Friend (1999) and Samuel et al. 2007).

> *Most species of birds and mammals can become infected with the bacteria, Pasteurella multocida, that causes avian cholera. The majority of the bird species are susceptible to the clinical disease when exposed to virulent strains of this bacterium. Avian cholera commonly occurs in waterfowl and major die-offs occur almost yearly, whereas, it occurs less frequently with only occasional die-offs in coots and scavenging gulls and crows. There are only a small number of reports in shorebirds, cranes and songbirds. Losses can occur any time of year, but predictable seasonal patterns exist in areas where avian cholera has become well established as a disease of wild waterfowl, particularly in waterfowl movement corridors west of the Mississippi River. Transmission occurs by direct bird-to-bird contact or by ingestion of contaminated food or water and possibly by aerosols. Transmission is enhanced by the gregarious nature of most waterfowl species and by dense concentrations of migratory water birds. The bacteria can persist in water for several weeks, in soil for up to 4 months and in decaying bird carcasses for at least 3 months. Acute infections in birds can result in rapid death 6 to 12 hours after exposure, therefore, early detection of outbreaks is crucial in stopping the disease. Rigorous and careful collection, removal, and incineration of waterfowl carcasses is recommended to control the outbreaks and to reduce exposure of scavenging birds.*

Studies found that while *P. multocida* bacteria can be detected in water and soil samples from wetlands immediately after an outbreak (Moore et al. 1998), wetlands are probably not an important reservoir for maintaining the bacteria (Lehr et al. 1998). Little evidence of infection of blackbirds with *P. multocida* bacteria has been found or evidence to suggest they are involved in avian cholera outbreaks. The risk of exposing waterfowl to avian cholera from the presence of blackbird carcasses in the dense cattail marsh habitat where most are likely to occur is considered low.

2.3.8 WS's Impact on Biodiversity

No WS wildlife management program is conducted to eradicate a native wildlife population. WS operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. Any reduction of a local population or group would be temporary because immigration from adjacent areas or reproduction would soon replace the animals removed. The impacts of the current WS BDM programs on biodiversity are not significant nationwide (USDA 1997) or in Colorado. WS operates on a relatively small percentage of the land area in Colorado and WS take is a small proportion of the total population of the species analyzed in Chapter 4.

2.3.9 Wildlife Damage Should Be an Accepted Loss -- A Threshold of Loss Should Be Reached before Providing BDM Services

WS is aware of concerns that federal WDM should not be allowed until economic losses become unacceptable. Although some loss of resources to wildlife can be expected and tolerated, WS has the legal direction to respond to requests for WDM, and it is Program policy to aid each requester to minimize losses. WS uses the Decision Model discussed in Chapter 3 to determine an appropriate strategy.

In a ruling for Southern Utah Wilderness Alliance, et al. vs. Hugh Thompson, Forest Supervisor for the Dixie NF, et al., the United States District Court of Utah upheld the determination that a WDM program may be established based on threatened damage. In part, the court found that a forest supervisor need only show that damage (from predators) is threatened to establish a need for WDM (Civil No. 92-C-0052A January 20, 1993). Thus, there is precedent for conducting BDM when damage has not yet occurred but is only threatened.

2.3.10 Wildlife Damage Management Should Be Fee Based and Not a Taxpayer Expense

WS is aware of concerns that WDM should not be provided at the expense of the taxpayer or that it should be fee based. WS was established by Congress as the agency responsible for providing WDM to the people of the United States. Funding for WS BDM comes from a variety of sources in addition to Federal appropriations. Such non-Federal sources include local government funds (state, county or city), producer associations, and individual private citizens which are all applied toward program operations. Federal, state, and local officials have decided that WDM needs to be conducted and have allocated funds for these activities. Additionally, WDM is an appropriate sphere of activity for government programs, since wildlife management is a government responsibility. A commonly voiced argument for publicly funded WDM is that the public should bear the responsibility for damage to private property caused by "publicly-owned" wildlife.

2.3.11 Environmental Justice and Executive Order 12898

Environmental Justice is a movement promoting 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, also known as Environmental Equity, has been defined as the pursuit of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status.

Environmental Justice is a priority both within APHIS and WS. 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. APHIS implements Executive Order 12898 principally through its compliance with the provisions of NEPA.

All WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to insure Environmental Justice. WS personnel use wildlife damage management methods as selectively and environmentally conscientiously as possible. It is not anticipated that the proposed action or any alternative would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations.

2.3.12 Lethal Starling and Blackbird Control Is Futile Because 50-60% Die Annually Anyway

Because natural mortality in blackbird populations is 50 - 65% per year (see section 4.1.1.1), some persons argue that this shows lethal BDM actions are futile. However, the rate of natural mortality has little or no relationship to the effectiveness of lethal BDM because natural mortality generally occurs randomly throughout a population and throughout the course of a year. Natural mortality is too gradual in individual concentrations of depredating birds to adequately reduce the damage that such concentrations are causing. It is probable that mortality caused by BDM actions is not "additive" to natural mortality but merely displaces it, otherwise known as "compensatory" mortality. In any event, it is apparent that the rate of mortality from BDM is well below the extent of any natural fluctuations in overall annual mortality and is, therefore, insignificant to regional populations. The objective of lethal BDM in the alternatives analyzed in this EA is not to necessarily add to overall blackbird or starling mortality, which would be futile under current funding limitations, but to redirect mortality to a segment of the population that is causing damage in order to realize benefits during the current production season. The resiliency of these bird populations does not mean individual BDM actions are not successful in reducing damage, but that periodic and recurring BDM actions are necessary in many situations.

2.3.13 Cost Effectiveness of BDM

Perhaps a better way to state this issue is by the question "Does the value of damage avoided equal or exceed the cost of providing BDM?" The Council on Environmental Quality (CEQ) regulations (40 CFR 1502.23) do not require a formal, monetized cost-benefit analysis to comply with NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. USDA (1997) determined that cost effectiveness is not, nor should it be, the primary goal of the WS program. Additional constraints, such as environmental protection, land management goals, and others, are considered whenever a request for assistance is received. These constraints increase the cost of the program while not necessarily increasing its effectiveness, yet they are a vital part of the WS program.

An analysis of cost-effectiveness in many BDM situations is exceedingly difficult, if not impossible to perform, because the value of benefits is not readily determined. For example, the potential benefit of eliminating feral domestic pigeons from roosting and nesting around heating and cooling structures on a school or hospital could be reduced incidence of illness among an unknown number of building users. Since some of the bird-borne diseases described in Chapter 1 are potentially fatal or severely debilitating, the value of the benefit may be high. However, no studies of disease problems with and without BDM have been conducted, and therefore, the number of cases *prevented* by effective BDM is not possible to estimate. Also, it is rarely possible to conclusively prove that birds are responsible for individual disease cases or outbreaks.

The WS programs in Arizona (WS 1996), Idaho (WS 1998), and Nevada (WS 2006) prepared an analysis of cost versus avoided losses for feedlot and dairy operations that received BDM service. The analyses in these EAs indicated that the cost:benefit of providing BDM and the feed saved from starling and blackbird damage was 1:3, 1:4, and 1:5, respectively. These analyses did not consider other benefits such as prevention of disease transmission, restored weight gain performance of livestock, and milk yields. Thus, these analyses showed that the BDM programs were beneficial and WS anticipates the same.

An agency reviewer suggested that a rigorous cost:benefit analysis of all possible combinations of nonlethal and lethal alternatives would demonstrate that costs of lethal BDM are greater than of implementing most if not all nonlethal BDM. WS does not currently have the resources to conduct such a cost:benefit analysis, but believes that it would even be greater because Colorado CAFOs have had diseases outbreaks which would increase the benefits greatly. An important cost:benefit consideration of implementing scaring programs is whether the birds would be expected to simply relocate to other facilities (Johnson and Glahn 1994), requiring more facility managers to resort to the costs of scaring or other control programs. Thus, the overall cost of BDM at multiple facilities within broader localized areas could be expected to be greater with purely nonlethal strategies than under strategies in which the damaging birds could be removed.

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

Children may suffer disproportionately from environmental health and safety risks for many reasons. Bird damage management at livestock feeding facilities as proposed in this EA would only involve legally available and approved damage management methods in situations or under circumstances where it is highly unlikely that children would be adversely affected. Therefore, implementation of the proposed action or other alternatives involving direct assistance by WS would not increase environmental health or safety risks to children.

2.3.15 Impacts on the Natural Environment Not Considered

USDA (1997) evaluated many WS BDM activities for their impacts on several other natural environmental factors not discussed above. USDA (1997) concluded that WS would have negligible impacts on air quality from the use of WDM methods. In addition, the proposed action does not include construction or discharge of pollutants into waterways and therefore, would not impact water quality or require compliance with related regulations or Executive Orders. The proposed action would cause only very minimal or no ground disturbance and therefore, would impact soils and vegetation insignificantly. WS uses very little fossil fuels and contributes negligible greenhouse gases that could impact global warming.

2.3.16 Irreversible and Irretrievable Commitments of Resources

No irreversible or irretrievable commitments of resources are expected, other than the minor use of fuels for motor vehicles and other equipment, and similar materials. These will not be discussed further.

CHAPTER 3: ALTERNATIVES INCLUDING THE PROPOSED ACTION

3.1 ALTERNATIVES ANALYZED IN DETAIL

Four alternatives will be analyzed in detail in this EA:

1) **Alternative 1 - Continue the Current Federal BDM Program (No Action/Proposed Action).** This is the Proposed Action as described in Chapter 1 and is the No Action Alternative as defined by the Council on Environmental Quality (40 CFR 1500-1508) for analysis of ongoing programs or activities. Under the proposed action, WS will continue to provide an integrated BDM program.

2) **Alternative 2 – Nonlethal BDM by WS Only.** Under this alternative, WS would use only nonlethal methods in BDM. WS could still recommend the use of lethal methods, but would not partake in implementing them.

3) **Alternative 3 – WS Provides Technical Assistance Only for BDM.** Under this alternative, WS would not conduct direct operational BDM activities in Colorado. If requested, WS would provide affected resource owners with technical assistance information only.

4) **Alternative 4 - No Federal WS BDM.** This alternative consists of no federal BDM program by WS or other federal agency.

3.2 DESCRIPTION OF THE ALTERNATIVES

3.2.1 Alternative 1 – Continue the Current Federal BDM Program

The No Action Alternative, the Proposed Action Alternative in this EA, a procedural NEPA requirement (40 CFR 1502), is a viable and reasonable alternative that could be selected. The No Action Alternative provides a baseline to compare with the other alternatives. The proposed action is to continue the current portion of WS that responds to requests for BDM to protect human health and safety, agricultural and natural resources, and property as discussed in Section 1.3, and conduct surveillance projects involving birds as needed. A major component of the current program is providing BDM at airports to reduce wildlife hazards and bird strikes. Another facet of the BDM program is to protect livestock, especially newborns, from raven predation. Another facet of the program is the protection of human health and safety and property from feral Rock Pigeon damage. Finally, WS would also operate to reduce or minimize damage by invasive species (several identified in Appendix C: Table C4) such as starlings and Rock Pigeons.

To meet these goals WS would have the objective of responding to all requests for assistance with, at a minimum, technical assistance or self-help advice, or, where appropriate and when cooperative or congressional funding is available, direct damage management assistance in which professional WS Specialists or Biologists conduct BDM. An IWDM approach would be implemented which would allow use of any legal technique or method, used singly or in combination, to meet requestor needs for resolving conflicts with birds. Agricultural producers and others requesting assistance would be provided with information regarding the use of effective nonlethal and lethal techniques as available and appropriate. Lethal methods used by WS would include shooting, trapping, egg addling/destruction, DRC- 1339, Avitrol, and euthanasia following live capture with trapping, hand capture, nets, or the use of A-C. Nonlethal methods used by WS may include harassment with pyrotechnics, scare crows, propane exploders, and other noises or visual stimuli to frighten birds away from an impacted area, porcupine wire deterrents, wire barriers, the tranquilizer A-C, and chemical repellents (*e.g.,* methyl anthranilate, polybutene tactile repellents, etc.). In many situations, the implementation of nonlethal methods such as exclusion-type barriers would be the responsibility of the requestor to implement which means that, in those situations, WS's only function would be to implement lethal methods, if any were determined to be necessary to resolve a damage problem.

BDM by WS would be allowed in Colorado when requested to conduct such activities to protect resources on private and public property where a need has been documented following the completion of an Agreement for Control or similar conveyance (*e.g., Annual Work Plan*). All management actions would comply with applicable federal, state, and local laws which include obtaining the necessary permits to take birds. A detailed description of the methods that could be used in BDM is given in Section 3.3.1.3. NWRC would continue to conduct research on BDM methods with more than 75% of the budget being spent on nonlethal control methods.

3.2.2 Alternative 2 - Nonlethal BDM by WS Only

This alternative would require WS to use only nonlethal methods to resolve bird damage problems. Persons receiving BDM assistance could still resort to lethal methods that were available to them. DRC-1339 and A-C are currently only available for use by WS employees and could not be used by private individuals. Section 3.3.1.3 describes nonlethal methods available for use by WS under this alternative and the lethal techniques that could potentially be used by State agency personnel and private individuals. NWRC would continue to conduct research on nonlethal methods to resolve bird damage problems.

3.2.3 Alternative 3 - WS Provides Technical Assistance Only for BDM

This alternative would not allow for WS operational BDM in Colorado. WS would only provide technical assistance and make recommendations when requested. Producers, property owners, State and local agency personnel, or others could conduct BDM using traps, shooting, Avitrol, or any nonlethal method that is legal. Avitrol could only be used by State certified pesticide applicators. Currently, DRC-1339 and A-C are only available for use by WS employees and could not be used by private individuals. Section 3.3.1.3 describes BDM methods that could be employed by private individuals or other agencies after receiving technical assistance advice under this alternative. NWRC would continue to conduct research on nonlethal methods to resolve bird damage problems for incorporation into WS personnel's "tool box" of BDM methods.

3.2.4 Alternative 4 - No Federal WS BDM

This alternative would eliminate federal involvement in BDM in Colorado. WS would not provide direct operational or technical assistance and requestors of WS services would have to conduct their own BDM without WS input. This alternative was discussed in detail in USDA (1997). Section 3.3.1.3 describes BDM methods that could be employed by private individuals or other agencies under this alternative, except that DRC-1339 and A-C would not be available for use. Avitrol could be used by State certified restricted-use pesticide applicators. Information on future developments in nonlethal and lethal management techniques that culminate from NWRC would also not be available to producers or resource owners.

3.3 BDM STRATEGIES AVAILABLE TO WS UNDER THE ALTERNATIVES

The strategies and methodologies described below include those that could be used or recommended under Alternatives 1, 2 and 3 described above. Alternative 4 would terminate both WS technical assistance and operational BDM by WS.

3.3.1 Alternative 1 – Continue the Current Federal BDM Program

WS currently uses many of the BDM methods available for use. Some BDM methods are widely used, while others are used infrequently. WS recommends the use of many BDM methods, but does not implement them. The BDM methods available for use are described in Section 3.1.3.3.

The most effective approach to resolving wildlife damage is through IWDM, the integration of one or more damage management methods, used alone, simultaneously, or sequentially, to achieve the desired effect. The philosophy behind IWDM is to implement the best combination of effective management methods in a cost-effective manner while minimizing the potentially harmful effects on humans, target and nontarget species, and the environment. IWDM may incorporate cultural practices (i.e., animal husbandry), habitat modification (i.e., exclusion), animal behavior modification (i.e., scaring), removal of the individual offending animal, suppression or removal of a local population, complete removal of an invasive species, or any combination of these, depending on the circumstances of the specific damage problem and the species targeted. IWDM is being implemented by WS under the current BDM program.

3.3.1.1 The IWDM Strategies That WS Employs.

Technical Assistance Recommendations

"Technical assistance" as used herein is information, demonstrations, and advice on available and appropriate WDM methods. The implementation of damage management actions is the responsibility of the requestor. In some cases, WS provides supplies or materials that are of limited availability for non-WS entities to use. Technical assistance may be provided following a personal or telephone consultation, or during an on-site visit with the requestor. Generally, several management strategies are described to the requestor for short and long-term solutions to damage problems; these strategies are based on the level of risk, need, and the practicality of their application by the requestor.

Under APHIS NEPA Implementing Regulations and specific guidance for the WS program, WS technical assistance is categorically excluded from the need to prepare an EA or EIS. However, it is discussed in this EA because it is an important component of the IWDM approach to resolving bird damage problems.

Direct Damage Management Assistance

Direct BDM assistance is given when technical assistance alone is not sufficient to resolve a problem and landowners are unable to resolve the problem by themselves. Direct damage management assistance may be initiated *Agreements for Control* or other comparable instruments provide for WS direct damage management. The initial investigation defines the nature, history, extent of the problem, species responsible for the damage, and methods that would be available to resolve the problem. Professional skills of WS personnel are often required to effectively resolve problems, especially if restricted use pesticides are necessary, or if the problem is complex. WS direct BDM assistance involves the implementation of lethal control or nonlethal capture or harassment methods.

3.3.1.2 WS Decision Making. WS personnel are frequently contacted after requestors have tried or considered both nonlethal and lethal methods and found them to be ineffective for any number of reasons. Misapplied or inappropriate methods are often impractical, too costly, time consuming, or inadequate for reducing damage to an acceptable level. WS personnel assess the problem and evaluate the legal and administrative appropriateness and availability of potential strategies and methods based on biological, economic and social considerations. Following this evaluation, the methods deemed practical for the situation are developed into a management strategy. After the management strategy has been implemented, monitoring and evaluation are conducted to assess the effectiveness of the strategy. This conscious thought process for evaluating and responding to damage complaints are the steps involved in the WS Decision Model (Slate et al. 1992) (Figure 5 in Section 1.6.4). In the model, most damage management efforts consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a documented process, but a mental problem-solving process common to most, if not all, professions. As depicted in the Decision Model, consideration is given to the following factors before selecting or recommending control methods and techniques:

- Species responsible for damage
- Magnitude, geographic extent, frequency, and duration of the problem
- Status of target and nontarget species, including T&E species
- Local environmental conditions
- Potential biological, physical, economic, and social impacts
- Potential legal restrictions
- Costs of control options
- Prevention of future damage (lethal and nonlethal techniques)

WS recognizes that the decision to implement lethal bird damage reduction activities is a serious professional responsibility. Treves and Naughton-Treves (2005) stated that lethal control can foster the coexistence between people and wildlife and has a legitimate role in wildlife management, but it must be undertaken with care. They stated further that the BDM methods to be used in an operation must be considered carefully and should most often be implemented by a government agency. The authors described a decision-making process for determining the methods and approach (lethal or nonlethal) that the applicator should consider in conducting wildlife damage management, similar to the Decision Model (Slate et al. 1992) used by APHIS-WS personnel. An example of WS decision making in selecting BDM methods is given for a common problem species in Colorado, the feral domestic pigeon.

Feral Domestic Pigeon Problems. Feral domestic pigeons are responsible for many nuisance bird damage requests for assistance in Colorado. The most common situation with this species involves pigeons roosting and nesting on buildings and structures in both urban and rural areas. The main nuisance problem is from the droppings which are most frequently addressed by recommending exclusion devices/barriers (such as netting, hardware cloth, screen, porcupine wire) or habitat modification and local population reduction. With feral pigeons, the population using a structure typically must be removed before exclusion and other techniques will work effectively because the resident population will diligently remain at the site and continue to cause damage. Methods that could be used for population reduction include shooting with pellet rifles, .22 caliber rifles with low velocity rounds, shotguns (mostly in rural or semi-rural situations), live-capture with cage traps followed by euthanasia, and DRC-1339 or Avitrol applications. Once a population at a particular site is removed, cleanup of droppings and feathers (an attractant to new pigeons), the use of exclusion techniques, especially from nesting sites (new pigeons looking for nesting sites are less likely to take up residence), and potentially building modifications such as replacing broken windows, covering open doorways with doors or plastic strips, and other methods are effective in minimizing the potential for a problem to recur. All of these options are available to WS Specialists determining what the best strategy would be to resolve a particular damage situation. In addition, depending on the particular situation, the WS Specialist must determine if the problem should be resolved by the requestor or if assistance is needed.

3.3.1.3 BDM Methods Available for Use. WS has been conducting WDM in the United States for more than 90 years. WS has modified WDM activities to reflect societal values and minimize impacts to people, wildlife, and the environment. The efforts have involved research and development of new field methods and the implementation of effective strategies to resolve wildlife damage. WS personnel use a wide range of methods in BDM and strategies are based on applied IWDM principles. Some techniques suggested for use by resource owners, by other entities or individuals, to stop bird damage may not be considered by WS if they are biologically unsound, legally questionable, or ineffective such as ultrasonic devices to repel birds and the use of illegal chemicals.

Resource Management

Resource management includes a variety of practices that may be used by agriculture producers and other resource owners to reduce their exposure to potential wildlife depredation losses. Implementation of these practices is appropriate when the potential for depredation can be reduced without significantly increasing the cost of production or diminishing the resource owner's ability to achieve land management and production goals. Changes in resource management are usually not conducted operationally by WS, but WS could assist producers in implementing changes to reduce problems.

Animal Husbandry. This category includes modifications in the level of care and attention given to livestock, shifts in the timing of breeding and births, selection of less vulnerable livestock species to be produced, and the introduction of human custodians to protect livestock. The level of attention given to livestock may range from daily to seasonally. Generally, when the frequency and intensity of livestock handling increases, so does the degree of protection especially during calving and lambing when young livestock are vulnerable to species such as Common Ravens and Turkey Vultures. The use of human custodians, such as sheep herders, can significantly reduce damage levels, but can be very costly.

The risk of predation to poultry and small livestock, primarily newborns, can be reduced when operations monitor their livestock during the hours when predatory birds are most active. The risk of predation is usually greatest with immature livestock, and this risk can be reduced by holding pregnant females in pens or sheds to protect newborn livestock and keeping newborn livestock in pens for their first 2 weeks. The risk of predation to livestock diminishes with age and the increase in size. For example, Turkey Vultures and Common Ravens kill calves within a short time after they are born and keeping cows gathered during calving can reduce the opportunity for this, if custodians are present to scare away the birds. Shifts in breeding schedules can also reduce the risk of predation by altering the timing of births to coincide with the greatest availability of natural food items for predators or to avoid seasonal concentrations of migrating predators such as ravens and vultures.

Altering animal husbandry to reduce wildlife damage has many limitations though. Gathering may not be possible where livestock are in many fenced pastures and where grazing conditions require livestock to scatter. Hiring extra herders, building secure holding pens, and adjusting the timing of births is usually expensive. The timing of births may be related to weather or seasonal marketing of livestock. The expense associated with a change in husbandry practice may exceed the savings. WS encourages resource owners to use these strategies where they may be beneficial, but does not conduct these techniques operationally.

Guard Animals. Guard animals are used in WDM to protect a variety of resources and can provide significant protection at times. Guard animals (i.e., dogs, burros, and llamas) have proven successful in many sheep and goat operations. The effectiveness of guarding animals may not be sufficient in areas where there is a high density of wildlife to be deterred, where the resource, such as sheep foraging on open range, is widely scattered, or where the guard animal to resource ratios are less than recommended. WS often recommends the use of guard animals, but has not had an operational guard animal program.

Several breeds of dogs such as the Great Pyrenees and Komondor have been used to protect sheep and goats. Border collies and other dogs can sometimes be very effective for Canada Goose damage reduction at parks and golf courses. However, the supply and longevity of proven guard dogs is generally quite limited. Resource owners typically must purchase and rear their own guarding dog. Therefore, a 4 to 8 month lag-time is necessary to raise a guarding dog before it becomes an effective deterrent to wildlife such as vultures and geese. Since 25% to 30% of dogs are unsuccessful, the first dog raised as a protector may not be useful. Guard dogs may be ineffective for a number of reasons, but usually because they kill the livestock they are protecting or because they do not stay with the livestock or resource they are intended to guard. Guard dogs can harass and kill nontarget wildlife while protecting resources (Timm and Schmidt 1986). They do have the potential for capturing any of the mammalian and avian T&E predators if they tried to depredate on the resource being protected (*e.g.*, lambs).

Crop Selection/Scheduling. In areas where damage to crops from wildlife is expected, different crops can be planted that are less attractive to the wildlife causing damage or crops can be planted at an earlier or later date to avoid damage. This practice depends on the species causing damage (*e.g.*, resident vs. migrant), the availability of alternate food sources, and the market for alternative crops. Research has been conducted on damage resistant crop varieties with little success.

Lure Crops. If depredations are not avoided by careful crop selection or a modified planting schedule, lure crops can sometimes be used to mitigate the potential loss (Cummings et al. 1987). Lure crops are planted or left for consumption by wildlife as an alternate food source. To improve the efficacy of this technique, it is recommended that frightening devices should be used in nearby non-lure crop fields and wildlife should not be disturbed in the lure crop fields. This approach provides relief for critical crops by sacrificing less important or specifically planted fields. Establishing lure crops is sometimes expensive, requires considerable time and planning to implement, and may attract other unwanted species to the area. Lure crops have been used successfully to reduce damage by cranes and geese in the Middle Rio Grande Valley of New Mexico for many years (WS 2009).

Habitat Management. Localized habitat management is often an integral part of WDM. The type, quality, and quantity of habitat are directly related to the wildlife produced or attracted to an area. Habitat can be managed to not produce or attract certain wildlife species. For example, vegetation can be planted that is unpalatable to certain wildlife species or trees and shrubs can be pruned or cleared (Figure 9) to make an area unattractive for roosting birds. Ponds or other water sources can be eliminated to reduce certain wildlife species. Habitat management is typically aimed at eliminating nesting, roosting, loafing, or feeding sites used by particular species. Limitations of habitat management as a method of reducing wildlife damage are determined by the characteristics of the species involved, the nature of the damage, economic feasibility, and other factors. Legal constraints may also exist which preclude altering particular habitats. Most habitat management recommended by WS is aimed at reducing wildlife aircraft strike hazards at airports, eliminating bird winter roosts, or managing field rodent populations at airports so not to attract raptors.

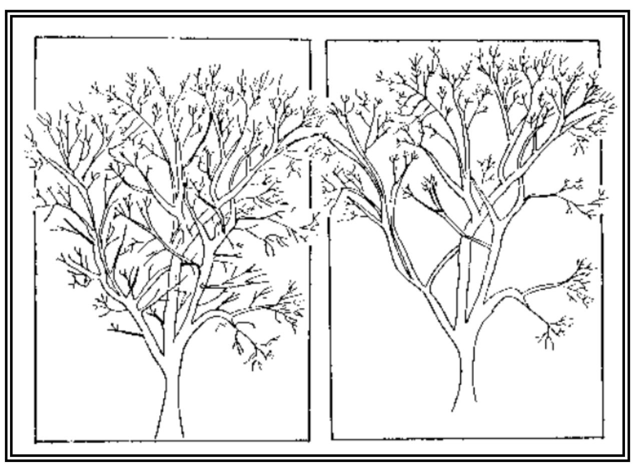

Figure 9. Tree pruning is an example of habitat management.

Change in the architectural design of a building or a public space can often help to avoid potential wildlife damage. For example, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential wildlife damage to parks, public spaces, or residential areas. Similarly, incorporating spaces or open areas into landscape designs that expose wildlife can significantly reduce potential problems. Modifying public spaces to remove the potential for wildlife conflicts is often impractical because of economics or the presence of other nearby habitat features that attract wildlife. Some forms of habitat management may also be incompatible with the aesthetic or recreational features of the site.

Birds use trees and poles for roosting, perching and nesting, and the removal or modification of these items will often reduce the attractiveness of the area. Large winter bird roosts can be greatly reduced at roost sites by removing all the trees or selectively thinning the stand or branches in used trees. Roosts often will re-form at traditional sites, and substantial habitat alteration is the only way to permanently stop such activity. Poles can also be used to attract raptors to sites where reductions in rodent populations are desired.

Habitat management does have the potential to have an effect on all T&E species if present in an area, especially where a T&E species is present that uses the habitat to be modified. If WS determines habitat management would be appropriate to reduce wildlife damage or the threat of damage at a site, such as an airport where wetlands often should be removed, WS will ensure that the cooperator is aware for the need to address T&E species impacts. Habitat management instigated by WS will only be conducted following a consultation with USFWS on a site-specific basis where T&E species are present. Any efforts to mitigate identified effects will be the responsibility of the landowner, but must be agreed upon before WS will commence WDM activities. This will ensure that WS habitat management activities will not have an adverse impact on T&E species and their habitat.

Glyphosate, such as Glypro® Specialty Herbicide and AguaNeat® Aquatic Herbicide**,** is used by WS to reduce cattail (*Typhus spp*.) choked marshes in the Dakotas that are used by blackbirds for roosts and nesting habitat. Glyphosate treatments are conducted to reduce the density of cattails from a wetland for a period of 3-5 years, depending on weather conditions (i.e., moisture levels). Invasive nonnative and hybrid cattail stands have recently invaded the wetlands of the Plains and are a comparatively new habitat type which has changed the species composition of the area to some degree. The marshes, where they are present, easily become inundated with the hybrid cattails and the stands become dense or “choked” with cattails (i.e., little open water exists). A few species of wildlife favor this habitat type, especially for cover, while others, do not such as waterfowl and those that become more vulnerable to predation. Toxicity studies have shown that the glyphosate is non-toxic to all wildlife and safe for use. It is commonly used on many of the National Wildlife Refuges where marsh habitat becomes choked and makes waterfowl habitat relatively unavailable. Although this method is not currently used by WS in Colorado, it could be, especially to disperse blackbird roosts near crop fields.

Prey-base Control with Insecticides and Rodenticides is conducted primarily at airports to reduce the attractiveness of an area to predators including raptors such as Red-tailed Hawks, American Kestrels, and Great Blue herons. All pesticides used by WS are registered for use by EPA and CDA and are not expected to have more than a minimal effects on nontarget species. A reduction in insects at an airfield in Texas was shown to reduce the number of bird strikes as well as bird abundance (M. Bodenchuk, WS, TX pers. comm. 2010).

Modification of Human Behavior. WS often tries to alter human behavior to resolve potential conflicts between humans and wildlife. For example, WS may talk with residents of an area to eliminate the feeding of wildlife that occurs in parks, recreational sites, or residential areas to reduce damage by certain species of wildlife, such as Rock Pigeons, Canada Geese, and gulls. This includes inadvertent feeding allowed by improper disposal of garbage or leaving pet food outdoors where wildlife can feed on it, especially near fast food restaurants. Many wildlife species adapt well to human settlements and activities, but their proximity to humans may result in damage to structures or threats to public health and safety. Eliminating wildlife feeding and handling can reduce potential problems, but many people who are not directly affected by problems caused by wildlife enjoy wild animals and engage in activities that encourage their presence. It is difficult to consistently enforce no-feeding regulations and to effectively educate all people concerning the potential liabilities of feeding wildlife.

Physical Exclusion

Physical exclusion methods restrict the access of birds to resources. These methods can provide effective prevention of bird damage in many situations. Bird proof barriers can be effective but are often cost-prohibitive, particularly because of the aerial mobility of birds which requires overhead barriers as well as peripheral fencing or netting. Exclusion adequate to stop bird movements can also restrict movements of livestock, people, and other wildlife (Fuller-Perrine and Tobin 1993). Exclusionary devices are often more costly than the value of the resource being protected, especially for large areas, and therefore, are uneconomical and not used often. In addition, some exclusionary devices are labor intensive which can further reduce their cost-effectiveness. Exclusionary devices can potentially injure, maim, and kill nontarget wildlife, particularly birds. Netting can entangle birds and needs to be checked frequently to release birds that have been trapped. Wire grids can inadvertently injure or kill nontarget wildlife species, including T&E species, from impact at high speeds.

Fencing. Fences are widely used to prevent damage from wildlife. Exclusionary fences constructed of woven wire or multiple strands of electrified wire can be effective in keeping wading birds from some areas such as an aquaculture facility or molting Canada Geese out of crop fields. The size of the wire grid must be small enough and the height of the fence high enough to keep the birds from entering the area. For ponds, fencing at least 3 feet high should be erected in water 2 to 3 feet deep. If fences are built in shallow water, birds can easily feed on the pond side of the fence. Raceway fences should be high enough to prevent feeding from the wall. Occasionally, blackbirds will cling to fencing or screening near the water and feed on small fish. A slippery surface created by draping plastic over the fence or screen can be used to eliminate this problem. Electric fences or wires have also been used with limited success. This type of exclusion can make routine work around ponds and hatcheries difficult or impossible. Fencing does have limitations. Even an electrified fence is not always bird-proof and the expense of the fencing can often exceed the benefit. In addition, if large areas are fenced, the wildlife being excluded has to be removed from the enclosed area to make it useful.

Overhead Barriers. Overhead barriers such as netting and wire grids are mostly used to prevent access to areas such as gardens, fish ponds and raceways, dwellings, and livestock and poultry pens. Selection of a barrier system depends on the bird species being excluded, expected duration of damage, size of the area or facility to be excluded, compatibility of the barrier with other operations (*e.g.*, feeding, cleaning, harvesting, etc.), possible damage from severe weather, and the effect of on-site aesthetics. The barrier system also depends on the resource being protected and its value. Overhead barrier systems can initially be very costly and expensive to maintain.

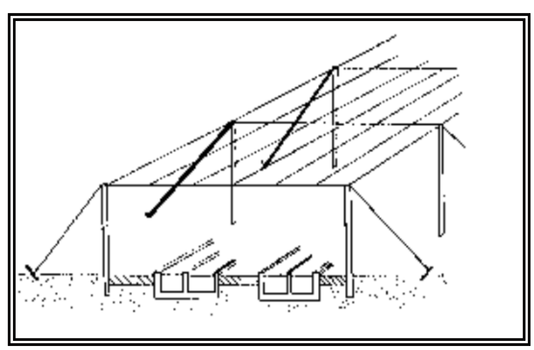

Figure 10. Overhead wire grid to exclude birds.

Netting consists of placing plastic or wire nets around or over resources in a small area, likely to be damaged or that have a high value. Netting is typically used to protect areas such as poultry pens, fish ponds and raceways, and high value crops. Complete enclosure of ponds and raceways to exclude all fish-eating birds requires 1.5- to 2-inch mesh netting secured to frames or supported by overhead wires (Figure 10). Gates and other openings must also be covered. Some hatchery operators use mesh panels placed directly on raceways to effectively exclude predatory birds. Small mesh netting or wire with less than 1-inch openings, secured to wood or pipe frames, prevents feeding through the panels. Because the panels may interfere with feeding, cleaning, or harvesting, they are most appropriate for seasonal or temporary protection. It is also used to prevent wildlife access to settling ponds that contain poisons which could kill them. Small mesh can also be used in ponds to prevent fish from entering shallow water where they would be easy prey for wading birds. Complete enclosure of areas with netting can be very effective at reducing damage by excluding all problem species, but can be costly.

Ponds, raceways, buildings, and other areas can be protected with overhead wires or braided or monofilament lines suspended horizontally in one direction or in a crossing pattern. Monofilament wires can effectively deter gull use of specific areas where they are causing a nuisance (Blokpoel 1976, Blokpoel and Tessier 1984, Belant and Ickes 1996). The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. The WS program in Washington has effectively utilized steel wires to deter gulls from preying on salmon fingerlings, including T&E species, at the base of dams. Spacing between wires or lines should be based on the species and habits of the birds causing damage. Where the wire grids need to be suspended up high to allow for maintenance, perimeter fencing or wire around ponds and raceways provides some protection from wading birds and is most effective for herons. Partial enclosures, such as overhead lines, cost less but may not exclude all bird species such as terns. Additionally, some areas in need of protection are too large to be protected with netting or overhead wires.

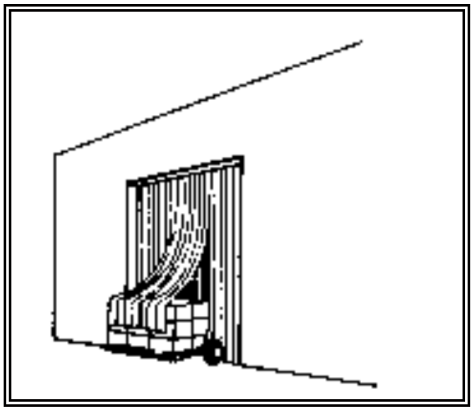

Figure 11. Entrance barricade to deter birds.

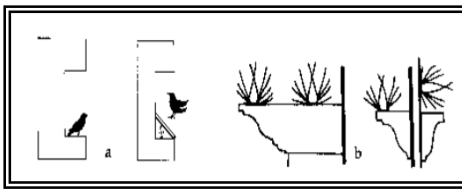

Figure 12. Porcupine wire on ledge to deter birds.

Other Exclusionary Methods. Entrance barricades of various kinds are used to exclude several bird species such as starlings, pigeons, and House Sparrows from dwellings, storage areas, gardens, or other areas. Heavy plastic strips hung vertically in open doorways (Figure 11) have been successful in some situations in excluding birds from buildings used for indoor feeding or housing of livestock (Johnson and Glahn 1994). Plastic strips, however, can prevent or substantially hinder the filling of feed troughs or feed platforms at livestock feeding facilities. Such strips can also be covered up when the feed is poured into the trough by the feed truck. They are not practical for open-air feedlot operations that are not housed in buildings. Metal flashing or hardware cloth may be used to prevent entry of wildlife into buildings or roosting areas. Floating plastic balls called Euro-Matic Bird Balls™ have successfully been used at airports and settling ponds to keep birds from landing on ponds. Porcupine wire (Figure 12) such as Nixalite™ and Catclaw™ is a mechanical repellent method that can be used to exclude pigeons and other birds from ledges and other roosting surfaces (Williams and Corrigan 1994). The sharp points inflict temporary discomfort on the birds as they try to land which deters them from roosting. Drawbacks of this method are that some pigeons will build nests on top of porcupine wire and it can be expensive to implement when large areas are involved. Electric shock bird control systems are available from commercial sources and, although expensive, can be effective in deterring pigeons and other birds from roosting on ledges, window sills and other similar portions of structures (Williams and Corrigan 1994). There are many more examples of these types of exclusionary devices to keep wildlife from entering or landing on areas where they are unwanted.

Wildlife Management

Reducing wildlife damage through wildlife management is achieved using a myriad of techniques. The objective of this approach is to alter the behavior of or repel the target species, remove specific individuals from the population, reduce local population densities, or suppress/extirpate exotic species populations to eliminate or reduce the potential for loss or damage to property and natural resources.

Frightening Devices. Frightening devices are used to repel wildlife from an area where they are a damage risk (i.e., airport, crops) or at risk of being contaminated (*e.g.,* oil spill, settling ponds). The success of frightening methods depends on an animal's fear of, and subsequent aversion to, offensive stimuli (Shivik and Martin 2001). A persistent effort is usually required to effectively apply frightening techniques and the techniques must be sufficiently varied to prolong their effectiveness. Over time, animals often habituate to commonly used scare tactics and ignore them (Arhart 1972, Rossbach 1975, Pfeifer and Goos 1982, Conover 1982 Shirota et al. 1983, Schmidt and Johnson 1984, Mott 1985, Dolbeer et al. 1986, Graves and Andelt 1987, Tobin et al. 1988, Bomford 1990). In addition, in many cases birds frightened from one location become a problem at another. Scaring devices, for the most part, are directed at specific target species by specialists working in the field. However, several of these devices, such as scarecrows and propane exploders can be automated and work without the presence of an operator.

Harassment and other scaring devices and techniques to frighten birds are probably the oldest methods of combating wildlife damage. These devices may be either auditory or visual and generally only provide short-term relief from damage. However, a number of sophisticated techniques have been developed to scare or harass birds from an area. The use of noise-making devices is the most popular and commonly used. Other methods include harassment with visual stimuli (*e.g.,* scarecrows, human effigies, balloons, Mylar® tape, and wind socks), vehicles, lasers, people, falcons, or dogs. These are used to frighten mammals or birds from the immediate vicinity of the damage prone area. As with other WDM efforts, these techniques tend to be more effective when used collectively in a varied regime rather than individually. However, the continued success of these methods frequently requires reinforcement by limited shooting (see Shooting). These techniques are generally only practical for small areas. Finally, it must be noted that sound-scare devices can also scare livestock when they are used in their vicinity.

Visual scaring techniques such as use of Mylar® tape (highly reflective surface produces flashes of light that startles birds), eye-spot balloons (the large eyes supposedly give birds a visual cue that a large predator is present), flags, effigies (scarecrows), sometimes are effective in reducing bird damage. Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988). 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.

Electronic distress sounds and alarm calls of various animals have been used singly and in conjunction with other scaring devices to successfully scare or harass animals. Many of these sounds are available on compact discs and tapes. Distress calls are broadcast to the target animals from either fixed or mobile equipment in the immediate or surrounding area of the problem. Animals react differently to distress calls; their use depends on the species and the problem. Calls may be played for short (*e.g.,* few second) bursts, for longer periods, or even continually, depending on the severity of damage and relative effectiveness of different treatment or "playing" times. Some artificially created sounds also repel wildlife in the same manner as recorded "natural" distress calls.

Propane exploders (Figure 13) operate on propane gas and designed to produce loud explosions at controllable intervals. They are strategically located (i.e., elevated above the vegetation, if possible) in areas of high wildlife use to frighten wildlife from the problem site. Because animals

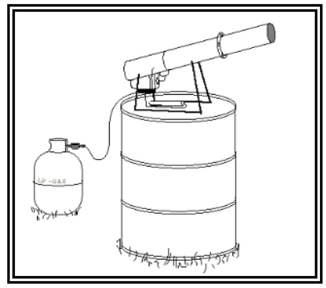

Figure 13. Propane exploder.

are known to habituate to sounds, exploders must be moved frequently and used in conjunction with other scare devices. Exploders can be left in an area after dispersal is complete to discourage animals from returning.

Pyrotechnics, shell-crackers and scare cartridges are commonly used to repel wildlife. Shell-crackers are 12-gauge shotgun shells containing firecrackers that are projected up to 75 yards in the air before exploding. They can be used to frighten birds or mammals, and are most often used to prevent crop depredation by birds or to discourage birds from undesirable roost locations. The shells should be fired so they explode in front of, or underneath, flocks of birds attempting to enter crop fields or roosts, or the air operating area at an airport. The purpose is to produce an explosion between the birds and their objective. Birds already in a crop field can be frightened from the field; however, it is extremely difficult to disperse birds that have already settled in a roost.

Noise, whistle, racket and rocket bombs are fired from 15 millimeter flare pistols. They are used similarly to shell-crackers but are projected for shorter distances. Noise bombs (also called bird bombs) are firecrackers that travel about 25 yards before exploding. Whistle bombs are similar to noise bombs, but whistle in flight rather than exploding. They produce a noticeable response because of the trail of smoke and fire, as well as the whistling sound. Racket bombs make a screaming noise in flight and do not explode. Rocket bombs are similar to noise bombs but may travel up to 150 yards before exploding.

A variety of other pyrotechnic devices, including firecrackers, rockets, and Roman candles, are used for dispersing wildlife. Firecrackers can be inserted in slow-burning fuse ropes to control the timing of each explosion. The interval between explosions is determined by the rate at which the rope burns and the spacing between firecrackers.

Lights, such as strobe, barricade, and revolving units, are used with mixed results to frighten waterfowl. Brilliant lights, similar to those used on aircraft, are most effective in frightening night-feeding birds. These extremely bright-flashing lights have a blinding effect, causing confusion that reduces the bird’s ability to see. Flashing amber barricade lights, like those used at construction sites, and revolving or moving lights may also frighten birds when these units are placed on raceway walls, fish pond banks, or ingress corridors. However, most birds rapidly become accustomed to such lights and their long-term effectiveness is questionable. In general, the type of light, the number of units, and their location are determined by the size of the area to be protected and by the power source available.

Lasers (the term of “laser” is an acronym for Light Amplification by Simulated Emission of Radiation) to alter bird behavior was first introduced nearly 35 years ago (Lustick 1973), but are a relatively new technique used to frighten and disperse birds from their roosts. The laser received very little attention, until recently, when it had been tested by NWRC. Results have shown that several bird species, such as Double-crested Cormorants, Canada Geese, other waterfowl, gulls, vultures, and American Crows have all exhibited avoidance of laser beams during field trails (Glahn et al. 2001, Blackwell et al. 2002). The repellent or dispersal effect of a laser is due to the intense and coherent mono-wavelength light that, when targeted at birds, can have substantial effects on behavior and may illicit changes in physiological processes (APHIS 2001). Best results are achieved under low-light conditions (i.e., sunset through dawn) and by targeting structures or trees in proximity to roosting birds, thereby reflecting the beam. In field situations, habituation to lasers has not been observed (APHIS 2001). Lasers are directional by the user and therefore, will have little effect on nontarget species.

Water spray devices from rotating sprinklers placed at strategic locations in or around ponds or raceways will repel certain birds. However, individual animals may become accustomed to the spray and feed among the sprinklers. Best results are obtained when high water pressure is used and the sprinklers are operated with an on-off cycle. The sudden startup noise also helps frighten birds from an area.

Physical harassment with radio controlled airplanes is effective in several situations for dispersing damage-causing birds. This tool is effective in removing raptors from areas that are not accessible by other means. Radio controlled airplanes allow for up close and personal harassment of birds, while combining visual (*e.g.*, eyespots painted on the wings) and auditory (*e.g.*, engine noise and whistles attached to the aircraft) scare devices. Disadvantages of method are birds in large flocks do not respond well to the plane, much training is required to become efficient, a good working relationship is required by the operator and air traffic controllers at airports where they are most commonly used, weather conditions may restrict the usefulness of the plane, and the planes require frequent mechanical up-keep.

Avitrol® (Avitrol Corporation, Tulsa, OK), 4-aminopyridine, is primarily used as a chemical frightening agent (repellent) for blackbirds in corn and sunflower fields and can be effective in a single dose when mixed with untreated baits. However, Avitrol is not completely a frightening agent because most birds that consume the bait die (Johnson and Glahn 1994). Avitrol comes preformulated with treated baits mixed with untreated baits (1:99) and applied to crop fields for birds to ingest. After ingesting the bait, the bird becomes ill, flies erratically, emits distress calls, and then dies. This behavior is intended to frighten the remaining blackbirds from the treated fields. NWRC research and producers have had mixed and inconsistent results with the technique's effectiveness. As a result, this formulation of Avitrol has not been used widely. Avitrol is more often used as a toxicant for other species of birds such as pigeons and it will be discussed further under chemical toxicants. Avitrol is a restricted-use pesticide that can only be sold to certified applicators. It is available in several bait formulations with only a small portion of the individual grains carrying the chemical. It can be used during anytime of the year, but is used most often during fall and winter just prior to harvest of a crop. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its bioavailability in aqueous media, is non-accumulative in tissues, and is rapidly metabolized by many species (Schafer 1991). Avitrol is acutely toxic to avian and mammalian species; however, blackbirds are more sensitive to the chemical with little evidence of chronic toxicity for many species. Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning, and during field use only magpies and crows appeared to have been affected (Schafer 1991). However, a laboratory study by Schafer et al. (1974) showed that magpies exposed to two to 3.2 times the published LD_{50} (Lethal Dose required to kill 50% of the test subjects of a given species) in contaminated prey for 20 days were not adversely affected and three American Kestrels were fed contaminated blackbirds for seven to 45 days were not adversely affected. Therefore, no probable risk is expected, based on low concentrations and low hazards quotient value for nontarget indicator species tested on this compound. No probable risk is expected for pets and the public, based on low concentrations and low hazards quotient value for nontarget indicator species tested on this compound.

Relocation. Translocation may be appropriate in some situations (i.e., if the problem species' population is at very low levels, a suitable relocation site is known, and the additional dollars required for relocation can be obtained.) However, those species that often cause damage problems (*e.g.*, blackbirds, Canada

Geese) are relatively abundant and relocation is not necessary for the maintenance of viable populations. Relocation may also result in future depredations if the relocated animal encounters protected resources again and, in some cases, could require payment of damage compensation claims. Any decisions on relocation of wildlife are coordinated with USFWS or CPW, and, in many instances, State laws require consultation with appropriate land management agencies/manager before relocating wildlife to these lands. Finally, some state agencies require veterinary examinations and disease tests prior to relocation.

The American Veterinary Medical Association, The National Association of State Public Health Veterinarians, and the Council of State and Territorial Epidemiologists all oppose the relocation of mammals because of the risk of disease transmission (Centers for Disease Control 1990). Although relocation is not necessarily precluded in all cases, it would in many cases be logistically impractical and biologically unwise. Relocation to other areas following live capture would not generally be effective or cost –effective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and relocation would most likely result in bird damage problems at the new location. Relocation of wildlife is also discouraged by WS policy (WS Directive 2.501) because of stress to the relocated animal, poor survival rates, and difficulties in adapting to new locations or habitats. However, there may be exceptions for relocating certain bird species. Relocation of damaging birds might be a viable solution and acceptable to the public when the birds were considered to have high value such as migratory waterfowl, raptors, or T&E species. In these cases, WS would consult with the USFWS or CPW to coordinate capture, transportation, and selection of suitable relocation sites.

Chemical Repellents. Chemical repellents are nonlethal chemical formulations used to discourage or disrupt particular behaviors of wildlife. There are three main types of chemical repellents: olfactory, taste, and tactile. Olfactory repellents must be inhaled to be effective. These are normally liquids, gases or granules, and require application to areas or surfaces needing protecting. Taste repellents are compounds (i.e., liquids, dusts, granules) that are normally applied to trees, shrubs and other materials that are likely to be ingested or gnawed by the target species. Tactile repellents are normally thick, liquid-based substances which are applied to areas or surfaces to discourage travel of wildlife by irritating the feet or making the area undesirable for travel. Most repellents are ineffective or short-lived in reducing or eliminating damage caused by wildlife, therefore, are not used very often by WS.

Effective and practical chemical repellents should be nonhazardous to wildlife; nontoxic to plants, seeds, and humans; resistant to weathering; easily applied; reasonably priced; and capable of providing good repellent qualities. The reaction of different animals to a single chemical formulation varies and this variation in repellency may be different from one habitat to the next. Development of chemical repellents is expensive and cost prohibitive in many situations. Chemical repellents are strictly regulated, and suitable repellents are not available for many wildlife species or wildlife damage situations. Chemical repellents are commercially available for birds and include active ingredients such as methyl anthranilate which is grape soda flavoring (i.e., Rejex-it®), anthraquinone (Flight Control®Plus, Avipel®), methiocarb (i.e., Mesurol), or polybutenes (i.e., Tanglefoot® - Tanglefoot Co., Grand Rapids, MI). These compounds are relatively nontoxic to the environment with the amount of active ingredient used in the different formulations, especially following label instructions (some problems have been brought forth regarding anthraquinone, but it should be relatively safe if used according to label). The active ingredients in many repellents are listed on the EPA's 25b exempt list and, as such, are considered to have relatively low risk to the environment. Registration requirements for these chemicals are reduced because they are relatively nontoxic. Most repellents have only "Caution" on the labels because they are relatively nontoxic. These can typically be purchased by the public. An exception is methiocarb which is discussed below. Applied in accordance with label directions, none of the other repellents discussed are expected to have an effect on nontarget species.

Methyl anthranilate (MA), an artificial grape flavoring used in foods and soft drinks for human consumption, could be used or recommended by WS as a bird repellent. MA has been shown to be an effective repellent for many bird species, including waterfowl (Dolbeer et al. 1993). It is equivalent in birds as capsaicin (hot peppers) is to mammals. It is registered under the brand name Rejex-it® (Natural Forces LLC, Davidson, NC) or applications to turf or to surface water areas used by unwanted birds. The material has been shown to be nontoxic to bees (LD_{50} > 25 micrograms/bee[10]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[11]), and of relatively low toxicity to fish and other invertebrates. MA is a naturally occurring chemical in concord grapes and the blossoms of several species of flowers which is used as a food additive and perfume ingredient (Dolbeer et al. 1992). It has been listed as "Generally Recognized as Safe" by the FDA (Dolbeer et al. 1992). Water surface and turf applications of MA are generally considered expensive. For example, the least intensive application rate required by label directions is 20 lbs. of product (8 lbs. active ingredient) per acre of surface water at a cost of about $64/lb. with retreatment required every 3-4 weeks; a golf course in Rio Rancho, New Mexico estimated that treating four watercourse areas would cost in excess of $25,000 per treatment for material alone (WS 2009). MA completely degrades in about 3 days when applied to water which indicates the repellent effect is short-lived. Cost of treating turf areas would be similar on a per acre basis.

Another, potentially more cost-effective, MA application is with the use of a fog-producing machine (Vogt 1997). The fog drifts over the area to be treated and is irritating to the birds while being nonirritating to any humans that might be exposed. Fogging applications must generally be repeated 3-5 times after the initial treatment before the birds abandon a treatment site. Applied at a rate of about .25 lb./ acre of water surface, the cost is considerably less than when using the turf or water treatment methods. However, WS would ensure that these methods were currently registered for use in Colorado as these or any chemical registration could be canceled.

Methiocarb is a chemical repellent used for nonlethal taste aversion and was first registered as a molluscicide, but found to have avian repellent properties. Mesurol®, the trade name, is registered with EPA (EPA Reg. No. 56228-33) as an aversive-conditioning egg treatment to reduce predation from Common Ravens, Chihuahuan Ravens, and American Crows on the eggs of T&E species or other wildlife species determined to be in need of special protection. Mesurol is registered for WS use only. The active ingredient is methiocarb which is a carbamate pesticide which acts as a cholinesterase inhibitor. Species which feed upon treated eggs may show signs of toxicity (*e.g.*, regurgitation, lethargy, or temporary immobilization). Occasionally, birds may die after feeding upon treated eggs, but most birds exposed to treated eggs survive. Avery et al. (1995) examined the potential of using eggs injected with 30mg of methiocarb to condition common ravens from preying on eggs of endangered California Least Terns. Results showed that proper deployment of treated eggs can be a useful, nonlethal method for reducing raven predation at Least Tern colonies. Avery and Decker (1993) evaluated whether predation might be reduced through food avoidance learning. They used captive Fish Crows to examine avoidance response from methiocarb (18mg/egg) and methyl anthranilate (100mg/egg). Their study showed that some crows displayed persistence to the 5-day exposure and that successful application may require an extended period of training for target predators to acquire an avoidance response. During the spring of 2001, WS conducted a field test on the Sterling Wildlife Management Area in Idaho, where Mesurol treated eggs were exposed to Black-billed Magpies to evaluate aversive conditioning to eggs of waterfowl and upland game birds. The number of magpies feeding on

[10] An LD_{50} is the dosage in milligrams of material per kilogram of body weight, or, in this case in micrograms per individual bee, required to cause death in 50% of a test population of a species.
[11] An LC_{50} is the dosage in milligrams of material per liter of air required to cause death in 50% of a test population of a species through inhalation.

treated eggs decreased after a period. However, their feeding behavior switched to pecking holes in eggs, possibly trying to detect treated eggs before consuming them. This behavior may suggest that at least some magpies experienced the ill effects of Mesurol, but the *"tasting"* of eggs may result in increased predation (Maycock and Graves 2001).

Capture or Take Methods. Several methods are available to capture or take offending animals. The appropriateness and efficacy of any technique will depend on a variety of factors.

Leghold traps are versatile and widely used by WS for capturing many species. These traps can be utilized to live-capture a variety of animals but are most often used by WS to capture mammals. Birds are rarely targeted with leg-hold traps, except padded jaw leg-hold pole traps (discussed below). Traps are effectively used in both terrestrial and shallow aquatic environments. Traps placed in the travel lanes of the targeted animal, using location to determine trap placement rather than attractants, are known as *"blind sets."* Three advantages of the leg-hold trap are: 1) they can be set under a wide variety of conditions, 2) nontarget captures can be released or relocated, and 3) pan-tension devices can be used to reduce the probability of capturing smaller nontarget animals (Turkowski et al. 1984, Phillips and Gruver 1996). Disadvantages of using leg-hold traps include: 1) the difficulty of keeping them in operation during rain, snow, or freezing weather, 2) the lack of selectivity where nontarget species are of a similar or heavier weight as the target species, and 3) the additional time and labor necessary over other methods to keep them functional.

Cage traps come in a variety of styles for WDM to target different species. The most commonly known cage traps used in the current program are box traps. Box traps are usually rectangular, made from wood or heavy gauge wire mesh. These traps are used to capture animals alive and can often be used where many lethal or more dangerous tools would be too hazardous. Box traps are well suited for use in residential areas.

Cage traps usually work best when baited with foods attractive to the target animal. They are used to capture birds ranging in size from sparrows to vultures. Cage traps do have a few drawbacks. Some individual target animals avoid cage traps. Some nontarget animals become "trap happy" and purposely get captured to eat the bait, making the trap unavailable to catch target animals. These behaviors can make a cage trap less effective. Cage traps must be checked frequently to ensure that captured animals are not subjected to extreme environmental conditions. For example, an animal may die quickly if the cage trap is placed in direct summertime sunlight. Another potential problem with the use of cage traps is that some animals fight to escape and injure themselves in the process. WS SOPs when conducting bird trapping operations is to ensure that an adequate supply of food and water is in the trap to sustain decoy and captured birds for several days. Active traps are checked regularly to replenish bait and water and to remove captured birds. Nontarget species are released during trap checks. USFWS BOs (USDA 1997) had no concerns with impacts to T&E species from the use of these traps.

Decoy traps, modeled after the Australian crow trap, are used to capture several species of birds, including crows, starlings, sparrows, magpies, gulls, and vultures. They are large screen enclosures with the access modified to suit the target species. A few live birds are maintained in the baited trap to attract birds of the same species and, as such, act as decoys. Non-target species are mostly released unharmed (as discussed above birds can injure themselves lethally or birds may be killed by a predator that gains access into the trap).

Nest box traps are used for a variety of damage situations to capture birds (DeHaven and Guarino 1969, Knittle and Guarino 1976). Traps are made of nylon netting, hardware cloth, and wood, and come in many different sizes and designs, depending on the species of birds being captured.

The entrances of traps also vary greatly from swinging-door, one-way door, funnel entrance, to tip-top sliding doors. Traps can be baited with grains or other feed, but mainly need to appear to be ideal nesting sites to attract the target birds.

Clover, funnel, and pigeon traps are enclosure traps made of nylon netting or hardware cloth and come in many different sizes and designs, depending on the species of birds being captured. The entrance of the traps also vary greatly from swinging-door, one-way door, funnel entrance, to tip-top sliding doors. Traps are baited with grains or other feed which attract the target birds. WS standard procedure when conducting trapping operations is to ensure that an adequate supply of food and water is in the trap to sustain captured birds for several days. Active traps are checked daily, every other day, or as appropriate, to replenish bait and water and to remove captured birds.

Cannon and rocket nets are normally used for larger birds such as waterfowl, but can be used to capture a wide variety of avian species. Cannons use mortar projectiles to propel a net up and over birds which have been baited to a particular site. Birds are taken from the net and disposed of appropriately.

Net guns have occasionally been used by WS to catch target waterfowl. These shoot from a "rifle with prongs," go about 20 yards, and wrap around the target animal.

Mist nets are very fine mesh netting used to capture several species of birds. Birds cannot see the netting when it is in place because the mesh is very fine and overlapping "pockets" in the net assure birds will become entangled. They typically become entangled after striking the net. Net mesh size determines the birds that can be caught (Day et al. 1980). These nets can be used for capturing small-sized birds such as House Sparrows and finches entrapped in warehouses and other structures. They can also be used to capture some larger birds such as blackbirds and starlings when they are going to a roost or feeding area. Mist nets are monitored closely, typically watched from a discreet location. Mist nets when used outdoors are often monitored at least hourly to ensure that any captured nontarget species, especially T&E species, can be released quickly and unharmed. Mist nets are more often used in buildings to catch birds such as sparrows and finches, but have been used recently by WS to capture birds to be sampled for disease and released.

Bow nets are small circular net traps used for capturing birds and small mammals. The nets are hinged and spring loaded so that when the trap is set it resembles a half moon. The net is set over a food source and triggered by an observer using a pull cord.

Hand nets are used to catch birds and small mammals in confined areas such as homes and businesses. These nets resemble fishing dip nets with the exception that they are larger and have long handles. A variant on the hand net is a round throw-net with weights at the edges of the net, similar to that used for fishing. This net is also used for capturing birds in urban areas.

Drive traps are used to herd some animals into pens where they are captured. Drive traps have been used for species such as Canada Geese, domestic waterfowl, jackrabbits (*Lepus* spp.), and ungulates. A drive-trap consists typically of wire panels that are erected into a 15 ft^2 to 100 ft^2 pen, depending on the number of geese or other target species, with two wings made of 2-3 ft. high plastic fencing extending 60-200 ft. in a 'V' from the pen. Target species are herded to the pen at each site with people on foot or in boats, depending on the target species and the existing conditions. WS uses the standard "drive-trap" (Addy 1956) to capture Canada Geese or domestic waterfowl during the molt when they are flightless (May-July) for relocation or euthanasia.

Raptor traps come in a variety of styles such as the bal-chatri, Swedish goshawk trap, and purse traps. These have been used by WS at airports to capture raptors to remove them from the airfield. Most raptors captured in these have been banded and relocated. Raptor traps are also used to remove birds from areas around nesting T&E shorebirds. Disposition of captured raptors is determined after consultation with the local USFWS office.

Padded-jaw pole traps (Figure 14) are modified No. 0 or 1 coil spring leg-hold traps used to capture specific target birds such as raptors, magpies and crows. These are placed on top of poles or typical roosting spots frequented by targeted birds. These traps are monitored frequently and nontarget species can be released unharmed. Target species can be relocated or euthanized, mostly depending on the species to be captured and the desires of CPW and USFWS.

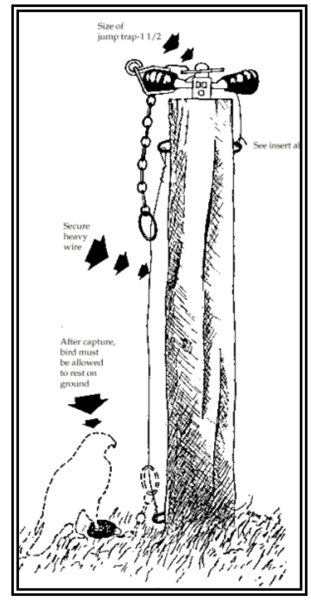

Figure 14. Padded-jaw pole trap.

Snap traps are modified rat snap traps used to remove individual woodpeckers, starlings, and other cavity use birds. The trap treadle is baited with peanut butter or other taste attractants and attached near the damage area, such as on the exterior wall of a home that is being damaged by a species such as a woodpecker. These traps pose no imminent danger to pets or the public.

Shooting is used selectively for target species, but may be relatively expensive because of the staff hours sometimes required. Nevertheless, shooting is an essential WDM method. Removal of feral pigeons may be achieved by night shooting with an air rifle and be quite effective in a short period. Shooting can also be a good method to target individual birds. However, shooting is mostly ineffective for flocking birds.

Lethal reinforcement through shooting is often necessary to ensure the continued success in bird scaring and harassment efforts (see the discussion on shooting under Frightening Devices). This is especially important where predatory birds are drawn by birthing activities, aquiculture facilities, sanitary landfills, and other locations where food is available. In situations where the feeding instinct is strong, most birds quickly adapt to scaring and harassment efforts unless the WDM program is periodically supplemented by shooting.

The risk of lead poisoning to birds was analyzed in Section 2.3.2. WS personnel use lead based ammunition in rifles and sometimes shotguns. WS personnel retrieve carcasses where possible to reduce the risk of lead poisoning. This has been discussed with the USFWS. Because of the recognized potential hazard associated with lead, WS often uses steel or other non-toxic shot as necessary to minimize the risk of lead poisoning to scavengers.

Sport hunting is sometimes recommended by WS as a viable BDM method when the target species can be legally hunted. A valid hunting license and other licenses or permits may be required by CPW and USFWS for certain species. This method provides sport and food for hunters and requires no cost to the landowner. Sport hunting is occasionally recommended if it can be conducted safely for pigeon damage management around feedlots and dairies and for Sandhill Cranes, Canada Geese, Snow Geese, and other damage causing waterfowl.

Egg, nest, and hatchling removal and destruction can be a means of maintaining populations of a damaging avian species at a static level. Nesting populations of Canada Geese and gulls, especially if located near airports, may pose a threat to public health and safety, as well as equipment. Pigeons and starlings can also cause extensive damage to public facilities. Egg and nest destruction is used mainly to control or limit the growth of a nesting population in a specific area through limiting reproduction of offspring or removal of nest to other locations. Egg and nest destruction is practiced by manual removal of the eggs or nest.

Some species frequently attack people to guard their nests. In Colorado, species that will actually strike people are Canada Geese and Mississippi Kites. This causes concern when the nest is located near a door or exit to a residential house or business. Of greatest concern is the threat to elderly people or bicyclist who may fall in response to the attack. Where these are creating a significant nuisance, WS may remove the nest, eggs, or hatchlings.

Egg addling or oiling is the practice of destroying the embryo prior to hatching. Egg addling is conducted by vigorously shaking an egg numerous times which causes detachment of the embryo from the egg sac. Egg oiling (a liquid spray) does not allow an egg to breathe or get oxygen, which prohibits the embryo from developing. Eggs are oiled and addled so that birds do not renest at least for an extended period; for example, Canada Geese will set on eggs an average of 14.2 days beyond the expected hatch date for addled eggs. Egg destruction can be accomplished in several different ways, but the most commonly used methods are manually gathering eggs and breaking them. This method is practical only during a relatively short time interval and requires skill to properly identify the eggs and hatchlings of target species. Some species may persist in nesting and the laying of eggs, making this method ineffective.

Chemical immobilizing and euthanizing drugs are important tools for managing wildlife. Under certain circumstances, WS personnel are involved in the capture of animals where the safety of the animal, personnel, or the public are compromised and chemical immobilization provides a good solution to reduce these risks. For example, chemical immobilization has often been used to capture aggressive Canada Geese in residential areas where public safety is at risk. It is also used to take nuisance waterfowl that cannot be easily captured with other methods. WS employees that use immobilizing drugs are certified to use these following the guidelines established in the WS Field Operational Manual under "Use of Immobilization and Euthanasia Drugs." A-C is an immobilizing agent used by WS to capture and remove/relocate waterfowl, coots, pigeons, and gulls. These are typically used in urban, recreational, and residential areas where the safe removal of a problem animal is most easily accomplished with a drug delivery system, hand-fed baits. Immobilization is usually followed by relocation when appropriate (i.e., mainly waterfowl) or euthanasia. Euthanasia is usually performed with drugs such as Beuthanasia-D® or Fatal-Plus® which contain forms of sodium phenobarbital. Euthanized animals are disposed of by incineration or deep burial to avoid secondary hazards. Drugs are monitored closely and stored in locked boxes or cabinets according to WS policies, and Department of Justice, Drug Enforcement Administration or FDA guidelines. Most drugs fall under restricted-use categories and must be used under the appropriate license from the U.S. Department of Justice, Drug Enforcement Administration which WS does hold. A-C is currently regulated by FDA.

Alpha-chloralose is an immobilizing agent used to capture and remove nuisance birds. The drug is currently approved for use by WS as an FDA Investigational New Animal Drug (Registration #6602) rather than a pesticide. A-C has been typically used in industrial and residential areas. Single bread or corn baits are fed directly to target birds and those treated are monitored until the drug takes effect. WS personnel remain at the application site until the immobilized birds are retrieved. Unconsumed baits are removed from the site following each treatment. A-C may be used only by WS personnel who have been trained and certified in its use. Pursuant to FDA restrictions, pigeons and waterfowl (during the hunting season) captured with A-C for subsequent euthanasia must be killed and buried or incinerated, or be held in captivity for at least 30 days, at which time the birds may be killed and processed for human consumption. If a bird is going to be relocated, it can be released once the effects of the drug wears off (about 10 hours) or after it is held 30 days if take will overlap with a hunting season. Use of this drug is labor intensive and therefore, not always cost effective (Wright 1973, Feare et al. 1981). A-C is typically delivered in small quantities contained in baits with minimal hazards to pets and humans because the single bread or corn baits are fed directly to the target birds.

A-C was eliminated from more detailed analysis in USDA (1997) based on critical element screening, therefore, environmental fate properties of this compound were not rigorously assessed. However, the solubility and mobility are believed to be moderate and environmental persistence is believed to be low. Bioaccumulation in plants and animal tissue is believed to be low. A-C is used in other countries as an avian and mammalian toxicant. The compound is slowly metabolized, with recovery occurring a few hours after administration (Schafer 1991). The dose used for immobilization is designed to be about 2 to 30 times lower than the LD_{50}. LD_{50} values are typically much higher for mammals than birds. Toxicity to aquatic organisms is unknown (Woronecki et al. 1990), but the compound is not generally soluble in water and therefore, probably remains unavailable to aquatic organisms. Since A-C is monitored at the application site, fed directly to target species, and uneaten baits are retrieved, the potential effect to nontarget species is low. Factors supporting the determination of this low potential impact included the lack of exposure to pets, non-target species and the public, and the low toxicity of the active ingredient. In addition, most A-C projects are conducted in urban-type environments. Other supporting rationale for this determination included relatively low total annual use by WS and a limited number of potential exposure pathways. However, because A-C is given in baits that the target species could drop or exposed in a free-feeding condition, rather than injected into the animal, a nontarget species could be exposed to its sedative affects. WS Specialists monitor areas for nontargets and tries to avoid them as possible.

Euthanasia can be accomplished with several methods. Several drugs and methods are available to euthanize captured animals. Euthanasia methods include registered drugs such as Beuthanasia-D®, Fatal Plus®, cervical dislocation, decapitation, a shot to the brain, or asphyxiation with CO or CO_2. These methods are completely target species -specific and animals euthanized with drugs are buried or incinerated.

Chemical pesticides have been developed to reduce or prevent wildlife damage and are widely used because of their efficiency. Although some pesticides are fairly group specific to certain of species (*e.g.,* birds vs. mammals), pesticides are typically not species specific and their use may be hazardous unless used with care by knowledgeable personnel. The proper placement, size, type of bait, and time of year are keys to selectivity and successful use of pesticides for WDM. When a pesticide is used according to its EPA registered label, it poses minimal risk to people, the environment, and non-target species. Neither EPA nor CDA would register a chemical that had not undergone rigorous environmental testing to determine its potential effects on humans and the environment including risks to nontarget species. Since the tests required by EPA to register a chemical, development of appropriate pesticides is expensive, and the path to a suitable end product is filled with legal and administrative hurdles. Few private companies are inclined to undertake such a venture. Most pesticides are aimed at a specific target species, yet suitable pesticides are not available for most animals. Available delivery systems make the use of pesticides unsuitable in many wildlife damage situations. This section describes the pesticides used by WS in BDM.

DRC-1339 (EPA. Reg. Nos. 56228-10, 56228-17, 56228-28, 56228-29, and 56228-30), 3-chloro-4-methylbenenamine hydrochloride, is an avian pesticide registered with EPA. For more than 30 years, DRC-1339 has proven to be an effective method of starling, blackbird, gull, crow, raven, magpie, and pigeon damage management (West et al. 1967, West and Besser 1976, Besser et al.

1967, and DeCino et al. 1966). DRC-1339 is a slow acting avicide that is rapidly metabolized into nontoxic metabolites and excreted after ingestion. This chemical is one of the most extensively studied and evaluated pesticides ever developed. Because of its rapid metabolism, DRC-1339 poses little risk of secondary poisoning to non-target animals, including avian scavengers (Cunningham et al. 1979, Schafer 1984, Knittle et al. 1990). This compound is also unique because of its relatively high toxicity to many pest birds, but low-to-moderate toxicity to most raptors with almost no toxicity to mammals (DeCino et al. 1966, Palmore 1978, Schafer 1981). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/ bird to cause death (Royall et al. 1967); many other bird species such as raptors, House Sparrows, and eagles are classified as non-sensitive (USDA 1997) requiring a much higher dose (Oral LD_{50}s doses for Golden Eagles = 450 mg, Northern Harrier = 45 mg, and House Sparrow = 99 mg), usually at least a 10-fold increase in dose over sensitive species. Numerous studies have shown that DRC-1339 poses minimal risk of primary poisoning to non-target and T&E species (USDA 1997). Secondary poisoning has not been observed with DRC-1339 treated baits. During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on birds killed by DRC-1339 and its tendency to be almost completely metabolized in target birds leaving little residue for scavengers to ingest. Secondary hazards of DRC-1339 are almost non-existent. DRC-1339 acts in a humane manner producing a quiet, painless death. Prior to the application of DRC-1339, pre-baiting is required to monitor for non-target species that may consume the bait. If non-target species are observed, then the use of DRC-1339 would be postponed or not applied. Research studies and field observations suggest that DRC-1339 treatments kill about 75% of the blackbirds and starlings at treated feedlots (Besser et al. 1967). The inherent safety features of DRC-1339 help avoid negative impacts to T&E species as well as preclude hazards to most species other than the target species listed.

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. DRC-1339 tightly binds to soil and has low mobility. The half-life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (i.e., degradation chemicals) have low toxicity. Aquatic and invertebrate toxicity is low (USDA 1997). USDA (1997, Appendix P) contains a thorough risk assessment of DRC-1339 and that assessment concluded that no adverse effects to T&E species are expected from use of DRC-1339.

DRC-1339 concentrate is used effectively under five EPA registered labels to reduce damage by specific bird species. Hard-boiled eggs and meat baits are injected with DRC-1339 and used to reduce raven, crow, and magpie damage for the protection of newborn livestock, the young or eggs of threatened, endangered, or sensitive species, human health and safety, and silage and fodder bags. It is also registered for application on grain, poultry pellets, raisins, and cull French fries to reduce damage caused by blackbirds and starlings at livestock and poultry feedlots. A similar label allows DRC-1339 to be used at blackbird and starling staging areas associated with nighttime roosts with similar baits. Another label allows DRC-1339 to be used on whole kernel corn to reduce health, nuisance, or economic problems caused by pigeons in and around structures in non-crop areas. A fifth label allows the use of DRC-1339 on bread cube baits to reduce damage caused by several species of gulls that, during their breeding season, prey on other colonially nesting bird species, or damage property and crops. The specified gull species can be managed to reduce damage or damage threats on their breeding grounds or several other areas including airports and landfills and for T&E species and human health and safety protection.

The use of DRC-1339 as per label instructions will have little effect on nontarget species in Colorado. DRC-1339 baits cannot be used in areas where potential consumption of treated baits by T&E species could occur. Observation of sites to be treated with or without prebaiting is necessary to determine the presence of nontarget species. DRC-1339 baits cannot be used directly in water or areas where runoff is likely.

Avitrol® (Avitrol Corp., Tulsa, OK), 4-aminopyridine, discussed as a chemical frightening agent (repellent) for blackbirds and starlings above, is often used as a toxicant at a 1 treated:9 untreated ratio for pigeons, House Sparrows, and other commensal birds (the ratio can be reduced to 1:5 for House Sparrows). Avitrol treated baits are placed in an area where the targeted birds are feeding and most all birds that consume treated baits normally die (Johnson and Glahn 1994). Birds display abnormal flying behavior after ingesting treated baits and emit distress vocalization (pigeons do not). This chemical is not normally used at airports because the abnormal flying behavior could cause affected birds to fly into the path of aircraft. Avitrol is a restricted use pesticide that can only be sold to certified applicators and is available in several bait formulations with only a small portion of the individual grains carrying the chemical. Any granivorous bird associated with the target species could be affected by Avitrol which none of the T&E species in the United States are. Blackbirds and corvids are slightly more sensitive to the chemical than other species of mammals and birds. In addition, chronic toxicity has not been demonstrated (Schafer 1991). Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning. However, in a field study, magpies and crows may have been affected secondarily (Schafer 1991). A laboratory study showed, though, that magpies which fed for 20 days on birds killed with 2 to 3.2 times the lethal dose of active ingredient were not affected (Schafer et al. 1974). Similarly, American Kestrels that fed on blackbirds for 7 to 45 days which had died from a lethal dose of Avitrol were not adversely affected (Schafer 1991). Therefore, no probable secondary risk is expected with use of this compound, even for pets and the public. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from 3 to 22 months. Avitrol may form covalent bonds with humic materials, which may serve to reduce its bioavailability in aqueous media. Avitrol is non-accumulative in tissues and rapidly metabolized by many species (Schafer 1991). WS has used Avitrol in the last 5 FYs (FY06 – FY10) for urban bird damage situations. Use of Avitrol by WS is not likely to have an adverse effect on T&E species, especially because it will be used according to label restrictions and primarily in urban environments by WS.

***Sodium Lauryl Sulfate* (SLS)** (Stephan Co., Northfield, IL), is a wetting agent in managing European starling; Red-winged, Yellow-headed, and Brewer's blackbirds; cowbird; grackle; American Crow; Common Raven and Black-billed Magpie roosts. SLS is a surfactant commonly used in soap products. Application of SLS 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, SLS allows water to penetrate and saturate the feathers so that with low temperatures (<41°F) and sufficient water, birds die of hypothermia. During 2004-2007, WS' NWRC and Missouri State Office conducted field tests to investigate the effectiveness of SLS in removing urban blackbird roosts. Results document that SLS causes mortality in starlings and blackbirds and may be useful as part of IWDM programs designed to reduce local blackbird populations. Birds died as soon as 30 minutes after exposure to SLS. 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. SLS (Chemical Abstract Service No. 151-21-3) was included on the list of 31 exempt compounds. WS anticipates possibly using this method in the future, especially to disperse blackbird/starling roosts in urban areas.

Chemosterilants and Contraception. Contraceptive measures can be grouped into four categories: surgical sterilization, oral contraception, hormone implantation, and immunocontraception (i.e., the use of contraceptive vaccines). These techniques require that each individual animal receive either single, multiple, or possibly daily treatment to successfully prevent conception. The use of oral contraception, hormone implantation, or immunocontraception is subject to approval by Federal and State regulatory agencies. Surgical sterilization and hormone implantation are generally impractical because it requires that each animal be captured, sterilization conducted by licensed veterinarians, and, thus, would be extremely labor intensive and expensive. As alternative methods of delivering sterility are developed, sterilization may prove to be a more practical tool in some circumstances (DeLiberto et al. 1998). Reduction of local populations could conceivably be achieved through natural mortality combined with reduced fecundity. No animals would necessarily be killed directly with this sterilization, however, and sterilized animals could continue to cause damage. Thus, sometimes culling the population to the desired level and then implementing a sterilization program would be the optimal solution to overabundant bird populations. Populations of dispersing animals would probably be unaffected. Potential environmental concerns with chemical sterilization would still need to be addressed, including safety of genetically engineered vaccines to humans and other wildlife. Several formulations of drugs have been and are being tested by NWRC and other researchers including nicarbazin, diazacon, and immunocontraceptives. These would have to be registered for use in Colorado before WS would use them. The only EPA approved contraceptive available is OvoControl™ G for Canada Geese in urban areas (population greater than 50,000) and FAA certificated airport environments. The active ingredient in OvoControl™ G is nicarbazin which was developed by WS NWRC researchers (WS 2004). Nicarbazin, a drug approved by FDA for use to control coccidiosis in chickens for the last 45 years, reduces the hatchability of eggs. This reduction only occurs while the bait is being consumed and, thus, primary and secondary hazards to other bird species and mammals are minimized or nullified. Following label directions further minimizes nontarget hazards. In Colorado, the use of this bait would have no effect on T&E or sensitive species, people, pets, or the environment. WS has not used OvoControl™ G, but could if registered with CDA. It is expected that this chemical would have minimal effect on the resident Canada Goose population in Colorado in the short-term because geese are long-lived. However, combined with culling, it would be effective at keeping local populations at manageable numbers.

3.3.2 Alternative 2 - Nonlethal BDM by WS Only

This alternative would require that WS use only nonlethal methods in addressing bird damage problems. For lethal BDM activities, producers, state agency personnel, or others could conduct BDM activities including the use of trapping, shooting, avicides, and any other lethal method. The basis of method selection may not be biologically sound or prudent. The chemicals DRC- 1339 and A-C are currently only available for use by WS employees. Therefore, the use of these chemical by private individuals would not be available. The only avian toxicants registered are Avitrol and Starlicide Complete® (PM Resources, Bridgeton, MO) which contains formulated DRC-1339 and these could be used to resolve some bird damage problems.

3.3.3 Alternative 3 - WS Provides Technical Assistance Only for BDM

Under this alternative, WS would only provide technical assistance and make recommendations when requested to resolve bird damage problems. This alternative would not allow WS operational BDM. Producers, state agency personnel, or others could conduct BDM activities including the use of traps, shooting, avicides, and any lethal or nonlethal methods they wish. The chemicals DRC- 1339 and A-C are currently only available for use by WS employees and could be the optimal method to resolve a bird damage situation. However, these chemical could not be used by private individuals or State personnel, but Avitrol and Starlicide Complete could be.

3.3.4 Alternative 4 - No Federal WS BDM

This alternative would consist of no federal involvement in BDM in the State -- neither direct operational management assistance nor technical assistance to provide information on nonlethal or lethal management techniques would be available from WS. Information on future developments in nonlethal and lethal management techniques that culminate from research efforts by WS' research branch would not be as accessible to affected resource owners or managers, as WS would not be a direct source of such information. Producers, state agency personnel, or others would be left with the option to conduct BDM activities including the use of trapping, shooting, and any lethal or nonlethal methods. The basis of method selection may not be biologically sound or prudent. The chemicals DRC-1339 and A-C are currently only available for use by WS employees. Therefore use of these chemicals by private individuals would be illegal, and private and commercial applicators would be left only with using an extremely narrow choice of legal or effective alternatives if chemical control was needed, (i.e. Avitrol, etc.).

3.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

Several alternatives were considered but not analyzed in detail. USDA (1997) discussed several alternatives that were not discussed in detail and the discussion in this EA would be the same. The reader is referred to USDA (1997) for a detailed discussion of these alternatives; these will only be listed here.

- Compensation for Bird Damage Losses
- Short Term Eradication and Long Term Population Suppression
- Use of Bird-Proof Feeders in Lieu of Lethal Control at Dairies and Cattle Feeding Facilities

Additionally a few other alternatives will not be analyzed in detail and are given with a discussion of why they were not considered for detailed analysis in Chapter 4.

3.4.1 Lethal BDM Only by WS

Under this alternative, WS would not conduct any nonlethal control of birds for BDM purposes in the State, but would only conduct lethal BDM. This alternative was eliminated from further analysis because many situations can be resolved effectively through nonlethal means. For example, for blackbird roosts in urban areas, WS has used nonlethal methods exclusively as an effective means to resolving damage. Lethal BDM only does not interface with the overall concept of IWDM, where multiple methods can achieve a desired cumulative effect. Restricting that portion of the program to lethal methods only would likely not be socially acceptable to various agencies, groups and individuals.

3.4.2 Relocation Rather Than Killing Problem Wildlife

Translocation may be appropriate in some situations (i.e., if the problem species' population is at very low levels such as the Ferruginous Hawk, suitable relocation sites are available, and the additional dollars required for relocation can be obtained). However, those species that often cause damage problems (*e.g.*, Canada Geese and Great-tailed Grackles) are relatively abundant or are not native (*e.g.,* starlings) and relocation is not necessary for the maintenance of viable populations. Relocation may also result in future depredations if the relocated animal encounters protected resources, and in some cases could require payment of damage compensation claims. Any decisions on relocation of wildlife by WS are coordinated with CPW or USFWS and consultation with the appropriate land management agency(ies) or manager associated with proposed release sites. Additionally, animals that are relocated become stressed and there is a potential for disease transmission into healthy populations. WS considers translocation for some species and conducts such, but does not relocate all damaging species.

3.4.3 Biological Control

The introduction of a species or disease to control another species has occurred throughout the world. Unfortunately, many of the introduced species become pests themselves. For example, in Hawaii, the Indian mongoose (*Herpestes auropunctatus*) was brought in to control rats (*Rattus* spp.), but wound up causing declines in many native Hawaiian bird species. Though many people think that this is a good idea for small flocking birds, WS dismissed it from further consideration because technology has not advanced to the point that biological control, even for non-native species such as the starling, is feasible and safe.

3.5 WS SOPs INCORPORATED INTO BDM TECHNIQUES

An SOP is any aspect of an action that serves to prevent, reduce, or compensate for negative impacts that otherwise might result from that action. The current program, nationwide and in Colorado, uses many such SOPs. Many WS SOPs are discussed in depth in USDA (1997, Chapt. 5). The key SOPs are incorporated into all alternatives as applicable, except the no federal program alternative (Alternative 4). Most SOPs are instituted to abate specific issues while some are more general and relate to the overall program. SOPs include those recommended or required by regulatory agencies such as EPA and these are listed where appropriate. Additionally, specific measures to protect resources such as T&E species that are managed by WS's cooperating agencies (USFWS and CPW) are included in the lists below.

3.5.1 General SOPs Used by WS in BDM

- WS BDM activities in Colorado are consistent with USDA (1997) SOPs.

- WS complies with all applicable laws and regulations that pertain to conducting BDM on private and public lands.

- WS coordinates with agency officials for work on public lands to identify and resolve any issues of concern with BDM.

- WS coordinates with tribal officials for work on tribal lands to identify and resolve any issues of concern with BDM.

- The use of BDM methods such as traps and avicides conform to applicable rules and regulations administered by the State.

- WS personnel adhere to all label requirements for toxicants. EPA approved labels provide information on preventing exposure to people, pets, and T&E species along with environmental considerations that must be followed. WS personnel abide by these. These restrictions invariably preclude or reduce exposure to nontarget species, the public, pets, and the environment.

- The WS Decision Model (Slate et al. 1992) thought process as discussed in Section 1.6.5 which is designed to identify effective WDM and their impacts, is consistently used.

3.5.2 WS SOPs Specific to the Issues

The following is a summary of the SOPs used by WS that are specific to the issues listed in Chapter 2 of this document.

3.5.2.1 Effects on Target Bird Species Populations.

- BDM is directed toward localized populations or individual offending animals, depending on the species and magnitude of the problem, and not an attempt to eradicate any native wildlife population in a large area or region. In the case of invasive species, the goal may be to eradicate them (this is rarely feasible for established populations).

- WS Specialists use specific trap types, lures, and placements that are most conducive for capturing the target animal.

- WS BDM kill is monitored. Both "Total Harvest" and estimated population numbers of key species are used to assess cumulative effects of harvest. WS BDM is designed to maintain the level of harvest below that which would impact the viability of populations of native species (see Chapter 4) as determined by WS in consult with USFWS and CPW, as appropriate. WS provides data on total take of target animal numbers to other agencies (i.e., USFWS, CPW) as required.

- WS currently has agreements for BDM on less than 5% of the land area in Colorado. This could be increased several-fold, but target bird take would be monitored to ensure that harvest remains below a level that would impact viability of a species. However, WS will not impact bird species populations on more than 95% of the lands in Colorado.

- WS will relocate birds, as appropriate, primarily for less abundant species such as Golden Eagles and other raptors. Nonnative species will not be relocated, but can be transferred to various facilities at the direction of USFWS or CPW.

3.5.2.2 Effects on Nontarget Species Populations, Including T&E Species.

- WS personnel are highly experienced and trained to select the most appropriate BDM method(s) for taking problem birds with little impact on nontarget species.

- WS personnel work with research programs such as NWRC to continually improve and refine the selectivity of management devices, thereby reducing nontarget take.

- Nontarget animals captured in traps or with any other BDM method are released at the capture site unless it is determined by WS Specialists that the animal is not capable of self-maintenance.

- WS personnel will adhere to the following SOPs to protect listed T&E and sensitive species. Several are method specific with consideration for a wide variety of T&E species while others are specific to certain species. Included below are SOPs incorporated into WDM in general, for specific methods, and for specific species or groups of species. Additionally, WS abides by the Reasonable and Prudent Alternatives and Measures, or Terms and Conditions for incidental take statements already in place for species that have been covered in a BO and for any newly issued BO.

- When working in an area that has T&E or sensitive species or has the potential for T&E species to be exposed to BDM methods, WS personnel will know how to identify the target and T&E species (*e.g.,* Turkey Vulture vs. juvenile Bald Eagle), and apply BDM methods accordingly. However, BDM in Colorado has little potential to impact T&E species.

- Avian predators of T&E or sensitive species such as the Gunnison's Sage-Grouse and Lesser Prairie-Chicken (candidates) could be captured, moved, or euthanized to enhance recruitment of the sensitive species. These actions would be conducted where they would provide a positive benefit to sensitive species with no significant negative impacts to target or nontarget populations.

X WS personnel using 4-wheel ATVs will use roads and existing trails as possible to conduct field work.

X If WS resumes disease surveillance involving bird species such as waterfowl and shorebirds, a new consult will be conducted specifically for that program with USFWS. T&E species that could be taken in AI surveillance include piping plover, mountain plover, least tern, and Sprague's pipit. Other disease surveillance work (*e.g.*, rabies, plague, and West Nile virus) could involve other species, depending on the type and location of the action.

Method Specific Measures for T&E Species

X WS projects involving habitat management where a T&E species could be affected will be discussed with USFWS prior to implementation. If WS recommends habitat management, the cooperator will be informed that they will need to consult with USFWS and obtain the necessary permits prior to receiving assistance from WS.

X Netting placed by WS personnel will be monitored frequently for ensnared birds or other wildlife.

X WDM projects involving the use of methiocarb require a site specific consultation with USFWS.

X WS personnel will not use electrical barriers including wires for birds where T&E species are found.

X Cage traps will be placed in areas where animals will not be exposed to extreme environmental conditions and checked frequently enough to release nontarget T&E species alive when used where T&E species could potentially be.

X Mist nets will be used in areas not conducive to trapping T&E species and checked frequently enough to release entrapped nontarget species.

X Raptor and pole traps, several styles of traps modified to capture raptors uninjured and most frequently used at airports so raptors can be relocated, will be monitored frequently to ensure that nontargets can be released without injury.

X Quick-kill traps, primarily snap traps used for woodpeckers, will not be used where T&E species would be exposed. Trap placement can nullify exposure to T&E species.

X WS personnel will retrieve the carcasses of animals shot with lead bullets as possible and dispose of them according to WS Policy.

X WS personnel adhere to all label requirements for toxicants. EPA labels have a section on T&E species and environmental considerations that must be followed for use and WS personnel will abide by these. These restrictions invariably preclude exposure to T&E species.

Piping Plover, Mountain Plover, and Least Tern SOPs

X WS will avoid the use of frightening devices where one of these T&E species is seen. If piping plover, mountain plover, or least tern becomes a persistent threat at an airport, WS may request an emergency Section 10 permit from USFWS to haze the bird from the airfield.

X WS will request a separate consult if WS conducts WDM to protect these species from predators. As stated in the text, the Corps of Engineers have asked us to do this.

X These species could be accidentally caught in mist nets or noose mats used to capture shorebirds for disease monitoring. These devices are monitored closely and species taken in them are released unharmed. Where these methods are used with the potential to take T&E species, WS has consulted nationally with USFWS under Section 7 of the ESA. WS SOPs to avoid impacts include ensuring WS Specialists are trained in plover and tern species identification, not working in areas known to be inhabited by these T&E species, monitoring mist nets and traps frequently, and pulling equipment if either species is seen in the vicinity of the trapping operations.

T&E and Sensitive Plant Species SOPs

- WS personnel will not collect plants while afield.

- WS personnel will wash vehicles regularly to ensure WS does not spread invasive plant seeds.

- WS personnel that travel with horses to areas where T&E species may be present will feed them certified weed-free hay.

- WS who use ATVs and horses will follow established roads and trails. Minimal travel is expected off-trails, but WS personnel will avoid travelling the same areas repeatedly so that new trails are not created.

Candidate Conservation SOPs

- WS will avoid the use of frightening devices where Sprague's Pipits have been seen if possible, except in air operating areas where they could be struck by aircraft.

3.5.2.3 Impacts on Public Safety, Pets, and the Environment.

- A formal risk assessment (USDA 1997, Appendix P and Q) concluded that hazards to the public from BDM devices and activities are low.

- All pesticides are registered with EPA and CDA. WS employees will comply with each pesticide's directions and labeling and any additional EPA and CDA rules and regulations.

- WS Specialists that use restricted use chemicals (i.e., pesticides or drugs) are trained and certified by program personnel or other experts in the safe and effective use of these materials under EPA and CDA approved programs. WS employees who use chemicals participate in continuing education programs to keep abreast of developments and to maintain their certifications.

- WS Specialists who use firearms and pyrotechnics are trained and certified by experts in the safe and effective use of these materials. WS policy has requirements for training, safe use, storage and transportation of firearms as prescribed by the WS Firearms Safety Training Manual (WS Directive 2.615). WS Policy also has the same for pyrotechnics.

- Conspicuous, bilingual warning signs, alerting people to the presence of traps, avicides, and other BDM methods, are placed at major access points when they are set in the field.

3.5.2.4 Effects of BDM on Aesthetics

- WS take is minimal compared with overall bird species populations, and, thus, does not impact the opportunity of the public to enjoy wild bird species.

- WS could conduct BDM projects that protect T&E and sensitive species which could offer the public the potential opportunity to view these rarer species.

- WS conducts most BDM projects in areas where the public has little access, and therefore, that portion of the public that finds certain BDM methods as objectionable will not be upset by visually viewing that action.

3.5.2.5 Humaneness of Methods Used by WS

- Chemical immobilization and euthanasia procedures that do not cause pain or undue stress are used by certified WS personnel when practical and where safe.

- WS personnel attempt to kill captured target animals that are slated for lethal removal as quickly and humanely as possible. In most field situations, cervical dislocation is performed which causes rapid unconsciousness followed by cessation of heart function and respiration which is in concert with the American Veterinary Medical Association's (1987) definition of euthanasia (Beaver et al. 2001). In some situations, accepted chemical immobilization and euthanasia methods are used.

- Cage and padded-jaw leghold pole traps are set and inspected according to WS policy. Water and food are replenished as necessary in decoy traps.

- Research continues with the goal of improving the humaneness of BDM devices.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative for meeting the purpose and need of the proposed action. This chapter analyzes the environmental consequences of each alternative discussed in Chapter 3 in relation to the issues identified for detailed analysis in Chapter 2. The environmental consequences of each alternative are compared with the proposed action to determine if the real or potential impacts would be greater, lesser, or the same. Therefore, the proposed action or current program alternative serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The background and baseline information presented in the analysis of the current program alternative, therefore, may also apply to the analysis of each of the alternatives.

4.1 ISSUES ANALYZED IN DETAIL

NEPA requires federal agencies to determine whether their actions have a "*significant impact on the quality of the human environment*." The environmental consequences of the 4 alternatives are discussed below with emphasis on the issues presented in Chapter 2. The comparison of alternatives will be used to make a selection of the most appropriate alternative for WS BDM activities. The alternatives selected for detailed assessment provide the best range of alternatives that could potentially meet the purpose and the need of BDM in Colorado as identified in Chapter 1.

4.1.1 Effects of BDM on Target Bird Species Populations

To adequately determine the magnitude of impacts in relation to birds and their populations, WS data and known cumulative or "other" take (sportsmen harvest and permitted depredation take) will be analyzed. The authority for management of migratory birds is USFWS and CPW for resident bird species. CPW regulates hunting of migratory game species under the direction of USFWS and monitors migratory nongame.

An aspect, perhaps overriding, that is germane to the determination of "significance" under NEPA is the effect of a federal action on the *status quo* of the environment. States have the authority to manage populations of wildlife species in its border, but, for migratory birds and T&E bird species, USFWS also has authority. Management direction for a given species can vary among states, and state management actions are not subject to NEPA compliance. Therefore, the *status quo* for the environment with respect to state-managed wildlife species is the management direction established by the States. Federal actions that are in accordance with state management have no effect on the *status quo*. Wildlife populations are typically dynamic and can fluctuate without harvest or control by humans. Therefore, the *status quo* for wildlife populations is fluctuation, both within and among years, which complicates determining the significance of human impact on such populations.

4.1.1.1 Alternative 1 - Continue the Current Federal BDM Program. Under the Current Federal Program Alternative, WS conducts BDM on bird species in Colorado causing problems or concerns with lethal and nonlethal BDM methods. Lethal take by WS and others will be considered statewide providing a more comprehensive picture of impacts to bird populations. Analyzing impacts of migratory bird species at the Statewide and Central/Pacific Flyways area provides a more comprehensive and statistically sound look at cumulative impacts because population estimates and take is statistically more credible on a statewide or regional scale, and impacts of BDM often involve a regional population because most birds are migratory.

BDM targets specific species and cumulative effects on those species populations from BDM and other actions are analyzed to determine the relative significance of impacts. In addition, management direction from the responsible agency (USFWS and CPW) is a determining factor. From a NEPA standpoint, justification for a finding of "*no significant impact on the quality of the human environment*" with respect to WS's take of most birds in Colorado is the fact that WS's involvement has no adverse effect on the *status quo* because, if WS was not available, under USFWS or CPW authority, virtually the same birds that are killed by WS could be taken by other agency or private actions. This suggests that, if WS stopped its involvement in most bird management, there would be virtually no change in environmental effects from BDM locally or cumulatively. Additionally, landowners that are given assistance with damage problems are much more likely to have a favorable view of wildlife (International Association of Fish and Wildlife Agencies 2004, Treves and Naughton-Treves 2005).

A "viable" wildlife population can exist at many levels between one that is at carrying capacity (the maximum number of a species that a particular habitat can support) and one that is at only a fraction of carrying capacity. Because rates of increase are mostly density dependent (i.e., the population grows at a faster rate as the population is reduced in relation to carrying capacity), bird populations have the ability to recover from declines that might result from mistakes in management. History has born this out by the fact that efforts in the early half of the 20th century to eradicate some of the larger mammalian predator species (i.e., coyotes, black bears, and mountain lions) failed to do so. However, the larger predator numbers were most likely reduced substantially (Evans 1983). Density dependent rates of increase are a built-in mechanism of most wildlife populations that serve to reduce effects of population reductions whether by harvest, localized control, or non-man-induced mortality. This provides additional assurance that a viable population of a target species would be maintained in Colorado, even if a sustainable harvest rate is exceeded in the short term in areas where the objective is to maintain the population.

The methods used by WS to take target bird species under the current program are the same as those that have been used in recent years and were described in Section 3.3.1.3. The methods used in each damage situation depend on the species causing damage and other factors including location (public versus private lands), weather, and time of year as discussed in section 3.2. The methods include physical exclusion, frightening devices, shooting, cage traps, padded-jaw pole traps, and avicides. Many BDM methods, especially those that can be safely implemented, may only be recommended by WS personnel and incorporated by the resource owner.

WS uses lethal and nonlethal methods as needed for appropriate biologically sound, effective BDM. Analysis of this issue is limited primarily to those species most often killed during WS BDM; however, nonlethal BDM will be analyzed for potential impacts as well. The analysis for magnitude of impact generally follows the process described in USDA (1997, Chapt. 4). Magnitude is described in USDA (1997) as "*. . . a measure of the number of animals killed in relation to their abundance*." Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations are based on population estimates, allowable harvest levels, and actual harvest data. Qualitative determinations are based on population trends and harvest data when available. In general, WS conducts most BDM on species whose population densities are high and usually only after they have caused damage. WS conducts both lethal and nonlethal BDM for birds. Lethal and nonlethal take will be given and then a discussion will follow regarding the impacts to species.

Impacts on Bird Populations from Lethal Take in BDM

WS conducted lethal BDM to protect resources and for disease surveillance from FY06 to FY10 involving 50 bird species in Colorado (Table 7), but had the potential for taking several others (Table 8, 9, and 10). The average annual take from FY06 to FY10 for these species involved 9 with take of 100 or more, 11 with take from 10-99, and 30 with minimal take (less than 10). The species that caused damage from FY06 to FY10 are listed in Table 1 (Section 1.3.1) with general information about them given in Section 2.1.1.1 and the agency, USFWS, CPW, or WS, that has primary responsibility for responding to damage complaints involving them. A few target species taken in Colorado are introduced commensal species (feral pigeons, Eurasian Collared-Doves, and European Starlings and House Sparrows) which are not protected by any agency. Most species of blackbirds, American Crows, and Black-billed Magpies can be taken under a USFWS depredations order. The remaining species are protected by USFWS and CPW. Of the average annual take of birds from FY06 to FY10, 98.5% of the take was for 6 species: starlings (85.8%), feral pigeons (7.6%), Mourning Doves (1.9%), Red-winged Blackbirds (1.6%), Cliff Swallows (0.9%), and Horned Larks (0.7%). The remaining 44 species combined accounted for less than 1.5% of WS's lethal take. From FY95 to FY05, WS did not take any other species than those in Table 7 with the possible exception of other blackbirds where DRC-1339 was used at feedlots and "mixed blackbirds" was recorded in the MIS, as discussed below.

WS uses several BDM methods that result in the lethal take of birds. The greatest number of birds is lethally taken with chemical methods. WS used 1 chemical toxicant (DRC-1339) and a chemical immobilizing agent (A-C) on birds from FY06 to FY10. Table 6 (Section 2.1.3) gives the amount of chemical used by WS. Take with DRC-1339 needed to be estimated because only dead birds found were mostly recorded in the MIS (Appendix B), though recently a more diligent effort to estimate take was initiated. However, for the purposes of this EA, take with DRC-1339 will be estimated. Take with DRC-1339 can conservatively be estimated for each species based on daily consumption and the bait applied by WS; this is discussed thoroughly in Appendix B. When a species was specified, the chemical take was estimated for that species. Blackbird take, including starlings, is often combined as blackbird (mixed species) in the MIS. Projects involving mixed blackbirds in feedlots have been estimated to be 95% starlings and 5% other blackbirds by WS Specialists in Colorado. WS Specialists see mostly Red-winged and Brewer's Blackbirds during BDM projects at CAFOs. However, Specialists did not use the "mixed blackbird" category from FY06 to FY10 for DRC-1339 use or other lethal take. Thus, mixed blackbird take was not estimated. In other RMS States, to analyze impacts for mixed blackbird projects, species composition for blackbirds other than starlings was estimated. For projects conducted from April 1 to November 30, species composition was averaged from BBS (USGS 2012) and CBC (NAS 2011b) data for the blackbird species found in Colorado. For mixed blackbird projects from December 1 to March 31, an estimate of species composition was derived from CBC data (NAS 2011b). These percentages are used to estimate take for the different species. The estimated take is added to other take to determine impacts to the species taken in BDM in Table 7. It should be noted that the take of Rusty Blackbirds, though minimal, is likely a high estimate because they mostly forage in wet woodlands away from other blackbirds and not in feedlots and urban areas where most projects occur.

To analyze impacts, blackbird take was estimated for all WS projects in the RMS region. The take for mixed blackbird projects is estimated by the species composition found in BBS and CBC data for each of the core states in the Central and Pacific Flyway (Figure 7) where BDM is conducted by WS, including Colorado, for analysis purposes. It should be noted that DRC-1339 treated baits are often greased, primarily to target starlings which are prevalent at feedlots during winter throughout the United States and especially in states north of Colorado when insects are relatively unavailable; starlings, requiring a high protein diet, favor the greased treated baits over the other blackbirds found in feedlots, and will seek them out, whereas the other blackbirds will eat what is available searching more for grain (Twedt 1985). Thus, fewer blackbirds, but more starlings are likely taken by WS than estimated as discussed in Appendix B.

The MIS does not record wastage (chemicals disposed of by deep burial because birds did not take all of the bait or the project failed due to birds not being present; the shelf-life of DRC-1339, once a bait is mixed, is about 3 to 7 days depending on environmental factors such as heat and humidity and, thus, baits from projects not completed in this time are disposed according to the label; and, finally, precipitation and harsh weather conditions can decrease a project's effectiveness because baits lose their efficacy). Thus, bird take estimates with DRC-1339 and Avitrol from Appendix B are estimated mostly at an "ideal" level and are likely high because many factors can reduce the success of projects, especially DRC-1339.

Table 8. Birds killed by WS in BDM from FY06 to FY10. Take was estimated for species taken with DRC-1339.

Species	FY06	FY07	FY08	FY09	FY10	Ave	RMBO (2007) Landbird or NAS (2011c) Water Associated Bird Estimated Breeding Population		
							Colorado	RMS	N. Amer.
Introduced Commensal Birds									
European Starling*	7	3,045	110,331	140,871	79,251	66,093	1,700,000	11,000,00000	120,000,000
Feral (Rock) Pigeon*	8,287	7,023	5,477	3,510	5,260	5,911	500,000	2,500,000	26,000,000
House Sparrow	16	23	3	98	59	40	1,700,000	8,100,000	82,000,000
Eurasian Collared-Dove	101	0	0	19	2	24	N/A	N/A	400,000
Feral Geese	1	0	0	0	0	0.2	N/A	N/A	N/A
Native Doves and Pigeons									
Mourning Dove	134	1,051	1,666	1,655	2,984	1,498	4,500,000	20,000,000	110,000,000
Blackbirds									
Red-winged Blackbird	18	22	259	1272	4,720	1,256	3,500,000	16,000,000	190,000,000
Common Grackle	0	0	0	42	12	11	3,000,000	4,400,000	97,000,000
Brewer's Blackbird	0	0	0	1	0	0.2	1,300,000	7,700,000	35,000,000
Nighthawks, Swifts, and Swallows									
Cliff Swallow	0	199	597	617	2,203	723	2,600,000	18,000,000	80,000,000
Barn Swallow	0	0	0	0	2	0.4	960,000	4,700,000	51,000,000
Grassland Passerines									
Horned Lark	33	35	729	811	1,225	559	9,200,000	37,000,000	99,000,000
Western Meadowlark	7	82	213	420	622	269	2,400,000	11,000,000	30,000,000
Western Kingbird	11	33	135	175	308	132	1,500,000	5,400,000	18,000,000
Lark Bunting	0	0	0	99	357	94	5,100,000	17,000,000	27,000,000
Waterfowl									
Canada Goose	13	17	124	203	357	139	18,000	na	5,300,000
Mallard	12	14	41	141	119	65	na	na	23,000,000
Snow Goose	0	34	0	0	0	7	nb	nb	3,900,000
American Coot	1	0	0	0	8	2	na	na	60,000,000
Lesser Scaup	0	0	1	5	0	1	na	na	4,400,000
Blue-winged Teal	0	0	0	3	2	1	na	na	74,000,000
Redhead Duck	0	0	0	2	0	0.4	na	na	1,200,00
Green-winged Teal	0	0	0	0	1	0.2	na	na	30,000,000
Corvids									
Common Raven*	61	122	36	104	65	78	24,000	310,000	4,000,000
American Crow	2	1	0	24	21	10	120,000	630,000	31,000,000
Black-billed Magpie	1	0	3	11	11	5	230,000	900,000	400,000
Raptors									
Red-tailed Hawk	4	3	73	85	145	61	39,000	360,000	2,000,000
Swainson's Hawk	2	0	16	25	39	16	48,000	180,000	460,000
Ferruginous Hawk	0	0	10	12	47	14	2,600	14,000	20,000
Northern Harrier	1	1	13	9	35	12	9,900	120,000	400,000
Turkey Vulture	2	1	9	11	16	8	7,000	150,000	1,300,000
Great Horned Owl	0	2	7	8	13	6	70,000	350,000	2,000,000
Rough-legged Hawk	0	0	2	4	23	6	nb	nb	300,000
American Kestrel	1	0	4	6	6	3	130,000	1,100,000	4,300,000
Peregrine Falcon	0	0	1	0	0	0.2	30	1,500	300,000
Prairie Falcon	0	0	0	0	1	0.2	2,000	16,000	30,000
Barn Owl	0	0	1	2	4	1	10,000	61,000	300,000
Shorebirds									
Killdeer	1[D]	0	11	7	12	6	na	na	1,400,000
Long-billed Dowitcher[D]	3	4	0	0	0	1	nb	nb	900,000
Baird's Sandpiper[D]	7	0	0	0	0	1	nb	nb	600,000
Greater Yellowlegs[D]	2	0	0	0	0	0.4	nb	na	200,000
Least Sandpiper[D]	1	0	0	0	0	0.2	nb	nb	1,200,000
Semipalmated Sandpiper[D]	1	0	0	0	0	0.2	nb	nb	7,000,000
Wading Birds									
Great Blue Heron	6	1	8	23	8	9	32,000na	67,000na	120,000
Gulls/Terns									
California Gull	0	0	0	15	5	4	na	na	414,000
Ring-billed Gull	0	0	0	3	8	2	na	na	1,700,000
Franklin's Gull	0	0	0	4	0	1	nb	na	32,000
Frugivorous Birds									
House Finch	0	0	0	0	10	2	180,000	3,400,000	16,000,000
Water Birds									
Double-crested Cormorant	2	0	0	0	1	0.6	na	na	1,600,000
American White Pelican	0	0	0	0	1	0.2	na	na	180,000

*****Take was estimated for DRC-1339 and Avitrol use – see Appendix B. **nb**=non-breeder **na**=not available **N/A**=not applicable
[D] – Disease monitoring only – no damage per se ^Population Estimate from BBS data without detectability parameters
[1]Population estimate from Donaldson et al. 2000 **[2]**Range 320,000-990,000 breeders **[3]**Range 47,000-52,000 breeders
[4]Estimate for Colorado Only **[5]**USFWS 2011e **[6]**Waterbird Conservation 2011b

Table 9. USFWS permitted take not including WS take in Colorado and the RMS region from Calendar Years 2006 to 2010.

Species	**2006**		**2007**		**2008**		**2009**		**2010**		**Ave**	
Area	**CO**	**RMS**	**CO**	**RMS**	**CO**	**RMS**	**CO**	**RMS**	**CO**	**RMS**	**CO**	**RMS**
Mourning Dove	-	2,787	1,051	3,342	258	1,113	15	16	3,044	3,074	874	2,066
Red-winged Blackbird	-	-	-	-	7	7	36	36	-	-	9	9
Common Grackle	-	-	36	36	-	-	-	-	1	1	7	7
Cliff Swallow	-	-	22	112	24	24	201	201	2,176	2,199	485	507
Barn Swallow	-	-	-	-	-	-	-	5	2	5	0.4	2
Bank Swallow	-	-	-	-	-	-	3	3	-	-	0.6	0.6
Horned Lark	-	138	218	269	100	107	931	1,082	2,341	2,389	718	797
Western Kingbird	-	-	97	97	23	28	410	415	323	337	171	175
Lark Bunting	-	-	-	-	-	-	-	-	357	357	71	71
Western Meadowlark	-	-	5	5	3	4	11	18	-	-	4	5
Say's Phoebe	-	-	-	-	4	4	-	-	-	-	0.8	0.8
Brewer's Sparrow	-	-	-	-	66	66	-	-	-	-	13	13
American Tree Sparrow	-	-	-	-	-	-	7	7	-	-	1	1
Canada Goose	2	103	199	597	20	31	28	316	514	678	153	345
Duck spp.	-	-	-	-	-	-	-	6	-	-	0	1
Mallard	-	133	20	211	53	166	1,642	1,681	131	269	369	492
Gadwall	-	-	-	-	-	-	-	13	-	10	0	5
Northern Pintail	-	-	-	-	-	4	-	1	-	-	0	1
Cinnamon Teal	-	-	-	-	-	-	-	12	-	8	0	4
Blue-Winged Teal	-	-	-	-	-	-	47	47	2	2	10	10
Green-winged Teal	-	-	-	-	-	4	-	29	1	1	0.2	7
Northern Shoveler	-	1	-	-	-	-	-	-	-	-	0	0.2
Lesser Scaup	-	-	-	-	3	3	132	132	-	-	27	27
Bufflehead	-	-	-	-	-	-	-	27	-	48	0	15
Ring-necked Duck	-	13	-	-	-	-	-	-	-	-	0	3
Common Goldeneye	-	-	-	-	-	-	-	31	-	47	0	16
Common Merganser	-	3	-	-	-	-	-	532	-	24	0	112
Red-Breasted Merganser	-	-	-	-	3	3	-	-	-	-	0.6	0.6
American Coot	-	157	-	4	5	15	18	25	22	209	9	82
Common Raven	209	909	192	1,005	4	249	66	169	285	1,909	151	848
Black-billed Magpie	-	-	-	-	257	690	4	37	1	14	52	148
American Crow	-	4	-	-	6	15	5	5	0	2	2	5
Turkey Vulture	-	43	-	52	30	97	178	216	16	91	45	100
Osprey	-	-	-	2	-	-	-	-	-	-	0	0.4
Northern Harrier	-	-	4	4	2	2	9	17	38	41	11	13
Red-tailed Hawk	-	18	33	44	2	11	105	195	174	188	63	91
Rough-Legged Hawk	-	-	-	-	4	4	12	12	27	27	9	9
Swainson’s Hawk	-	-	-	18	8	8	11	17	41	52	12	19
Ferruginous Hawk	-	-	-	-	-	-	4	5	51	59	11	13
Prairie Falcon	-	-	-	-	-	-	-	-	1	1	0.2	0.2
American Kestrel	-	10	-	-	25	25	25	30	13	18	13	17
Great Horned Owl	-	5	2	8	-	66	-	-	16	20	4	20
Barn Owl	-	-	-	-	3	3	224	224	-	-	45	45
Barred Owl	-	-	-	-	-	-	-	-	10	10	2	2
Killdeer	-	20	-	29	8	8	99	99	12	13	24	34
Great Blue Heron	4	76	7	83	6	236	8	273	20	83	9	150
Great Egret	-	5	-	4	-	-	-	-	-	-	0	2
Snowy Egret	-	-	-	-	-	-	-	-	-	4	0	0.8
Black-crowned Night-Heron	-	19	-	6	-	1	-	9	-	24	0	12
White-faced Ibis	-	-	-	-	-	-	-	2	-	8	0	2
Gull spp.	-	81	-	27	-	8	-	12	-	90	0	44
Ring-billed Gull	-	75	-	256	39	164	25	98	24	91	28	137
California Gull	17	594	20	1,745	20	351	617	788	56	490	146	794
Franklin’s Gull	-	8	-	11	-	224	35	69	-	56	7	74
Herring Gull	-	-	-	-	-	1		5	-	14	0	4
Caspian Tern	-	-	-	-	-	-		-	-	3	0	0.6
Forster’s Tern	-	-	-	-	-	-		50	-	1	0	10
American Robin	-	-	-	-	1	2	2	4	25	26	6	6
House Finch	-	-	-	-	-	1	9	9	10	10	4	4
Double-crested Cormorant	99	99	88	88	-	1	25	26	73	80	57	59
American White Pelican	23	25	95	175	2	5	34	43	25	77	36	65
Belted Kingfisher	-	26	-	2	-	-	-	-	-	-	0	6
Northern Flicker	8	23	3	25	3	208	1	15	50	67	13	68
Downy Woodpecker	-	-	1	1	-	-	-	-	2	2	0.6	0.6
Hairy Woodpecker	-	-	-	-	-	-	-	-	1	1	0.2	0.2
White-breasted Nuthatch	-	-	-	-	-	-	-	-	7	7	1	1
Lazuli Bunting	-	-	-	-	-	-	3	3	-	-	0.6	0.6

In addition to WS 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 feral pigeon, starling, and

House Sparrow and those under a USFWS Depredation Order such as blackbirds, magpies, and crows can be taken without a permit. Thus, take for these species can only be estimated. However, most other migratory birds require a USFWS permit with reporting requirements and resident birds require a CPW permit. USFWS (Region 6: Denver, CO, Region 2: Albuquerque, NM, and Region 1: Portland, OR 2011, *unpubl. data*) provided permitted take for Calendar Years 2006 to 2010 for the RMS area. Permits were issued for few species and take during this time involved 48 species in Colorado and 68 in the RMS area (Table 8).

Whenever applicable, WS uses the birds killed for BDM for research or disease surveillance purposes, thus, making use of the killed birds to further our knowledge of wildlife and wildlife diseases. WS obtains samples from birds targeted in BDM, from trap and release, and collecting programs, and from hunter harvested birds at check stations.

Impacts on Bird Populations from Nonlethal Methods in BDM

WS hazed 73 species (the MIS code mixed blackbirds was used which could have included a couple more species) and captured and released or relocated 25 species with nonlethal methods that had the potential to cause or were causing damage, or were involved in disease monitoring from FY06 to FY10. WS could potentially conduct nonlethal BDM for many more species (Appendix C: Tables C1 and C3). Operationally, WS conducts most all hazing activities for airports where birds are an aviation strike hazard, but also for crop protection. The bird species that caused damage in Colorado are listed in Section 1.2 with general information about them and the agency, USFWS, CPW, or WS, that has the primary responsibility to assist with damage complaints from these species.

WS averaged hazing about 384,000 birds annually from FY06 to FY10 (Table 9); it should be noted that many birds that are hazed are hazed several times before they are successfully moved and are reported every time they are hazed (*e.g.,* WS hazed 1.2 million Red-winged Blackbirds in FY09 from about 1,500 acres of sunflowers over a 3 week period, but the breeding population in all of Colorado is only about twice that at 2.9 million, though the project occurred during the height of migration). Additional hazing efforts were concentrated on reducing property damage and human health concerns for roosting starlings and blackbirds. The primary target species hazed by WS annually in Colorado have been Red-winged Blackbirds (67.6%), Canada Geese (19.6%), Mourning Doves (4.0%), Cliff Swallows (1.4%), Horned Larks (1.2%), mixed blackbirds (1.1%), Starlings (0.9%), and feral pigeons (0.9%) similar to the species taken lethally. Thus, 6 species accounted for 97% of all hazing activities with the remaining 67 species accounting for 3%. Hazing birds by WS 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 2004, 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.

WS also captures and relocates birds and frees nontarget species (Table 10). Capture with relocation is done with a nationwide banding permit for airports. Species that would most likely be involved in relocation would be several raptors such as Red-tailed Hawks, Ferruginous Hawks, Swainson’s Hawks, Rough-legged Hawks, Northern Harriers, Prairie Falcons, American Kestrels, Barn Owls, Short-eared Owls, Burrowing Owls, and Great Horned Owls, other less numerous species, and species at the request of CPW and USFWS.

Table 10. Birds hazed (scared with frightening devices or other nonlethal method) from damage situations from FY06 to FY10 by WS.

Species	FY06	FY07	FY08	FY09	FY10	Ave
Introduced Commensal Birds						
European Starling	0	6	1,317	8,627	6,619	3,314
Feral (Rock) Pigeon	45	0	3,507	8,400	5,767	3,544
House Sparrow	102	0	105	135	410	150
Native Doves and Pigeons						
Mourning Dove	160	3,246	11,714	33,051	28,751	15,384
Blackbirds						
Red-winged Blackbird	14	48	732	1,251,860	45,404	259,612
Brewer’s Blackbird	50	0	0	0	0	10
Common Grackle	0	0	70	190	43	61
Mixed Blackbird Species	0	25	20,415	1,000	0	4,288
Nighthawks, Swifts, and Swallows						
Common Nighthawks	0	0	3	0	0	1
Cliff Swallow	0	350	2,145	8,775	14,666	5,187
Barn Swallow	0	0	0	0	330	66
Grassland Passerines						
Horned Lark	150	164	1,337	5,725	16,313	4,738
Western Meadowlark	0	210	1,024	2,956	6,840	2,206
Western Kingbird	0	84	461	1,762	3,655	1,192
Lark Bunting	0	330	0	2,927	12,189	3,089
Waterfowl						
Greater White-fronted Goose	0	0	2	0	0	0.4
Canada Goose	2,326	7,224	39,747	52,861	273,306	75,093
Wood Duck	0	0	0	2	0	0.4
Gadwall	0	0	7	6	4	3
American Wigeon	0	0	12	0	11	5
Mallard	498	233	301	561	1,392	597
Blue-winged Teal	0	5	2	76	26	22
Cinnamon Teal	0	0	2	8	4	3
Northern Shoveler	0	0	2	28	121	30
Northern Pintail	0	0	0	4	90	19
Green-winged Teal	2	0	4	23	222	50
Canvasback Duck	0	0	0	3	2	1
Redhead Duck	0	0	74	2	2	16
Ringed-necked Duck	0	0	10	13	109	26
Lesser Scaup	10	0	92	10	7	24
Bufflehead	0	1	0	0	47	10
Common Goldeneye	10	0	0	0	20	6
Hooded Merganser	0	0	0	3	0	1
Common Merganser	15	0	0	0	2	3
Ruddy Duck	0	0	2	10	30	8
American Coot	7	0	55	22	181	53
Sandhill Crane	100	0	50	255	2,630	607
Corvids						
Common Raven	0	2	35	22	18	15
American Crow	0	0	9	13	5	5
Black-billed Magpie	0	0	5	7	196	42
Raptors						
Turkey Vulture	0	15	53	94	58	44
Osprey	1	0	0	0	0	0.2
Bald Eagle	0	0	6	45	310	72
Northern Harrier	10	1	292	771	3,151	845
Sharp-shinned Hawk	0	2	0	0	0	0.4
Cooper's Hawk	0	0	0	3	1	1
Northern Goshawk	0	0	1	0	0	0.2
Red-tailed Hawk	16	67	693	2,122	5,472	1,674
Swainson’s Hawk	3	25	86	467	2,051	526
Ferruginous Hawk	0	0	50	299	1,455	361
Rough-legged Hawk	13	14	6	78	588	140
Golden Eagle	1	1	4	16	139	32
American Kestrel	0	24	68	108	172	74
Peregrine Falcon	0	0	0	0	2	0.4
Prairie Falcon	0	1	0	8	17	5
Barn Owl	0	0	1	8	19	6
Great Horned Owl	0	0	5	30	38	15
Short-eared Owl	0	0	0	0	43	9
Loggerhead Shrike	0	0	0	16	0	3
Shorebirds						
Killdeer	0	0	172	147	460	156

American Avocet	0	0	0	34	0	7
Upland Sandpiper	1	0	0	0	0	0.2
Long-billed Curlew	0	0	0	15	0	3
Wading Birds						
Great Blue Heron	11	1	22	44	24	20
White-faced Ibis	98	0	0	3	2	21
Gulls/Terns						
California Gull	0	28	0	94	158	56
Herring Gull	0	0	0	2	0	0.4
Ring-billed Gull	0	0	50	591	61	140
Franklin’s Gull	3	0	0	21	0	5
Black Tern	0	0	0	5	0	1
Frugivorous Birds						
American Robin	0	0	72	31	248	70
Water Birds						
American White Pelican	41	0	29	10	54	27
Double-crested Cormorant	3	4	0	20	67	19
Western Grebes	0	0	0	0	1	0.2
Gallinaceous Birds						
Scaled Quail	0	0	102	0	60	32

Table 11. Birds trapped, sampled for disease, and freed or trapped and relocated away from damage situations in operations conducted by Colorado WS from FY06 to FY10. In addition, nontargets taken in BDM are included that were freed on-site.

Species	FY06	FY07	FY08	FY09	FY10	Ave
Introduced Commensal Birds						
House Sparrow*	392	283	123	0	0	160
Eurasian Collared-Dove	0	0	0	0	9	2
Native Doves and Pigeons						
Mourning Dove**	0	16	0	0	0	3
Blackbirds						
Brown-headed Cowbird	1	0	0	0	0	0.2
Waterfowl						
Mallard	0	0	13	0	0	3
Raptors						
Red-tailed Hawk	0	0	0	23	44	13
Swainson’s Hawk	0	0	0	6	28	7
Ferruginous Hawk	0	0	0	4	2	1
Rough-legged Hawk	0	0	0	0	2	0.4
American Kestrel	0	0	0	6	1	1
Prairie Falcon	0	0	0	0	1	0.2
Shorebirds						
Killdeer*	30	0	0	0	0	6
Black-Necked Stilt*	2	0	0	0	0	0.4
American Avocet*	2	0	0	0	0	0.4
Semipalmated Plover*	3	0	0	0	0	0.6
Greater Yellowlegs*	2	0	0	0	0	0.4
Lesser Yellowlegs*	11	2	0	0	0	3
Baird’s Sandpiper*	42	0	0	0	0	8
Least Sandpiper*	87	2	0	0	0	18
Semipalmated Sandpiper*	19	0	0	0	0	4
Western Sandpiper*	1	0	0	0	0	0
Pectoral Sandpiper*	7	1	0	0	0	2
Spotted Sandpiper*	22	0	0	0	0	4
Solitary Sandpiper*	1	0	0	0	0	0.2
Red-Necked Phalaropes*	5	0	0	0	0	1
Wilson's Phalarope*	3	0	0	0	0	1
Gulls/Terns						
Franklin’s Gull***	1	0	0	0	1	0.4
Other Birds						
Scaled Quail**	0	90	0	0	0	18

***** Disease Monitoring Only - freed after sampling ****** Nontargets freed ******* Nontargets freed, but samples taken for disease monitoring

WS conducted disease surveillance from FY06 through FY10. The primary focus of the disease surveillance work was to monitor for the presence of HP H5N1 AI, Toxoplasmosis (*Toxoplasma gondii)*, West Nile virus, Exotic Newcastle disease, and avian cholera. From FY06 to FY10, WS collected an annual average of 682 samples from 547 birds of 25 different species including samples originating from WS BDM take and hunter harvest. Additionally, an average of 467 tests was run on 427 fecal samples collected where birds had been roosting or feeding. The samples collected from birds varied, but included oral and cloacal swabs, blood, tissue, and fecal dropping (these last were recorded as non-wildlife in the MIS, but most were from species watched so the species was known). Most samples were taken from capture/release projects, hunter harvested waterfowl at check stations, and birds taken during BDM projects by WS. WS collected bird samples from a few birds taken lethally for specifically targeted species. However, many samples were collected from birds captured and released with rocket/cannon nets, mist nets, and cage traps, or from birds observed to collect fecal droppings. Birds captured with mist nets were released following sampling. Birds captured with nets or traps, sampled, and released are given in Table 10. WS does not anticipate lethal take to be high for disease monitoring. WS also occasionally captures wild birds to assist another agency in their own efforts. In these cases, the ultimate disposition of the captured birds may be release or euthanasia. However, WS' involvement in the capture of these birds does not change the *status quo* for these target species, because the other agency would have captured the birds without WS' involvement. WS' involvement in these cases serves only to (1) conserve agency resources (such as manpower) and (2) decrease the likelihood and extent of nontarget effects, due to our expertise with bird identification and capture methods.

WS concludes that the nonlethal BDM activities have been beneficial in reducing damage or monitoring for disease and have not created environmental concerns. However, nonlethal efforts have minimal potential to result in the take of a target bird if during the capture process, the bird dies from being caught or handling.

Impacts of Lethal and Nonlethal BDM on Bird Species in Colorado

As noted, WS conducted both lethal and nonlethal take of birds (Tables 9 and 11). For the analyses in this EA, bird populations were estimated population estimates for either Colorado or the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007) as given in Table 4 and Appendix A: Tables A1-A14. Table 9 gives WS take and other permitted depredation take was given in Table 10. Sportsman harvest was provided by estimates from USFWS (2008, 2010, 2011c) for game species. If permitted take was unnecessary or sportsman harvest was not tracked for a given species, take was estimated to determine cumulative impacts for the following analyses.

<u>Introduced/Invasive Commensal Birds</u>

Colorado hosts several species of introduced birds and most are considered invasive species. The goal of BDM for these species may be eradication from the "wild," but this would be difficult for the overabundant species such as starlings and Rock Pigeons. WS took 4 invasive species from FY06 to FY10 (Table 11) with the take of Eurasian Collared-Doves expected to increase as their population expands and they are rapidly becoming a problem at airports and CAFOs. Most damage problems from these species are associated with protecting agriculture and human health and safety. The take of these species by WS is considered to be of no significant impact on the human environment since they are not native components of ecosystems in Colorado. Most of these species are unprotected by federal and state laws, except for domestic strays which are protected by local laws.

European Starlings. The nationwide European Starling population was estimated at 140 million (Johnson and Glahn 1994). Feare (1984) estimated the starling population in North America at 200 million. Recent data from RMBO (2007) estimated the population to be about 120 million breeding starlings in North America, north of Mexico. BBS data have shown a nonsignificant (P=0.98) flat population trend of 0.0%/year from 1966 to 2007 in Colorado (Sauer et al. 2008), but a significant (P<0.01) decreasing trend of -0.9%/year from 1966 to 2007 survey-wide. BBS data from 2006 to 2010 (USGS 2012) indicate a population of about 1.6 million in Colorado (Appendix A, Table A14).

With a population of 1.6 million breeding starlings, the population would increase following the nesting season. Not all starlings may breed their first year, but it was estimated that at least 66% of females did. In many populations of starlings, the males outnumber the females 2:1. Starlings lay an average of 4-6 eggs with the average being 4.28 in the Midwest and have two clutches each year below 48° latitude (Cabe 1993). Fledgling success was found to average 76.1% in New York (higher in Ontario) for both clutches with the first being about 10% more successful (Cabe 1993). Using these parameters, a breeding population of 1.6 million in Colorado would have about 370,000 breeding females that fledge 2.4 million starlings, raising the post-fledgling population to about 4.0 million starlings in Colorado. Additionally, during winter months, when the majority of BDM projects are conducted, an influx of starlings is seen in Colorado with birds migrating into the State from northern areas. Some starlings may leave the state, but it is likely that Colorado actually has two or three times as many starlings coming into the state during winter from migration. However, not considering the migrant population, WS and others would have to take close to 2 million starlings annually to begin to have an effect on the population, the borderline between moderate and high magnitude of take. WS and other agencies have no idea how many starlings are taken by private efforts to reduce damage by starlings because they are unprotected and private individuals and others can take them without a permit. Thus, resource owners suffering damage can take starlings with available BDM methods. We believe that other individuals or agencies might possibly take up to 100,000 starlings in control projects in Colorado, primarily with shooting and possibly Avitrol and Starlicide Complete, commercially available products for certified pesticide applicators. With this information, Table 21 provides a cumulative impact analysis of WS and other starling take in Colorado from FY06 to FY10. FY09 had the highest estimated take at 6% of the post-breeding population, or 10% of the annual mortality. This would not be enough to cause the population to decline and would be a low magnitude of take. Barring emigration into the state, take would have to increase over 10 times the current rate before the population would likely begin to decline which may be the goal to reduce starling damage over the long term in Colorado. Thus, WS currently has a minimal impact on the starling population.

Table 12. Cumulative impact analysis for European Starlings killed in Colorado by WS and private individuals and entities (estimated) from FY06 to FY10.

EUROPEAN STARLING IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated Colorado Breeding Population	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000
Females to Males	50:100	50:100	50:100	50:100	50:100	50:100
% Breeding Females in Population	23%	23%	23%	23%	23%	23%
Estimated Number Breeding Females	370,000	370,000	370,000	370,000	370,000	370,000
Ave. Clutch	4.3	4.3	4.3	4.3	4.3	4.3
Ave. Nests	2	2	2	2	2	2
% Fledge	76%	76%	76%	76%	76%	76%
Young Produced/ Stable Pop. Ann. Mort.	2,400,000	2,400,000	2,400,000	2,400,000	2,400,000	2,400,000
Total Colorado Population	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
WS Take	7	3,045	110,331	140,871	79,251	66,701
WS Take % of Ann. Mort.	0.0%	0.1%	4.6%	5.9%	3.3%	2.8%
Private Take in Colorado	100,000	100,000	100,000	100,000	100,000	100,000
Total Take	100,007	103,045	210,331	240,871	179,251	166,701
% Colorado Post-breeding Pop.	3%	3%	5%	6%	4%	4%
% of Colorado Ann. Mortality	4%	4%	9%	10%	7%	7%

In addition to the above analysis, it must be reiterated that starlings are not indigenous to North America and are not protected by federal or state law. Therefore, the take of starlings by the WS program is considered to be of no significant impact on the human environment since starlings are not an indigenous component of ecosystems in Colorado. In fact, the removal of starlings could be beneficial for many native species such as the Eastern Bluebird that declined significantly earlier this century with the spread of European Starlings across the United States as discussed in Section 1.3.7.

Feral Pigeon. The feral domestic pigeon, also known as the Rock Pigeon, is an introduced (nonnative) species in North America not protected by federal or state law. BBS data indicate that they have experienced a nonsignificant (P =0.32) decreasing trend in Colorado from 1966 to 2007 at -1.6%/year (Sauer et al. 2008). Survey-wide the decrease in their population has been significant (P <0.01) from 1980 to 2007 at -1.1%/year (Sauer et al. 2008). The breeding feral pigeon population in Colorado could be estimated from BBS data (Sauer et al. 2008) using corrective parameters (Rich et al. 2004, RMBO 2007) at 320,000 (Table 4). As with starlings, most BBS routes are conducted in rural areas, and, thus, BBS data most likely represent rural numbers of feral pigeons. Larger urban areas have significant numbers of feral pigeons that would not be counted. Even so, an impact analysis can be conducted with the above information, but is likely to be conservative.

Most pigeons breed their first year where habitat is available. For the purposes of impacts, it is assumed that 75% of females breed in a given year and that the sex ratio is 1:1 males to females. Pigeons usually lay 2 eggs per nest, and average 6.5 clutches per year. Fledgling success was found to average 43% (Johnston 1992). Using these parameters, a breeding population of 320,000 in Colorado would have about 120,000 breeding females that fledge 670,000 pigeons annually, raising the post-fledgling population to about 990,000 feral pigeons in Colorado. WS's impact to feral pigeons can then be calculated annually averaging less than 1% from FY06 to FY10 of the annual mortality with the highest impact in FY06 at 1.2%. WS cannot determine the number of feral pigeons cumulatively taken because no data is available. However, WS can make a conservative estimate (estimating a higher number taken than believed to be taken). Of the commensal species, the pigeon is probably taken more than any other species because many pest control operators are available to handle requests for feral pigeon control, people hunt them, and private individuals may take them. It is assumed for the purposes of this analysis that local pest control operators, private individuals, and hunters take about 50,000 pigeons annually. WS takes minimal numbers of pigeons averaging about 5,900 annually from FY06 to FY10. With this information, Table 10 provides a cumulative impact analysis of WS and other feral pigeon take. The average cumulative impact from FY06 to FY10 was 6% of the post-breeding population or 8% of the estimated annual mortality. This would be a low magnitude of impact on the population. As an invasive species that causes significant damage statewide, the goal of BDM may be to eliminate populations around the state. At the current level of take, the Colorado pigeon population is not likely to see any reduction, except potentially locally. WS would have to increase its take almost a hundred-fold to begin to impact the population.

Table 13. Cumulative impact analysis for Rock Pigeon killed in Colorado by WS and private individuals and entities (estimated) from FY06 to FY10.

ROCK PIGEON IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated Colorado Breeding Population	320,000	320,000	320,000	320,000	320,000	320,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Breeding Females	120,000	120,000	120,000	120,000	120,000	120,000
Ave. Clutch	2	2	2	2	2	2
Ave. Nests	6.5	6.5	6.5	6.5	6.5	6.5
% Fledge	43%	43%	43%	43%	43%	43%
Young Fledged/ Stable Pop. Ann. Mort.	670,000	670,000	670,000	670,000	670,000	670,000
Total Colorado Population	990,000	990,000	990,000	990,000	990,000	990,000
WS Take	8,287	7,023	5,477	3,510	5,260	5,911
WS Take % of Colorado Ann. Mort.	1.2%	1.0%	0.8%	0.5%	0.8%	0.9%
Private Take in Colorado Region	50,000	50,000	50,000	50,000	50,000	50,000
Total Take	58,287	57,023	55,477	53,510	55,260	55,911
% Colorado Post-breeding Pop.	6%	6%	6%	5%	6%	6%
% of Colorado Ann. Mortality	9%	9%	8%	8%	8%	8%

For the most part, any BDM involving lethal control actions by WS for this species would be restricted to isolated individual sites or communities. In those cases where feral pigeons are causing damage or are a nuisance, complete removal of the local population could be achieved. This would be considered a beneficial impact on the human environment because the affected property owner or administrator would request the action to stop or reduce damage at their site. Regional population impacts would be minor and most likely unnoticeable. Even if significant regional or nationwide reductions could be achieved, this would not be considered an adverse impact on the human environment because the species is not part of native ecosystems. However, some individuals who experience aesthetic enjoyment from watching or feeding pigeons may consider a widespread reduction in the population as a negative impact. Thus far, though, impacts from FY06 to FY10 were minimal from WS BDM and cumulative impacts would have amounted to, at most, 8% of their annual mortality.

House Sparrow. House Sparrows prefer human-altered habitats and are abundant on farms and in cities and suburbs. House Sparrows initially were a desired species, but before long became a pest species (Lowther and Cink 2006). Any reduction in their population, especially in areas where they are causing damage, would likely be considered beneficial on the human environment. BBS data indicate that the species has seen an insignificant (P=0.07) decrease in Colorado from 1966 to 2007 at -3.3%/year, but a significant (P<0.01) decrease of -2.5%/year survey-wide data (Sauer et al. 2008). The decrease in the House Sparrow population is likely due to a number of factors that have reduced their feed supply – reduced seeds form the replacement of horses with internal combustion engines (House Sparrows pick seeds from horse manure), reduced insects in urban areas and on farms from the use of insecticides, reduced grain from spillage from more efficient harvesters, and reduced weed seeds from weed control (Lowther and Cink 2006). The breeding population in Colorado is abundant and was estimated using 2006-2010 BBS raw data (USGS 2012) using corrective parameters from Rich et al. (2004) at 1.3 million. RMBO (2007) estimated their population at 1.7 million in Colorado, reflecting the negative trend.

Most House Sparrows breed their first year with available habitat. For the purposes of impacts, it is assumed that 75% of females breed in a given year and that the sex ratio is 1:1 males to females. House Sparrows lay an average of 5.1 eggs per nest and average 1.6 clutches per year, with fledgling success averaging 40% (Lowther and Cink 2006). Using these parameters, the breeding population of 1.3 million in Colorado would have about 1.6 million fledglings, raising the post-fledgling population to about 3 million in Colorado. Thus, a stable House Sparrow population more than doubles following the nesting season, but is reduced back to this number by the next nesting season and the annual mortality rate would equal 1.6 million.

Table 14. Cumulative impact analysis for House Sparrow killed in Colorado by WS and private individuals and entities (estimated) from FY06 to FY10.

HOUSE SPARROW IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated Colorado Breeding Population	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000	1,300,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Breeding Females	490,000	490,000	490,000	490,000	490,000	490,000
Ave. Clutch	5.1	5.1	5.1	5.1	5.1	5.1
Ave. Nests	1.6	1.6	1.6	1.6	1.6	1.6
% Fledge	40%	40%	40%	40%	40%	40%
Young Fledged/ Stable Pop. Ann. Mort.	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000	1,600,000
Total Colorado Population	2,900,000	2,900,000	2,900,000	2,900,000	2,900,000	2,900,000
WS Take	16	23	3	98	59	40
WS Take % of Colorado Ann. Mort.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Private Take in Colorado Region	10,000	10,000	10,000	10,000	10,000	10,000
Total Take	10,016	10,023	10,003	10,098	10,059	10,040
% Colorado Post-breeding Pop.	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
% of Colorado Ann. Mortality	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%

WS conducts minimal BDM for House Sparrows in Colorado, averaging 40 taken from FY06 to FY10. Because House Sparrows are not afforded protection by federal or state laws, depredation permits are not required for private individuals to take them. It is expected that the public conducts some control for House Sparrows, but much less than starlings and pigeons. House Sparrow control is probably conducted at a few CAFOs such as dairies and possibly for some urban damage situations by private pest control operators. These individuals and entities may conservatively take up to 10,000 House Sparrows annually, mostly with Avitrol and traps. A cumulative impact analysis, combining all WS take, would show that this would possibly take 1% of the expected annual mortality. Thus, this would be a minor impact on the population and not enough to cause the population to decline. In fact, take would have to be in the hundreds of thousands in Colorado before an impact would likely start to occur. However, an impact to this species may be desired in some areas because the House Sparrow is an invasive species and not a native component of the ecosystem. But as can be seen, WS take would have to increase almost a hundred –fold before and impact would occur. WS, though, has had only a minimal, low magnitude impact on this species.

Eurasian Collared-Doves. The Eurasian Collared-Dove, a recent invasive species, is becoming abundant in Colorado and WS has already been requested to conduct BDM for them in many states. Doves are smaller than pigeons, but they possess many of the same physical characteristics. They are fast-flying grayish-brown birds with a whitish tail band. Eurasian Collared-Doves were introduced to the Bahamas in the 1970s and, following self-introduction into Florida, their population rapidly expanded throughout the Southeast and further. BBS observers first recorded these doves in Colorado in 2003 and have documented increased numbers since. The population increased from 0.03 birds/route in 2003 to 1.74 birds/route in 2010. In that short time, using detectability parameters established by Rich et al. (2004), the estimated population in Colorado has increased to 120,000 for Colorado for the 5 year average from 2006 to 2010. The Eurasian Collared-Doves have become frequent problems in urban areas where they nest, at airports where they are an aircraft hazard, and at CAFOs where they feed on and contaminate livestock feed. WS expects that this damage will continue to increase as their population expands. Like starlings, feral pigeons, and House Sparrows, Eurasian Collared-Doves are considered by many wildlife biologists, ornithologists, and naturalists to be invasive species and an undesirable component of North American native ecosystems because they could potentially have negative impacts on resources and compete with native bird species. Thus, any reduction in their population would likely be considered beneficial on the human environment. Even so, WS has had minimal impact on the doves considering WS took <0.1% of their estimated breeding population from FY06 to FY10.

Eurasian Collared-Doves are not protected by USFWS. WS took an annual average of 24 from FY06 to FY10 with a high of 101 in FY06 or less than 0.1% of their estimated population. In FY06, collared-doves were taken at one site where they were causing damage to gardens and buildings. Collared-dove mortality from WS BDM activities in FY09 and FY10 took place at airports and CAFOs. It is unknown how many collared-doves were harvested by sport hunters during prior hunting seasons, but it was not a significant amount since the population has continued to increase. The sport hunting season is very liberal with no bag limit because the collared-doves are invasive. WS could take hundreds of these doves, but this take would have a very minor impact on their population. It is anticipated that the population and their damage will continue to increase, but eventually level out which could take several years. The anticipated number of Eurasian Collared-Doves that will be killed by WS will likely be extremely low in comparison to sport hunter harvest. WS take will be insignificant in their overall mortality.

Feral Poultry. Several species of domestic waterfowl are common in some parks and lakes in Colorado (Appendix C: Table C4) 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 received as gifts for different holidays by people who cannot raise them fully). They are often released without landowner permission. Their numbers can grow and often surpass the carrying capacity of the area. Feral waterfowl can create severe problems including damage to landscaping and grass, water contamination, disease, and hybridizing with wild ducks. The chickens and other poultry are more of a nuisance and typically do not cause as much damage as waterfowl. WS lethally took an average of 0.2 feral geese from FY06 to FY10 and no other feral domestic poultry. The effect of feral poultry removals is likely positive, with the exception of at parks where people feed them. These people could see control as negative because they like to feed them. However, opportunities to feed feral and wild ducks and geese are abundant and probably close to areas of removal. It should be noted that many parks have “No Feeding” policies, but these are often disregarded and not enforced. However, the take of feral poultry by WS is considered to be of no significant impact on the human environment since feral domestic ducks and geese, chickens, peacocks, and guineas and not indigenous components of ecosystems in Colorado.

Exotic Birds. Many exotic birds, undomesticated, could escape captivity or be intentionally released in Colorado. Some can damage different resources and WS may be contacted to conduct BDM for them. WS did not lethally take any exotic birds from FY06 to FY10. Thus, exotic birds have not been that much of a problem. The take of these species would have no effect on the human environment because they are not indigenous components of ecosystems in Colorado. In fact, for most species, it would be seen as beneficial for their removal so a population does not get started, such as with the Monk Parakeet (*Myiopsitta monachus*) which has caused thousands of dollars damage to the power industry in southern states. WS expects that the take of exotics will remain fairly low because Colorado does not have established populations of any.

Native Doves and Pigeons

Colorado commonly hosts 3 species of native doves and pigeons including the Mourning Dove, White-winged Dove, and Band-tailed Pigeons with the Inca Dove and the Common Ground-Dove accidentally seen in the State. Pigeons are relatively large birds with a square tail. Doves are smaller than pigeons, but possess many of the same physical characteristics, except typically sport a longer tail. All are fast-flying grayish or brown birds that usually feed on seeds or spilled grain. WS conducted an average of 313 work tasks annually from FY06 to FY10 for Mourning Doves, but none for the other 2 species. The Mourning Dove is abundant in Colorado and the species mostly likely to be involved in BDM at airports, and for the protection of some agricultural crops and property. Band-tailed Pigeons and White-winged Inca Doves are rare and not as likely to be the focus of a BDM project, but possibly could be. The Band-tailed pigeon is found mostly in western Colorado and are more likely to be a problem in orchards, but WS has not documented this and has not conducted BDM for them. White-winged Doves are sporadically found in eastern Colorado where their population range is expanding. They could be involved in BDM at airports and possibly for other resources.

The Mourning Dove population increased in the United States with the westward expansion of settlers. The White-winged Dove has been increasing too, but confined mostly to southern states. BBS data from 2006-2010 (USGS 2012) suggests that the breeding population of Mourning Doves is abundant at 4.1 million in Colorado and 19 million in the RMS area (Appendix A). Band-tailed Pigeons and White-winged Dove populations are less numerous at 6,300 and 210 in Colorado using USGS (2012) data for 2006-2010. Of the three species, WS lethally took only the Mourning Dove. RMBO (2007) determined that the survey-wide population of Mourning Dove was 114 million. Mourning Dove BBS data from 1966 to 2007 showed a nonsignificant (P=0.08 and 0.91) increasing and neutral trend of 1.1%/year in Colorado and 0.0%/year survey-wide (Sauer et al. 2008). However, Sauer et al. (2011) showed a significant ($P \leq 0.05$) decreasing trend survey-wide at -0.3%/year. The Band-tailed Pigeon showed a significant ($P \leq 0.05$) decreasing trend of -2.8%/year and White-winged Dove a nonsignificant ($P > 0.05$) increasing trend of 1.5%/year survey-wide from 1966-2009 (Sauer et al. 2011). The Mourning Dove is ranked high in relative abundance on BBS routes and is among the top ten most abundant species in the United States (Mirarchi and Baskett 1994). However, as suggested by BBS trends, populations have declined in recent years likely as a result of land-use changes such as cleaner farming, removal of shelterbelts and fencerows, shifts in land use such as from agriculture to intensive forestry, grain crops to cotton, shrubland to grazing lands, or natural habitats to urban areas, and other sources of habitat loss (Mirarchi and Baskett 1994). Even so, Mourning Doves are still abundant. At one time, they were estimated to be the second most abundant species in the North America at 475 million (Dunks et al. 1982) following the Red-winged Blackbird. The White-winged Dove is not as abundant as Mourning Doves, but still is very common south of Colorado and expanding their range northward. WS has only conducted BDM for the mourning dove, but could conduct BDM for the other two species. However, WS anticipates that it would likely take few, if any, which would not impact their populations.

Female Mourning Doves can breed if born early enough in the year at 90 days, but most all as yearlings (second year); males can breed at 80 days (Otis et al. 2008). For the sake of estimating the population for this EA, it is assumed that 75% of the female Mourning Doves breed as yearlings, the sex ratio is 1:1 males to females, females lay 2 eggs and have an average of 3.75 nests annually; fledgling success was found to be 3.6 in the United States for each breeding female (Otis et al. 2008). Using these parameters, the estimated RMS breeding population of 19 million would have about 7 million breeding females that successfully fledge about 25 million nestlings, raising the post-fledgling population to about 44 million Mourning Doves. This would be an increase in the population by a factor of 2.3. Mourning Dove populations experience very high annual mortality rates; depending on geographical region, 50 – 75% of the population dies each year. Significant causes of mortality include predation, hunting, weather events, and disease, but the significance of each is not well understood; for example, hunting mortality is considered compensatory, but weak evidence exists that it may be additive to other causes (Otis 2008).

WS took an average of 1,498 Mourning Doves in Colorado and 3,647 in the RMS area FY06 to FY10, with a high of 5,200 in FY10 (Table 14). Under the proposed action (Alternative 1), it is estimated that up to 10,000 might be taken by WS and 50,000 in the RMS region by WS programs for the protection of several resources, but primarily aircraft and safety at airports. The cumulative impact from all RMS WS Programs averaged less than 1% of the annual mortality of Mourning Doves with a high of 0.2% in FY10. Additionally, private individuals and other agencies took an average 874 in Colorado and 2,066 in the RMS region with permits from USFWS. Additionally, harvest was estimated 1,470,000 in the RMS region (USFWS 2008b, 2010, 2011c). With this information, Table 16 provides a cumulative impact analysis for Mourning Dove take by WS, other RMS WS Programs, and private individuals and entities and sportsmen in the RMS region. The cumulative impact from all sources from FY06 to FY10 has averaged about 3% of the post-breeding population or about 6% of the expected annual mortality. Thus, this level of take would have little impact on the population. If the WS programs in the RMS region increased its level of take to 50,000, the cumulative impact would remain at 6% of the expected annual mortality, well within compensatory mortality which would be absorbed by the population. Thus, WS concludes that the current and potential level of take is not expected to have an effect on the Mourning Dove population and BDM is not being conducted at a level that would cumulatively impact it.

WS has not worked with any other native doves or pigeons in Colorado. WS anticipates that a few White-winged Doves, a species that is expanding northward that WS is anticipating becoming a hazard at some airports, and Band-tailed Pigeons could be taken, at a level not likely to exceed 50 for either species. Populations based on USGS (2012) BBS data indicates that Colorado has a breeding population of 6,200 Band-tailed Pigeons and 210 White-winged Doves breeding in Colorado. The estimated annual harvest from the 2006 to 2010 hunting seasons was 1,380 Band-tailed Pigeons and 3,740 White-winged Doves. Thus, the estimated harvest for Band-tailed Pigeons is 22% of the breeding population which would be reasonable. However, the estimated harvest for White-winged Doves is much higher than the estimated breeding population. The White-winged Dove population is likely very low because BBS routes are not where they are found during the breeding season or they have a reverse migration in fall, moving northward. CBC data (NAS 2012b) first documented White-winged Doves in the 100th CBC and shows an increasing trend since that time (Figure 14), but they are still somewhat rare. This possibly could account for the high estimated level of harvest (USFWS 2008, 2010, 2011c). CPW, under USFWS, regulates the harvest of White-winged Doves and has hunting regulations for them, recognizing the northward expansion of the species. The take of 50 of either species would be less than 10% of hunter harvest and at a level that would not impact their populations, primarily considering the population estimate and hunting harvest for Band-tailed Pigeons and the northward expansion of White-winged Doves into Colorado.

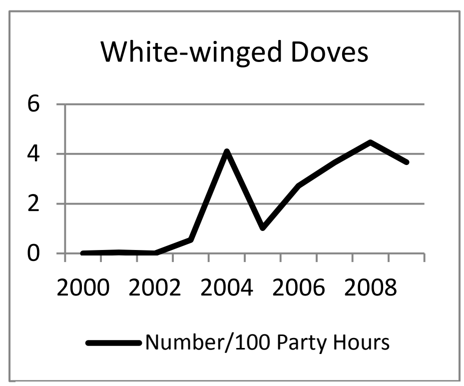

Figure 14. Index of the White-winged Dove population in Colorado from CBC (NAS 2011b).

Table 15. Cumulative impact analysis for Mourning Doves killed in Colorado by WS, other WS Programs in the RMS region, and private individuals and entities (estimated) from FY06 to FY10.

MOURNING DOVE IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated RMS Breeding Population	19,000,000	19,000,000	19,000,000	19,000,000	19,000,000	19,000,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Estimated Number Breeding Females	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000
Ave. Clutch	2	2	2	2	2	2
Ave. Nests	4	4	4	4	4	4
% Fledge	45%	45%	45%	45%	45%	45%
Young Produced/ Stable Pop. Ann. Mort.	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000	25,000,000
Total RMS Population	44,000,000	44,000,000	44,000,000	44,000,000	44,000,000	44,000,000
Colorado WS Take	134	1,051	1,666	1,655	2,984	1,498
All WS RMS Take	2,848	3,253	3,256	3,692	5,184	3,647
WS Take % of RMS Ann. Mort.	0.01%	0.01%	0.01%	0.01%	0.02%	0.01%
USFWS Permitted Take	2,787	3,342	1,113	16	3,074	2,066
Sport Harvest in RMS	1,467,900	1,652,300	1,403,100	1,496,400	1,329,900	1,469,920
Total Take	1,473,535	1,658,895	1,407,469	1,500,108	1,338,158	1,475,633
% RMS Post-breeding Pop.	3%	4%	3%	3%	3%	3%
% of RMS Ann. Mortality	6%	7%	6%	6%	5%	6%

Blackbirds

Colorado has 6 species of blackbirds that are common, mostly during the breeding season, the Red-winged, Brewer's, and Yellow-headed Blackbirds, the Common and Great-tailed Grackles, and Brown-headed Cowbirds. WS lethally took 3 species from FY06 to FY10, the Red-winged and Brewer's Blackbirds, and Common Grackle (Table 10) in minimal numbers (about 1,300), but hazed an average of 260,000 blackbirds annually, more than all other species combined (69% of the species hazed from FY06 to FY10 involved blackbirds). It is possible that all 6 species commonly found in Colorado were hazed from FY06 to FY10 because some projects were recorded as mixed blackbirds in the MIS. WS anticipates that it could lethally take many more blackbirds than it has, but all projects conducted at CAFOs from FY06 to FY10 involved starlings. Most damage problems from these species are associated with protecting agriculture such as crops and livestock feed and human health and safety, primarily at airports. WS had an annual average of 212 work tasks associated with them from FY06 to FY10. Because WS expects that it may take these species in the future, all species will be discussed in greater detail below. The Rusty Blackbird and Bronzed Cowbird have also been recorded in the State. The Bronzed Cowbird will not be discussed further. However, the Rusty Blackbird is a species of concern and will be discussed.

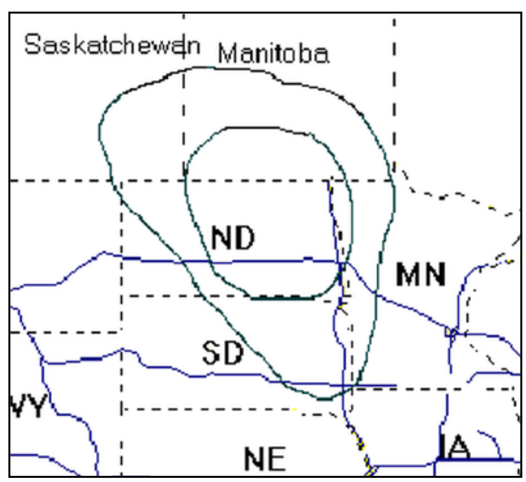

Figure 15. The Northern Prairie-Pothole region used by Peer et al. (2003) to make an estimate of the population of 3 blackbird species.

Precise counts of blackbird populations do not exist but one estimate placed the United States summer population of the blackbird group, which includes starlings, at over 1 billion (USDA 1997) and the winter population at over 500 million (Meanley and Royal 1976, Royall 1977). The majority of wintering blackbirds and starlings occur in southeastern United States roosts where their numbers were estimated to be 350 million (Bookhout and White 1981). The northwest and southwest regional population of the blackbird group was estimated at 111 million (Meanley and Royall 1976). An intensive study from 1996 to 1998 in the Northern Prairie-Pothole Region (Peer et al. 2003) including areas in North and South Dakota, Minnesota, Saskatchewan, and Alberta (Figure 15) found 61 million breeding Red-winged and Yellow-headed Blackbirds, and Common Grackles (Table 12) indicating the potential numbers breeding in a relatively small area. Data from BBS indicate that the blackbird population (excluding starlings) survey-wide is about 400 million with about 94 million in the RMS region (Figure 7). This EA will use the population estimated for Colorado and the RMS.

Meanley (1971) analyzed band return data which showed that blackbirds wintering in Arkansas, Mississippi, and Louisiana in the Mississippi Flyway, and Colorado in the Central Flyway came from 13, 16, 14, and 15 different states and provinces, respectively, ranging east to west from Alberta to New England and Quebec. Knittle et al. (1987) documented 86% of marked Red-winged Blackbirds dispersing from spring roosts in Missouri and southeastern South Dakota migrated to breeding sites in western Minnesota, North Dakota, and eastern South Dakota, and provided evidence that some Red-winged Blackbirds coming from spring roosts in the central United States breed in Canada. As part of an ongoing NWRC research project, Red-winged Blackbirds which were color marked in North Dakota in early fall were collected around Cheyenne Bottoms in Kansas later in the year. Thus, it is probable that blackbirds wintering in Colorado come from a much broader area than just RMS. This means that the mortality of blackbirds at Colorado CAFOs and airports during winter months would not just be focused on the RMS population of blackbirds, but would be distributed across much of the northern part of the United States and Canada. This factor would serve to lessen the effects of BDM-induced mortality in Colorado on the breeding population of blackbirds. It would also mean population impacts, including cumulative impacts as discussed herein, would be distributed across a broad segment of the North American population of blackbirds. However, population estimates from this area will be used to determine impacts to the various populations of blackbirds because it is likely that the majority of birds come from the RMS.

Table 16. Estimate of the breeding and fall blackbird population sizes in the Northern Prairie-Pothole region (Peer et al. 2003), an area that includes parts of Canada in the Central Flyway where many blackbirds breed.

	Red-winged Blackbird	Common Grackle	Yellow-headed Blackbird
Breeding Population	27,076,061	13,069,332	11,610,860
Fall Population	39,260,288	18,950,531	16,835,747

Based on observations of WS personnel at several affected Colorado feedlots where WS starling and blackbird damage management operations are concentrated, the species composition of the birds causing damage has been estimated to typically be a minimum of 95% starlings and at most 5% blackbirds. However, projects conducted at CAFOs during winter months from 2006 to 2010 have been almost entirely starlings with few, if any, blackbirds. Blackbird populations have been estimated as discussed in Appendix A using BBS and CBC data for the regions where the damage occurs. However, this was used only for states where mixed blackbirds were targeted (Colorado WS did not work on any projects involving mixed blackbirds from FY06 to FY10). USFWS established a standing depredation order for use by the public to take blackbirds causing or about to cause damage. This suggests that USFWS believes that native blackbird populations are healthy enough, and the problems they cause great enough, to allow such activities. Under this "order" (50 CFR 21.43), no federal permit is required by anyone to remove blackbirds if they are committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance. Thus, it appears that previous human-caused mortality or other factors have not resulted in major declines in the blackbird populations. It must be noted that USFWS removed the Rusty Blackbird from the list of species that can be taken under the Depredation Order. In all likelihood, WS in Colorado and the RMS areas has taken relatively few Rusty Blackbirds, if any, and does not anticipate the take of more than a few at most throughout the RMS region. Further information is discussed in this Section.

Colorado's estimated populations of the species regularly found in the State for data from 2006-2010 (USGS 2012) are 2,900,000 Red-winged Blackbirds, 1,200,000 Brewer's Blackbirds, 220,000 Yellow-headed Blackbirds, 1,300,000 Common Grackles, 67,000 Great-tailed Grackles, 580,000 Brown-headed Cowbirds. The estimated populations of these blackbirds for the RMS area from 2006-2010 are 16 million Red-winged Blackbirds, 7.6 million Brewer's Blackbirds, 2.2 million Yellow-headed Blackbirds, 2.4 million Common Grackles, 1.8 million Great-tailed Grackles, and 5.4 million Brown-headed Cowbirds. These population estimates will be used to determine impacts at the regional level where most take occurred. Colorado WS had relatively little take of these species from FY06 to FY10, but anticipates that some projects could occur where many are taken.

Red-winged Blackbirds. Red-winged Blackbirds are one of the most abundant breeding birds in North America and had the highest relative abundance between 1966 and 2009 on BBS routes (Sauer et al. 2011). Of all the species documented survey-wide, it only followed the Brown-headed Cowbird in the number of routes where it was recorded (4,188 *vs.* 4,125). The survey-wide BBS data showed a significant (P<.01) downward trend in the Red-winged Blackbirds population of -1.0%/year from 1966 to 2007 survey-wide, but nonsignificant (P=0.68) in Colorado at -0.3%/year (Sauer et al. 2008). However, more recent data (Sauer et al. 2011) shows a significant (P<0.05) downward trend of -1.0%/year from 1966 to 2009 in Colorado. The national decline mirrors the loss of wetland nesting habitat, primarily from changing agricultural practices and development (Dolbeer 2003). The combined United States and Canadian population of Red-winged Blackbirds has been estimated at nearly 190 million birds, based on winter roost surveys (Meanley and Royall 1976) and BBS data in the 1990s (Rich et al. 2004, RMBO 2007). The RMS region (Figure 7) and Colorado populations were estimated at about 16 million and 2.9 million (Appendix A: Table A2) using data from 2006 to 2010 (USGS 2012).

Female Red-winged Blackbirds breed as yearlings (second year); males do not breed until their third year. For the sake of estimating the population for this EA, it is assumed that 75% of the female Red-winged Blackbirds breed, the sex ratio is 1:1 males to females, females lay 3-5 eggs with the average of 3.3, and they have an average of 1.7 nests annually (Yasukawa and Searcy 1995). Fledgling success was found to range from 40% to 88% for the first clutch varying with climatic conditions; for the analysis of population impacts it will be assumed, to be conservative, that only 40% fledge. Far fewer nestlings were found to be successfully fledged from a second clutch, 4%, which will be used in this analysis (Yasukawa and Searcy 1995). Using these parameters, the estimated RMS breeding population of 16 million would have about 6 million breeding females that successfully fledge about 8 million nestlings, raising the post-fledgling population to about 24 million Red-winged Blackbirds. This would be an increase in the population by a factor of 1.5. Peer et al. (2003) used a factor of 1.45 to estimate the fall population (Table 12). Thus, about 5% of the population would die from fledging to fall, presumably mostly juveniles, which would be expected.

Natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997). Based on population modeling, Dolbeer (1998) showed that the effect of reducing survival of two blackbird species by 50% (additional loss following natural mortality prior to breeding) was only a 41% reduction in the population by the end of three years. For a population of 190 million Red-winged Blackbirds with an assumed average annual survival of 50%, cutting the survival in half would require the mortality of an additional 47 million per year over the natural mortality level. Assuming that human-induced mortality is mostly compensatory, instead of additive, to natural mortality, this level of impact is well within the extent of normal mortality levels and, thus, well within the ability of the population to withstand. To further illustrate the minor degree of impact, Sawin et al. (2003) found that the removal of all males over a large area, those that did not breed during a given year because they were unsuccessful in establishing a territory (floaters), did not have any effect on the population or the number of floaters the following year. This suggests that recruitment and immigration replaced those blackbirds lost to the population and the population remains stable for the available habitat.

WS conducts few BDM projects for Red-winged Blackbirds specifically. More often, they are targeted when in mixed flocks of blackbirds and starlings at CAFOs. The take of Red-winged Blackbirds by WS in the Colorado annually averaged 1,256 from FY06 to FY10 with a high of 4,720 in FY10. The WS

Program cumulatively in the RMS region took an average of 132,819 Red-winged Blackbirds. Because the public is permitted to take Red-winged Blackbirds that are causing depredations or are a health nuisance under a depredation order by USFWS, depredation permits are not required to be obtained by private individuals or agencies to take them. The public conducts control of Red-winged Blackbirds to protect livestock feed and health at CAFOs and crops such as sunflower, corn, and wheat in the RMS region and much of this is done with trapping, shooting, and the use of Avitrol. However, WS has no way of determining how many blackbirds are taken by private efforts. It is expected that this effort occurs, especially to protect crops, but the numbers actually taken are probably minimal. However, for the purposes of this analysis, it is estimated that up to 0.5 million Red-winged Blackbirds would be taken by private efforts (we believe this to be an exaggeration of actual private depredation take, to be conservative).

Table 17. Cumulative impact analysis for Red-winged Blackbirds killed in Colorado by WS, other WS Programs in the RMS region, and private individuals and entities (estimated) from FY06 to FY10.

RED-WINGED BLACKBIRD IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated RMS Breeding Population	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Estimated Number Breeding Females	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000
Ave. Clutch	3.3	3.3	3.3	3.3	3.3	3.3
Ave. Nests	1.7	1.7	1.7	1.7	1.7	1.7
% Fledge 1st Nest/2nd Nest	40%/4%	40%./4%	40%/4%	40%/4%	40%./4%	40%/4%
Young Produced/ Stable Pop. Ann. Mort.	8,000,000	8,000,000	8,000,000	8,000,000	8,000,000	8,000,000
Total RMS Population	24,000,000	24,000,000	24,000,000	24,000,000	24,000,000	24,000,000
Colorado WS Take	18	22	259	1,272	4,720	1,256
All WS RMS Take	70,622	183,105	209,054	172,106	29,179	132,819
WS Take % of RMS Ann. Mort.	2.3%	2.3%	2.6%	2.2%	0.4%	1.7%
Private Take in RMS	500,000	500,000	500,000	500,000	500,000	500,000
Total Take	570,622	683,105	709,054	672,106	529,179	632,819
% RMS Post-breeding Pop.	2%	3%	3%	3%	2%	3%
% of RMS Ann. Mortality	7%	9%	9%	8%	7%	8%

With this information, Table 13 provides a cumulative impact analysis for Red-winged Blackbird take by WS, WS Programs in the RMS region, and private individuals and entities along with WS cumulatively. A recent EA (WS 2009) for New Mexico analyzed take in the RMS area with similar levels of take. The cumulative impact to the Red-winged Blackbird population from FY06 to FY10 averaged about 3% of the post-breeding population and up to 8% of their expected annual mortality. This would not be enough to cause the population to decline. Doubling the percentage of blackbirds other than starlings taken in DRC-1339 projects at feedlots did not appreciably elevate take percentages. In fact, take would have to be in the millions before an impact would likely occur in the RMS region. Under the Proposed Action (Alternative 1), potentially up to 1 million Red-winged Blackbirds could be taken by WS in the RMS which would be 13% of the expected annual mortality and 19% cumulatively. Even at this level, more than 80% of the expected mortality would still occur above that taken by WS. It would be expected that the mortality would be considered compensatory and not additive. Habitat loss, primarily a decline in breeding habitat, over the last 60 years has been the primary contributor to their decline (Dolbeer 2003). We do not expect that take will ever go above a threshold considered significant.

Brewer's Blackbirds. The Brewer's Blackbird breeds in western and northern North America, mostly south of the Rusty Blackbird. Its range expanded in the early 1900s eastward and northward facilitated by human habitat modifications, principally forest clearing for farming, logging, and railroad and highway development. However, its population increase was followed by a decrease. Its breeding range includes the northern RMS region, including Colorado, and the winter range includes the southern RMS region, including Colorado. Estimated trends from 1966 to 2007 have been negative, significantly (P<.01) survey-wide at -1.3%/year, but not significantly (P=.55) at -0.4%/year in Colorado (Sauer et al. 2008). Newer analysis (Sauer et al. 2011) has found that the decline survey-wide and in Colorado is significant (P<0.05) at -2.1%/year and -2.4%/year. The population of Brewer's Blackbirds was estimated at 35 million based on BBS data from the 1990s (RMBO 2007). The estimated population for the RMS region from BBS data (2006-2010) is 7.6 million and 1.2 million for Colorado. Brewer's Blackbirds typically do not cause as many problems as other blackbird species, but can cause damage at feedlots where they are often separate or in loose flocks with other blackbirds.

Brewer's Blackbirds breed as yearlings (second year). For the sake of estimating the population for this EA, it is assumed that 75% of the blackbird females breed, the sex ratio is 1:1 males to females, females lay 1-8 eggs with an average eggs/nest of 5.0, and an average nests/season of 1 (Martin 2002). About 63% of the eggs hatch with subsequent fledgling success 63%, for an egg to fledgling success of 40%. Using these parameters, a breeding population of 7.6 million in the RMS region would have about 2,900,000 breeding females that successfully fledge about 5,800,000 nestlings, raising the post-fledgling population to about 12 million Brewer's Blackbirds. This would be an increase in the population by a factor of 1.75, similar to other blackbirds.

Table 18. Cumulative impact analysis for Brewer's Blackbirds killed in Colorado by WS, RMS WS Programs, and private individuals and entities (estimated) from FY06 to FY10.

BREWER'S BLACKBIRD IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated RMS Breeding Population	7,600,000	7,600,000	7,600,000	7,600,000	7,600,000	7,600,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Breeding Females	2,900,000	2,900,000	2,900,000	2,900,000	2,900,000	2,900,000
Ave. Clutch	5.0	5.0	5.0	5.0	5.0	5.0
Ave. Nests	1	1	1	1	1	1
% Fledge	40%	40%	40%	40%	40%	40%
Young Fledged/Stable Pop. Ann. Mort.	5,800,000	5,800,000	5,800,000	5,800,000	5,800,000	5,800,000
Total RMS Population	12,000,000	12,000,000	12,000,000	12,000,000	12,000,000	12,000,000
CO WS Take	0	0	0	1	0	0.2
RMS WS Total Take	25,255	65,435	99,761	65,850	11,854	54,177
WS Take % of RMS Annual Mortality	0.4%	1.1%	1.7%	1.1%	0.2%	0.9%
Private Take in RMS Region	200,000	200,000	200,000	200,000	200,000	200,000
Total Take	227,350	270,865	304,696	273,401	212,490	257,760
% RMS Post-breeding Pop.	2%	2%	3%	2%	2%	2%
% of RMS Annual Mortality	4%	5%	5%	5%	4%	4%

Natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997) and a stable population of Brewer's Blackbirds would have a 75% mortality rate under the current assumptions (includes nestlings that die before fledging). The numbers that might be taken by WS in Colorado under the proposed action or Alternative 1 have been negligible averaging 0.2 annually from FY06 to FY10 (potentially up to 500,000 might be taken by WS in the RMS region in any one year, about 6% of the annual mortality - Table 16). These numbers are well within normal mortality levels for this species. WS mortality in the RMS area averaged almost 58,000 from FY06 to FY10. Additional human-induced mortality of this species occurs from private individuals and could potentially be 200,000 annually (Brewer's Blackbirds are not as likely to be taken as Red-winged Blackbirds due to foraging habits). However, WS has no way of knowing what the level of take is by private individuals since permits are not required. With this information, Table 18 provides a cumulative impact analysis for Brewer's Blackbird take by WS, RMS WS Programs, and private individuals and entities in the RMS region. This would bring the total take in the RMS region to 258,000, about 2% of the RMS total population or 4% of the estimated annual mortality (Table 18). If the WS programs in the RMS region increased their level of take to 500,000, the cumulative impact would be 12% of the expected annual mortality, likely within compensatory mortality which would be absorbed by the population. WS concludes that this is a minor level of take and would not impact the population.

It should be noted that Brewer's Blackbirds are not as likely to be taken when insects are available because of their preference for feeding on them over waste grain, when available (Martin 2002). Thus, it is likely that the estimates of take are highly conservative, that is, higher than they are in actuality.

Yellow-headed Blackbirds. The Yellow-headed Blackbird breeds in north central western states including the northern states in the RMS region, and to a lesser degree in southern States of the RMS region. It requires emergent wetland habitat for breeding which limits its distribution. The Yellow-headed Blackbird begins migration to its wintering grounds in southern Arizona, New Mexico and southwest Texas south into Mexico starting in July and finishes by mid-September, mostly coinciding with the completion of its pre-basic molt (their migration is missed by both CBC and BBS). Yellow-headed Blackbirds mostly miss BDM activities conducted by WS in the RMS region, except for those that linger prior to heading for their wintering grounds. However, its migration coincides with the ripening of some sunflowers and other crops, and therefore, it may be involved in some BDM activities. Estimated trends from 1966 to 2009 have been slightly negative survey-wide (-0.6%/year) and slightly positive in Colorado (0.2%/year), but not significant (P>.05) (Sauer et al. 2008). Reductions in breeding populations for this species have primarily been attributed to the loss of nesting habitat from drought and development (Twedt and Crawford 1995). The population of Yellow-headed Blackbirds was estimated at 23 million based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). A detailed study in the northern prairie pothole region (Peer et al. 2003) estimated 11.6 million Yellow-headed Blackbirds in that area. Recent BBS data (2006-2010) estimated the RMS population at 2.2 million and the Colorado population at 220,000.

Yellow-headed Blackbirds breed as yearlings (second year). For the sake of estimating the population for this EA, it is assumed that 75% of the blackbird females breed, the sex ratio is 1:1 males to females, females lay 1-5 eggs with an average of 3.2-4.0 eggs/nest (3.2 will be used for the EA), and average 3 nests/season (Twedt and Crawford 1995). Averages of 2.1 nestlings fledge the first nest, 1.0 from the second, and 0.9 from the third for an egg to fledgling success of 42%. Using these parameters, a breeding population of 2.2 million in the RMS region would have about 830,000 breeding females that successfully fledge about 3.3 million nestlings, raising the post-fledgling population to about 5.5 million Yellow-headed Blackbirds. This would be an increase in the population by a factor of 2.5, somewhat higher than other blackbirds.

Natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997) and a stable population of Yellow-headed Blackbirds would have a 77% mortality rate under the current assumptions (includes nestlings that die before fledging) or a 59% mortality from fledging to breeding. This is a fairly high annual mortality rate.

Table 19. Cumulative impact analysis for Yellow-headed Blackbirds killed in Colorado by WS and other WS Programs in RMS region, and private individuals and entities (estimated) from FY06 to FY10.

YELLOW-HEADED BLACKBIRD IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated RMS Breeding Population	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Estimated Number Breeding Females	860,000	860,000	860,000	860,000	860,000	860,000
Ave. Clutch	3.2	3.2	3.2	3.2	3.2	3.2
Ave. Nests	3	3	3	3	3	3
% Fledge	42%	42%	42%	42%	42%	42%
Young Produced/ Stable Pop. Ann. Mort.	3,300,000	3,300,000	3,300,000	3,300,000	3,300,000	3,300,000
Total RMS Population	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000
CO WS Take	0	0	0	0	0	0
All RMS WS Take	26,900	69,706	66,128	57,658	8,180	45,715
WS Take % of RMS Ann. Mort.	0.8%	2.1%	2.0%	1.7%	0.2%	1.4%
Private Take in RMS	100,000	100,000	100,000	100,000	100,000	100,000
Total Take	126,900	169,706	166,128	157,658	108,180	145,715
% RMS Post-breeding Pop.	2%	3%	3%	3%	2%	3%
% of RMS Ann. Mortality	4%	5%	5%	5%	3%	4%

WS in Colorado did not take any Yellow-headed Blackbirds. The WS Programs in the RMS region did take some Yellow-headed Blackbirds, primarily in New Mexico and Arizona. Estimated annual average take by WS in the RMS region was 46,000 from FY06 to FY10. Private take may be much higher, but mostly where large acreages of sunflowers are grown or at CAFOs in southern states. Additionally, large numbers of Yellow-headed Blackbirds may also stage longer in areas before completing migration, though doubtful, and may get taken during BDM at a CAFO. Thus, WS estimates that up to 200,000 could be taken by WS in the RMS States and possibly up to 100,000 by agricultural producers and other private entities and agencies in the RMS region. This would equate to 9% of the estimated annual mortality which would be a very low level effect on the population. Thus, WS concludes that current impacts are negligible, and even at a high level of take, impacts would be minor.

Great-tailed Grackles. The Great-tailed Grackle population has expanded its range in recent history, especially north and west of their historic boundaries, and has increased in abundance over its new range. Estimated BBS trends from 1966 to 2009 have increased significantly ($P<.05$) survey-wide at 2.8%/year, but not significantly ($P>.05$) in Colorado at 16.5%/year (Sauer et al. 2011). Their range expansion has been credited to their adaptability to altered habitats such as urban and agricultural landscapes with irrigation (Johnson and Peer 2001). The United States population of Great-tailed Grackles has been estimated at 7.8 million birds, based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). Recent BBS data (2006-2010) (USGS 2012) for the RMS population estimated a population of 1.8 million and 67,000 in Colorado.

Great-tailed Grackles breed as yearlings (second year). For the sake of estimating the population for this EA, it is assumed that 75% of the Great-tailed Grackle females breed, the sex ratio is 1:1 males to females, females lay 1-5 eggs with an average eggs/nest of 3.2, and an average nests/season of 1.37 (Johnson and Peer 2001). About 75% of the eggs hatch, but fledgling success was high and found to be 93% in Texas, once hatched, for a rate from egg to fledgling of 70% (Johnson and Peer 2001). Using these parameters, the RMS breeding population of 1.8 million would have about 680,000 breeding females that successfully fledge about 2.1 million nestlings, raising the post-fledgling population to about 3.9 million Great-tailed Grackles. This would be an increase in the population by a factor of 2.2. Of the population, natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997) and a stable population of Great-tailed Grackles would have a 54% mortality rate under the current assumptions.

WS in Colorado did not lethally take any Great-tailed Grackles from FY06 to FY10, but anticipates that take could easily occur given their population expansion. WS in the RMS region took an average of 15,000 Great-tailed Grackles from FY06 to FY10, with a high of 24,000 in FY09 (Table 14). Under the proposed action (Alternative 1), it is estimated that up to 200,000 might be taken by WS in the RMS region. Additionally, private individuals and other agencies take Great-tailed Grackles and it is estimated that these entities could possibly take an additional 100,000, especially to protect citrus crops (this, though, like the Red-winged Blackbird, is likely a gross over exaggeration to ensure a conservative analysis). With this information, Table 14 provides a cumulative impact analysis for Great-tailed Grackle take by WS, other RMS WS Programs, and private individuals and entities in the RMS region. The cumulative impact from all RMS WS Programs averaged 0.7% of the annual mortality of Great-tailed Grackles and cumulative impact, assuming private entities and individuals took 100,000, was 5% of the annual mortality. It is anticipated that the cumulative take in the RMS region by WS and others could be as high as 300,000 or 14% of the estimated annual mortality for the protection of a variety of resources, but primarily to protect crops and human health and safety at airports and in residential neighborhoods where they congregate. Thus, this level of take would have little effect on the population. If the WS programs in the RMS region increased its level of take to 200,000, the cumulative impact would be well within compensatory mortality which would be absorbed by the population. Thus, WS concludes that the current and potential level of take is not expected to have an effect on the Great-tailed Grackle population.

Table 20. Cumulative impact analysis for Great-tailed Grackles killed in Colorado by WS, other RMS WS Programs, and private individuals and entities (estimated) from FY06 to FY10.

GREAT-TAILED GRACKLE IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated RMS Breeding Population	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5	37.5%	37.5
Breeding Females	680,000	680,000	680,000	680,000	680,000	680,000
Ave. Clutch	3.2	3.2	3.2	3.2	3.2	3.2
Ave. Nests	1.37	1.37	1.37	1.37	1.37	1.37
% Fledge	70%	70%	70%	70%	70%	70%
Young Fledged/ Stable Pop. Ann. Mort.	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000	2,100,000
Total RMS Population	3,900,000	3,900,000	3,900,000	3,900,000	3,900,000	3,900,000
CO WS Take	0	0	0	0	0	0
All RMS WS Take	7,881	21,008	22,788	23,587	1,953	15,443
WS Take % of RMS Annual Mortality	0.4%	1.0%	1.1%	1.1%	0.1%	0.7%
Private Take in RMS Region	100,000	100,000	100,000	100,000	100,000	100,000
Total Take	107,881	121,008	122,788	123,587	101,953	115,443
% RMS Post-breeding Pop.	3%	3%	3%	3%	3%	3%
% of RMS Ann. Mortality	5%	6%	6%	6%	5%	5%

Common Grackles. Common Grackles are abundant in central and eastern North America which is reflected in their high estimated population of 97 million survey-wide (Table 4). Trend data for 1966 to 2007 shows a significant decline ($P<0.01$) survey-wide of -.1.0%/year, but a nonsignificant ($P=0.33$) positive trend in Colorado of 1.3%/year (Sauer et al. 2008). From 1966 to 2009, BBS data indicates a similar significant ($P<0.05$) decline at -1.5%/year survey-wide, but a significant increase ($P<0.05$) in Colorado of 2.8%/year (Sauer et al. 2011). The declines survey-wide are thought to have occurred to habitat loss and, in some areas, the spread of Great-tailed Grackles. Control efforts, especially in eastern United States, have been also theorized as a reason for decline (Peer and Bollinger 1997). The North American population of Common Grackles has been estimated at 100 million birds, based on winter roost surveys (Meanley and Royall 1976) and 97 million based on BBS data (Rich et al. 2004, RMBO 2007). BBS data for the RMS region from 2006-2010 provided an estimate of 2.4 million, but much of the RMS area is west of their core area.

Common Grackles breed as yearlings (second year). For the sake of estimating the population impacts for this EA, it is assumed that the Common Grackle sex ratio is 1:1 males to females, 75% of the females breed laying 3-7 eggs with the average of 4.8, and have an average of 1 nest/season (Peer and Bollinger 1997). Grackles renest if their initial attempt fails. Fledgling success was found to be 49%. Using these parameters, a RMS breeding population of 2.4 million would have about 900,000 breeding females that successfully fledge about 2.1 million nestlings, raising the post-fledgling population to about 4.5 million Common Grackles. This would be an increase in the population by a factor of 1.9. Peer et al. (2003) used a factor of 1.45 to estimate the fall population of three blackbird species (Table 10). Thus, about 24% of the population would die from fledging to fall, presumably mostly juveniles. This would be a high mortality rate from early summer to fall, but could possibly occur. Natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997. Under the current assumptions, the Common Grackle population would have a 47% mortality rate, slightly lower than USDA (1997).

WS in the RMS took an average of 62 Common Grackles from FY06 to FY10, with a high of 296 in FY10 (Table 16). Colorado WS took an average of 12. The take was negligible in comparison to the population. Under the proposed action (Alternative 1), it is estimated that up to 100,000 might be taken by WS in the RMS region and 50,000 by private individuals and other agencies to protect various resources. The cumulative impact of this potential take from all RMS WS Programs and private individuals and organizations would be 7% of the expected annual mortality. This level of take is well within the ability of the overall population to withstand. Thus, WS concludes that the current and potential level of take is not expected to have an effect on the Common Grackle population and BDM is not being conducted at a level as described by Peer and Bollinger (1997).

Brown-headed Cowbirds. Brown-headed Cowbirds are an abundant species that have been estimated to have a population of more than 90 million nationwide (Meanley and Royall 1976). Recent data (RMBO 2007) suggest that the population is 51 million. BBS data from 1966 to 2009 show a significant ($P<0.05$) declining trend for Brown-headed Cowbirds of -0.7%/year. Colorado has a nonsignificant (P>0.05) upward trend of 1.3%/year. The decline survey-wide is thought to have occurred because of 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 cowbird greatly expanded its range from where buffalo roamed in the central Great Plains eastward as the deciduous forests were opened for agriculture (Mayfield 1965). 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. This is an abundant species in the RMS region (5.4 million).

Brown-headed Cowbirds breed as yearlings (second year). For the sake of estimating the population for this EA, it is assumed that 75% of the cowbird females breed, the sex ratio is 1:1 males to females, females lay an average of 41 eggs/season, and an average of 13% fledge with 3 (7%) cowbirds developing to maturity from other species rearing them (Lowther 1993). Using these parameters, a breeding population of 5.4 million in the RMS region would have about 2.0 million breeding females that successfully fledge about 6.0 million nestlings, raising the post-fledgling population to about 11 million Brown-headed Cowbirds. This would be an increase in the population by a factor of 2.1. It would be expected that the mortality rate through the course of a year for Brown-headed Cowbirds would be higher than other species of blackbirds because of the higher population increase factor as well as smaller body size.

Brown-headed Cowbirds would most likely be targeted at airports to reduce hazards to aircraft. They also could be targeted by WS, private individuals, and other agencies to protect livestock feed, crops, and T&E bird species from nest parasitism. It should be noted that few cowbirds would be taken for the protection of crops. WS in Colorado did not take any Brown-headed Cowbirds, but anticipates that many could be taken. WS in the RMS region took an average of 14,510 Brown-headed Cowbirds from FY06 to FY10 or 0.2% of the expected annual mortality, a minimal number. Under the proposed action (Alternative 1), it is estimated that up to 200,000 might be taken by WS in the RMS region and 100,000 by private individuals and organizations. Cumulative take of 300,000 Brown-headed Cowbirds in the RMS region would be 5% of the expected annual mortality, well within a level that could be withstood by the population. Thus, WS concludes that the current and potential level of take is not expected to have an effect on the Brown-headed Cowbird population.

Rusty Blackbirds. Rusty Blackbirds breed in Alaska and Canada, and winter in the southeastern United States. Their winter range includes the southeastern states from eastern portions of South Dakota south through the RMS region. Very few Rusty Blackbirds winter in western States, including Colorado, but have been documented in NAS Christmas Counts (NAS 2012b). Eastern Colorado is the primary area where a few Rusty Blackbirds might be found during winter months, but they are at relatively low densities, but get higher traveling east and southeast. To illustrate this, Colorado CBC data for FY06 to FY10 show an average number of birds/party hour of 0.0043 Rusty Blackbirds, increasing to 0.5608 in Kansas, to 1.0186 in Missouri. Travelling southeast densities are 1.3589 /party hour in Oklahoma, 0.8784 in Arkansas, and 7.2510 in Mississippi. Thus, it can be seen that many more are further east and southeast of Colorado with Mississippi having the highest wintering density.

Rusty Blackbirds primarily feed on invertebrates in wet woodlands and near streams throughout the year. Even though they roost with other blackbirds, Rusty Blackbirds usually will not feed with them. It should be noted that Rusty Blackbirds are a species not likely to be taken protecting crops because during winter they mostly feed in wet woodland bottoms on acorns, pine seeds, fruits, and animal matter, but sometimes will be found in feedlots (Avery 1995). Thus, few are likely ever taken by WS during BDM. Even so, we will analyze take for the species composition found in Colorado.

Estimated trends from 1980 to 2007 have been significantly (*P*<.01) negative survey-wide at -9.7%/year. Declines have been linked to a loss of wet woodland breeding habitat (Avery 1995). The population of Rusty Blackbirds was estimated at 2.0 million based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). The Rusty Blackbird is a species on the Audubon Watchlist and is being removed from the USFWS Blackbird Depredation Order. As such, estimated take will be analyzed, but at a maximum, would be minimal. Take would most likely occur during DRC-1339 projects to protect rice, but one has never documented to be taken by WS personnel. NWRC researchers never found one in treated rice field plots during numerous research studies (John Cummins, WS-NWRC, Research Biologist, retired, pers. comm. 2008). Rusty Blackbirds do not breed in the RMS region and therefore, do not have an estimated population in this area.

Even though Rusty Blackbirds do not breed in the RMS, its population can be estimated. This species has been declining for a number of years. If it declined 15% annually from 2000 to 2008, its population, using the RMBO (2007) estimate of 2 million, would be about 650,000 in 2008. Rusty Blackbirds breed as yearlings (second year). For the sake of estimating the population in this EA, it is assumed that 75% of the blackbird females breed, the sex ratio is 1:1 males to females, and females lay an average of 4.5 eggs/nest with 1 nest/season (Avery 1995). No other data is available (NAS 2012a), but it assumed that from egg to fledgling, success is 40% (using Brewer's Blackbird parameters). Using these parameters, a breeding population of 640,000 would have about 240,000 breeding females that successfully fledge about 430,000 nestlings, raising the post-fledgling population to about 1.1 million Rusty Blackbirds. This would be an increase in the population by a factor of 1.7, similar to other blackbirds.

Natural mortality in blackbird populations is between 50% and 65% of the population each year, regardless of human-caused control operations (USDA 1997) and a stable population of Rusty Blackbirds would have a 53% mortality rate under the current assumptions and an assumption that 67% of the eggs in a nest hatch (the mortality rate includes nestlings that die before fledging). WS take has been estimated to be 1 from FY06 to FY10 based on species composition in the RMS Region. However, take has been 0 in Colorado from FY06 to FY10. Take was estimated to be 15 in all RMS states, including Colorado. It is likely that private take is few, if any, because feeding behavior would likely preclude their take. However, for the sake of estimating impact, it is assumed that 10 are killed by individuals or other organizations. The cumulative take would be <0.01% of the estimated annual mortality. If WS and other RMS states increased take to 50, the cumulative impact would be 0.1% of the estimated annual mortality, a very low take. It should be noted that cumulative take should actually encompass the entire area where Rusty Blackbirds are taken because the entire population is being used. Since that data is unavailable, we can also compare take with CBC data (NAS 2011b). From FY06 to FY10, an annual average of 206 count circles in the RMS region found 25 Rusty Blackbirds which directly equates to 510 Rusty Blackbirds considering the percentage of land area covered by CBC count circles. This is without determining detectability factors for the Rusty Blackbird. Using this for the population would equate to a 10% cumulative impact to the RMS wintering population. WS concludes that current levels of take in the Colorado and the RMS region are very low to nonexistent and at a potential level of take that would not impact the population. The loss of wetland nesting habitat, especially in the breeding area, is attributed to their decline (Avery 1995).

Swallows, Nighthawks, and Swifts

WS is often requested to control damage caused by swallows, nighthawks, and swifts (aerialists), mostly from the mud nests built by some swallows, nest insect infestations that spread to livestock, or protecting aircraft from strikes at an airport. The 3 aerialist groups, respectively, were associated 3,063, 270, and 322 strikes to civil aircraft in the United States from FY01 to FY10 (Appendix D) with about 3% of the strikes causing damage. From FY06 to FY10, WS annually averaged 101 work tasks for 4 species of swallows (Cliff, Barn, Tree, and Bank Swallows) and 0.2 for Common Nighthawks. The breeding populations in Colorado using BBS data from 2006 to 2010 (USGS 2012) were estimated to be 2,200,000 Cliff Swallows, 720,000 Barn Swallows, 410,000 Tree Swallows, 48,000 Bank Swallows, and 310,000 Common Nighthawks. Colorado also has 3 other species of swallows and 3 species of swifts that could potentially cause problems, primarily at airports. However, WS anticipates very few requests for these species whereas Cliff Swallows and, to a much lesser extent Barn Swallows, build mud nests that cause problems at some sites and they hunt insects in open areas such as that found at airports. Outside of Colorado, WS conducted very little work for Cliff and Barn Swallows and USFWS permitted very little take in the other RMS States. Thus, we will analyze take of Cliff and Barn Swallows for Colorado.

BBS data from 1966 to 2007 indicate that in Colorado, of the species being lethally taken, the Cliff Swallow saw a significant increase survey-wide of 0.7%/yr. (P=0.03), but the Barn Swallow declined at 0.9%/yr. (P<0.01). In Colorado, their trends were similar, but not significant. Data for 1966 to 2009 (Sauer et al. 2011) shows similar trends, but the Cliff Swallow increase was no longer significant. For the other species the Black and Chimney Swifts, and the Tree and Bank Swallows are declining significantly with the Violet Green Swallow increasing significantly, but only in Colorado. Loss of nesting habitat is believed to be the primary cause for the declining trend for these species. Thus, the populations will decline regardless of any BDM conducted for them because their populations are limited by habitat.

Cliff Swallows, a colonial nester, were taken the most with an average of 723 taken by WS in Colorado from FY06 to FY10 with a maximum of 2,203 in FY10. USFWS permitted take averaged 485 from 2006 to 2010 in Colorado with a maximum of 2,176 in 2010. Thus, cumulative take (1,208) from FY06 to FY10 averaged 0.05% of the breeding population in Colorado, with a maximum take (4,379) in FY10 of 0.2%. These are minimal take numbers that would not impact the population. Take could easily increase a hundred-fold without an impact on the population. Barn Swallow take cumulatively in Colorado was an average of less than 1 from FY06 to FY10. USFWS permitted the take of few Barn Swallows, an average of less than 1 in Colorado, an indication of the limited damage they cause. This level of take would be imperceptible. Take could increase several thousand-fold without an impact on this species. However, WS believes that this will not occur because most Barn Swallows nest singly in areas where they would not cause damage. WS concludes that BDM will have no more than an imperceptible impact on any of the aerialist species, even if take were to increase to 1,000 for all of the species with the exception of the Black Swift. This species numbers few in Colorado, estimated at about 500, but will not likely be the focus of any damage management program, primarily because it generally is found in out of the way canyons near waterfalls. Therefore, WS believes that it will not take this species.

Grassland Passerine Species

Several species of passerines frequent grasslands and could become a problem with most only causing potential damage at airports. A few of these species, though, cause damage to crops. True grassland species include the meadowlarks, Horned Lark, pipits, emberizids (Lark Bunting, certain sparrows, and longspurs), Dickcissels, and Bobolinks. The grassland birds were responsible for 5,218 strikes from FY01 to FY10 (Appendix D). We include the open woodland birds, flycatchers/kingbirds, thrashers, buntings, finches, and goldfinches (579 strikes), and orioles (18 strikes) with this group because they are often found in open grassland areas with some perches (trees, wires, poles, shrubs), but favor a wider variety of habitats. For the most part, damage associated with grassland species is typically confined to airports where the grassland environment is attractive to them. In all, these species were responsible for 5,815 strikes at U.S. airports from FY01 to FY10 (appendix D), with all grassland species causing 122 damaging strikes (4%), open woodland 16 (5%), and orioles 1 (8%) of the strikes with information reported on the strike other than the species (Appendix D); in all 5%. This group has about as many strikes as raptors, but the percentage of damaging strikes is much lower (5% *vs.* 27% for raptors). Of these species, the only species causing other types of damage, primarily to small grain crops, are Horned Larks, Lark Buntings, Dickcissels, White-crowned Sparrows, and goldfinches.

About half of the true grassland species are significantly declining, even more than the grassland habitat making it difficult to determine limiting factors (North American Bird Conservation Initiative, U.S. Committee 2011). Grassland habitat is being reduced across North America, including the central United States and this is considered a prime factor for their decline. However, many of these species' declines are occurring more rapidly than the decline of grasslands. Other factors have been postulated such as habitat reduction on their wintering grounds and the use of unknown pesticides on their wintering grounds. Grassland species with significant declining trends from 1966 to 2009 in Colorado included the White-crowned Sparrow and Lark Bunting (Sauer et al. 2011). Survey-wide, the list includes Eastern Kingbird, Scissor-tailed Flycatcher, Horned Lark, Sprague's Pipit, White-crowned Sparrow, Savannah Sparrow, Bobolink, McCown's Longspur, and Western Meadowlark. Of the significantly declining species from 1966 to 2009 (Sauer et al. 2011), 3 species were taken lethally by WS, the Horned Lark (-2.4%/yr.), Western Meadowlark (-1.1%/yr.), and Lark Bunting (-5.7%/yr.). The only other species that was taken lethally by WS, the Western Kingbird (0.5%/yr.), shows a significant positive trend.

Most grassland species have fairly high breeding populations in Colorado and the RMS area, except those on the edge of their range (*e.g.,* Eastern Phoebe, Scissor-tailed Flycatcher) or those that only winter in Colorado (*e.g.*, Gray-crowned Rosy Finch, Black Rosy Finch, Sprague's Pipit). Species taken lethally from FY06 to FY10 (Table 7) included birds that breed in Colorado all with estimated populations greater than a million, the Horned Lark, Western Meadowlark, Western Kingbird, and Lark Bunting. Thus, the average take of these species by WS was minimal considering their population. Cumulative take, combining the average WS and permitted take, and the maximum take for any year from FY06 to FY10 was below 0.1% of the breeding population. The average annual take of these species by WS and persons with a USFWS permit from FY06 to FY10 was 1,277 Horned Larks (high 3,566), 273 Western Meadowlarks (high 622), 307 Western Kingbirds (high 631), and 165 Lark Buntings (high 751). The high and average represent less than 0.1% of these species' breeding populations in Colorado and even less in the RMS area. Colorado WS of the WS Programs had the highest take for all of these species in RMS area. For example, Colorado averaged the take of 718 Horned Larks from FY06 to FY10. Arizona and Utah WS were the only other RMS programs that took Horned Larks, averaging 92 and 2 from FY06 to FY10. Thus the cumulative take in the RMS area would have been 812. This level of take would have no perceptible effect on the population estimated to be 20 million in the RMS area. Take would have to increase more than a thousand-fold before an impact from BDM may start to be noticeable, though not likely significant. WS anticipates that, at most, it is perceivable that take could increase a hundred-fold for these species depending primarily on the airports that request assistance from WS, or the number of private pest control operators or airport personnel involved in BDM to reduce wildlife hazards. Thus, at current levels of take, and even at potential levels of take, WS will not have more than an imperceptible impact on these species. Table 21 looks at the productivity of Horned Larks in Colorado based on their population parameters (Beason 1995) and the impacts from Colorado WS and USFWS permitted take on the Horned Lark population for Colorado. As discussed, the impact in the RMS area would be less.

Several other grassland bird species listed in Table C1 have estimated populations at least in the tens of thousands in Colorado (estimates using BBS raw data from 2006-10 using Rich et al. (2004) detectability parameters) including the Says Phoebe, Cassin's Kingbird, American Pipit, Savannah Sparrow, White-crowned Sparrow, McCown's Longspur, Dickcissel, Lesser Goldfinch, and American Goldfinch. Some species do not have breeding populations in Colorado. Some are only found in the eastern part of Colorado and mostly on the periphery of their range such as the Eastern Phoebe and Scissor-tailed Flycatcher. Some winter in or migrate through Colorado from northern areas, including Sprague's Pipit, American Tree Sparrow, Lapland Longspur, Snow Bunting, Black Rosy Finch, and Gray-crowned Rosy Finch. The only other species given in Table C1, the Brown-capped Rosy Finch, nests in Colorado, but in alpine areas where few BBS routes census. Their population is estimated from BBS data at 620, but

Audubon estimates their global population at 45,000 with most being in Colorado (NAS 2011a). The Sprague's Pipit, a candidate for the federal list of T&E species, has a population of 130,000 in Montana based on BBS data from 2006 to 2010 (USGS 2012). It also breeds east into North Dakota and north into Canada had an estimated population 900,000 (RMBO 2007) in North America from data in the 1990s, but has declined since. WS does not anticipate working with Sprague's Pipits, but possibly could since one has been struck at an airport in Colorado (Appendix D: Table D1).

Table 21. Cumulative impact analysis for Horned Larks killed in Colorado by WS and private individuals and entities under USFWS permits from FY06 to FY10.

HORNED LARK IMPACT ANALYSIS						
	FY06	FY07	FY06	FY09	FY10	Ave.
Estimated Colorado Breeding Population	6,800,000	6,800,000	6,800,000	6,800,000	6,800,000	6,800,000
% Breeding Females in Population	37.5%	37.5	37.5%	37.5%	37.5%	37.5%
Estimated Number Breeding Females	2,600,000	2,600,000	2,600,000	2,600,000	2,600,000	2,600,000
Ave. Clutch	3.0	3.0	3.0	3.0	3.0	3.0
Ave. Nests	2.0	2.0	2.0	2.0	2.0	2.0
% Fledge for All Nests	23%	23%	23%	23%	23%	23%
Young Produced/ Stable Pop. Ann. Mort.	3,600,000	3,600,000	3,600,000	3,600,000	3,600,000	3,600,000
Post-breeding Population	10,400,000	10,400,000	10,400,000	10,400,000	10,400,000	10,400,000
Colorado WS Take	33	35	729	811	1,225	559
WS Take % of RMS Ann. Mort.	0.00%	0.00%	0.02%	0.02%	0.03%	0.02%
Private Take in Colorado	0	218	100	931	2,341	718
Total Take	33	253	829	1,742	3,566	1,277
% RMS Post-breeding Pop.	0.00%	0.00%	0.01%	0.02%	0.03%	0.01%
% of RMS Ann. Mortality	0.00%	0.01%	0.02%	0.05%	0.10%	0.04%

WS did not take any of the other grassland species from FY06 to FY10, but USFWS permitted the take of an average of 13 Brewer's Sparrows, 1 Say's Phoebe, and 1 American Tree Sparrow. Thus, BDM take has been minimal or nonexistent for all of these species and is expected to continue to be minimal. The take of 1,000 cumulatively of any of these species in the RMS region would not impact any of these species' populations overall. WS does not anticipate taking many of these species, especially the Sprague's Pipit and Rosy Finches, but expects potential take could possibly reach 5 in a given year. This level of take would have no perceptible impact on the population. To illustrate this with the Sprague's Pipit, if the population has a sex ratio of 1:1, and 75% of the females breed, they produce an average of 4.4 eggs/nest, nest 1.5 times/season, fledge 1.4 young per season (Robbins and Dale 1999), then the estimated annual mortality would be 100,000 for the RMS region (based on the population in Montana of 130,000). The take of 5 would less than 0.1% of the estimated annual mortality in a stable population, or negligible impact to the population. However, WS does not anticipate that this would level of take would occur, only theorizes the potential impact of such a take. This illustrates that impacts to grassland species' populations would be negligible if minimal numbers were taken with the Sprague's Pipit representing a species with a low population.

Of the grassland species from that WS expects could be part of a BDM project (Appendix C: Table C1), the Sprague's Pipit, Lark Bunting, McCown's Longspur, and Dickcissel are Birds of Conservation Concern (USFWS 2008). The Sprague's Pipit is being considered for ESA listing (FRN Vol. 74, No. 231:63337-43, Dec. 3, 2009) and reflects the significant declining trend in this species' population. Loss of grassland habitat is believed to be the primary cause for the decline for many of the true grassland-associated species including all of the Species of Conservation Concern discussed. Thus, the populations will decline if the loss of grasslands continues regardless of any BDM conducted for them because the population is limited by habitat. WS concludes that BDM will have no more than an imperceptible impact on any of the grassland species even if take were to increase

Waterfowl

Many species of waterfowl are present during some portion of the year in Colorado with most during migration and winter coming from northern breeding grounds including 19 ducks, 5 geese, 1 swan, 1 coot, and 1 crane. Of these, 16 species of waterfowl commonly breed in the State and are documented on BBS transects: the Canada Goose, Gadwall, American Wigeon, Mallard, Blue-winged Teal, Cinnamon Teal, Northern Shoveler, Northern Pintail, Green-winged Teal, Redhead, Ring-necked Duck, Lesser Scaup, Common Merganser, Ruddy Duck, American Coot, and Sandhill Crane (USGS 2012). Four other species have been documented on BBS routes prior to 2006 in Colorado including the Wood Duck, Canvasback, Bufflehead, and Hooded Merganser, but only in minimal numbers. In addition, Colorado has 15 species of ducks, swans, and geese and 2 gallinules that are accidental in the State. Conservation efforts over the last several decades such as closely regulating hunter harvest, slowing the loss of wetlands, and improving the quality of wetland habitat have helped reverse declining numbers in the early to mid-twentieth century for many waterfowl species. In response to the conservation efforts of wildlife managers, sportsmen, conservationists, and others, waterfowl populations, particularly Canada Geese, Snow Geese, Ross's Geese, and Mallards, have flourished in recent years. These species of waterfowl, especially the midcontinent populations of geese, are considered "overabundant" and cause extensive damage to natural resources (Snow Geese are damaging their breeding grounds from their sheer numbers), agricultural crops, property, and other resources, and can pose a threat to human health and safety, especially at airports. Of the 44 species that have been found in Colorado, including accidentals, any could be associated with a BDM project at an airport, but few actually damage other resources such as agricultural crops. WS lethally took only 8 species of waterfowl from FY06 to FY10, and only Canada Geese and Mallards had an average of more than 10 during this time. Most all have been for the protection of airplanes and their passengers at airports, though a few were collected for disease surveillance projects; migratory waterfowl are good to monitor for disease such as AI because they breed in areas (*e.g.*, Alaska) where they mingle with waterfowl that potentially come from other parts of the world. It should be noted that any of the 50 of any of these species could be involved in BDM and could be taken, though the 5 year averages in Tables 7 and 9 give a good indication of which species and the number that would be involved in BDM projects.

Of the 16 species that currently breed in Colorado and the 4 others that bred in Colorado (probably still do, but have not been seen during BBS counts) and the survey-wide BBS area (including Sandhill Crane, American Coot), only the American Wigeon (-3.6%/yr.), Northern Pintail (-2.9%/yr.), and Lesser Scaup (-2.6%/yr.) have seen significant declines from 1966 to 2009 (Sauer et al. 2011). On the other hand, the Canada Goose (10.9%/yr.), Wood Duck (2.4%/yr.), Gadwall (2.4%/yr.), and Sandhill Crane (5.3%/yr.) have seen significant increases from 1966 to 2009 (Sauer et al. 2011). The remaining waterfowl have shown nonsignificant increases or losses. In Colorado, the Canada Goose (9.6%/yr.) and Common Merganser (4.5%/yr.) are the only species showing significant positive trends. In all, most waterfowl populations are doing very well despite annual harvests from sportsmen in the thousands, a much higher percentage of the population than the cumulative impacts discussed thus far in this document. Hunters annually harvest a much higher percentage of the estimated population (1-50%) than WS take (<1%) (Table 22), but most populations have remained relatively stable or increased. This level of take gives a good indication of the low impact of BDM on these species and what the level of cumulative take bird populations can withstand. Table 22 gives estimated waterfowl populations for different areas, their average harvest in the estimated population area, the average annual take for FY06 toFY10 by WS in the RMS area and the average annual USFWS permitted take for 2006 to 2010. It also gives the cumulative impact percentage for all take on their populations and the depredation percent take compared to hunter harvest. Depredation take (WS and permitted take not including sportsman harvest) did not exceed 0.1% of the harvest except for Canada Geese (0.17%), merganser species (0.58%) and American Coots (0.41%); the first causes the most damage of all the waterfowl, primarily in urban areas and the latter two are not highly sought after game birds, thus minimal take represents a higher percentage (Table 22). However, the take of waterfowl by WS is an imperceptible percentage of the total take and an unnoticeable impact on the population (cumulative depredation take was typically much less 0.1% of the population in the RMS region).

Table 22 also includes an estimate of the maximum potential take by WS for waterfowl. The species that Colorado WS anticipates taking the most are Canada Geese and Mallards, the species most associated with damage in Colorado other than at airports and are often taken to reduce their damage. However, WS averaged lethally taking 139 and 65 from FY06 to FY10, a minimal number. The most work tasks (WTs) associated with waterfowl (ave. 630) from FY06 to FY10 were for Canada Geese (53%), Mallards (31%), Blue-winged Teals (4%), and American Coots (3%) (Table 1). However, the species with the highest averages of being hazed from FY06 to FY10 (Table 8) were Canada Geese (75,000/yr.), Sandhill Cranes (600/yr.), and Mallards (600/year) with most all of these at airports. Thus, several species of waterfowl have the potential to be involved in BDM in Colorado and some can be taken as indicated in Table 7. WS anticipates that take will remain fairly minimal, especially in comparison to hunting harvest. WS believes that, for the most part, the maximum take will be less than 1% of the average harvest in Colorado. The primary exception would be coots and mergansers which are not hunted at the magnitude of other waterfowl, and Canada Geese as they have the potential to cause excessive damage, especially at airports and in urban areas where "resident" populations stay in areas where hunters cannot harvest them.

Table 22. Estimated waterfowl populations for the United States and Canada (USFWS 2008b), hunter harvest (USFWS 2008a), and potential WS take (note: any average greater than 0 = 1).

Annual Average Harvest/Take from 2006 to 2010								
Species	Est. Breeding Pop. Central/ Pacific Flyway Unless Noted	Hunter Harvest Central/ Pacific Flyway	CO Hunter Harvest	WS RMS. Take	RMS USFWS Permit Take	Cum. Impact % of Estimated Pop.	WS & USFWS Permit Take % Harvest	Potential Colorado WS Maximum Est. Annual Lethal Take
Greater White-fronted Goose[1,3]	675,000	26,024	262	0	0	3.9%	0.00%	5
Snow Goose[1]	136,000	27,546	7,014	7	0	20.3%	0.03%	50
Ross' Goose[1]	68,000	6,350	2,775	0	0	9.3%	0.00%	10
Canada Goose	451,000	347,167	75,512	234	345	51.1%	0.17%	500 (2000#)
Cackling Goose	230,000							100
Wood Duck[2]	4,600,000	110,780	1,851	1	0	2.4%	0.00%	5
Gadwall	2,988,000	605,093	9,633	5	5	20.3%	0.00%	50
American Wigeon	2,472,000	628,951	7,018	8	0	25.4%	0.00%	100
Mallard	8,050,000	2,010,981	56,666	134	492	25.0%	0.03%	1,000
Blue-winged Teal	6,584,000	354,589	8,472	2	10	5.4%	0.01%	100
Cinnamon Teal				3	4			
Northern Shoveler	4,035,000	417,589	3,434	2	1	10.3%	0.00%	50
Northern Pintail	3,214,000	393,765	1,692	6	1	12.3%	0.00%	50
Green-winged Teal	3,075,000	893,912	9,862	3	7	29.1%	0.00%	50
Canvasback	658,000	45,352	342	0	0	6.9%	0.00%	5
Redhead	1,018,000	102,848	1,865	1	0	10.1%	0.00%	10
Ring-necked Duck	618,000	132,548	2,024	4	3	21.4%	0.01%	10
Greater Scaup	128,000	20,425	78	1	0	16.0%	0.00%	1
Lesser Scaup	3,643,000	81,038	384	2	27	2.2%	0.04%	10
Bufflehead[1]	987,000	55,761	596	0	15	5.7%	0.03%	10
Goldeneyes	418,000	40,645	1,848	0	16	9.7%	0.04%	10
Merganser spp.[1]	233,000	19,459	320	0	113	8.4%	0.58%	10
Ruddy Duck	633,000	14,103	190	0	0	2.2%	0.00%	5
Scoter spp.[1]	526,000	6,276	18	0	0	1.2%	0.00%	1
American Coot[1]	2,352,000	55,600	700	146	82	2.4%	0.41%	1,000
Sandhill Crane^	502,000	37,738	90	0	0	7.5%	0.00%	10

[1] Harvest estimates for Central and Pacific Flyways in United States; duck and goose harvest estimates include SK and AB from USFWS (2008, 2010, 2011); coot estimate for RMS region only. Population Estimates from USFWS database (includes USFWS Waterfowl Strata 13-18, 20-23, 25-49, 75-77) Note: Population estimates only include estimates from the standard sampled USFWS tiers in North Dakota and above; excludes lower U.S. which misses breeding pop. of Canada Geese and Mallards in lower states.

[2] Continental Population (NAS 2011b) [3]Fall Mid-continent population estimate (USFWS 2009) #"Resident" Canada Geese.

^ Midcontinent and Rocky Mountain populations (the midcontinent population is hunted in Colorado, no season on the Rocky Mountain population). The midcontinent population estimate and harvest for the Central Flyway includes eastern portions of CO, MT, NM, and WY, KS, ND, OK, SD, TX (no harvest in NE), and Canada, and harvest only in AK, AZ, MN, and Mexico; and the Rocky Mountain population includes the RMS States (no hunting in Colorado). Population estimates came from surveys for 2006-2010 (no survey was conducted for Rocky Mountain population in 2006 so 2005 data was used), and the hunting seasons included the 2006-2010 hunting season.

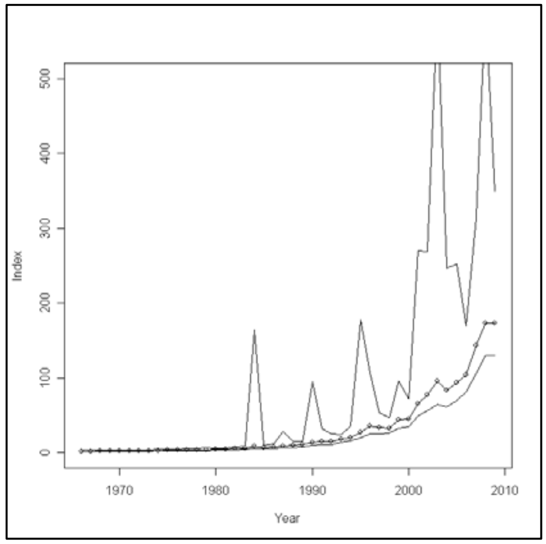

Figure 16. The Canada Goose BBS survey-wide population trend shows exponential growth in the survey area (*from* Sauer et al. 2011).

Canada and Cackling Geese. Canada Geese were recently split into 2 species, the Canada Goose and smaller Cackling Goose. BBS and other data did not separate these species until just recently. However, the Cackling Goose breeds mostly north of the BBS limit and, thus, the numbers in the BBS are those of Canada Geese. However, data for the 2 species were mostly combined in the CBC and will be for the purposes of this analysis (the "residents" are Canada Geese only). Of the waterfowl species, a significant increase has occurred with Canada Geese (Figure 16) at 7.3%/year (P<.01) from 1980 to 2007 (Sauer et al. 2008) survey-wide.

The establishment of Canada Geese has occurred throughout the United States, primarily from introduction and transplant programs (Oberheu 1973, Blandin and Heusmann 1974, Ankney 1996, Mowbray et al. 2002). These programs were very successful and Canada Geese established large "resident" populations in many urban centers in the continental United States, creating an increased number of conflicts between human interests and geese (Conover and Chasko 1985, Hindman and Ferrigno 1990, Ankney 1996). USFWS identifies "resident" Canada Geese as those nesting in any of the months from March to June or residing in any months from April to August within the lower 48 states and the District of Columbia (Fed. Reg. Notice 71(154):45964-45993). USFWS has provided a depredation order for Canada Geese and landowners that register with USFWS can take nests and eggs of Canada Geese to resolve or prevent injury to people, property, agricultural crops, or other interests (50 CFR 20 and 21). WS could be requested at any time to remove a significant portion of a "resident" population that has become too abundant and associated with excessive damage and health concerns such as in parks, at golf courses, and in residential areas. These geese are typically euthanized and could increase WS take. WS in many other State Programs have removed hundreds of "resident" geese to resolve conflicts, but Colorado has removed relatively few considering the Colorado "resident" population. Canada Geese have caused catastrophic incidents at airports such as that at Elmendorf Air Force Base. In 1995, a Boeing 700 AWACS jet taking off from Elmendorf Air Force Base in Alaska ingested geese into 2 engines and crashed, killing all 24 crew members and destroying the $180 million aircraft. The removal of geese in urban areas will not have significant on their population, as the population because it is above the desired number in the RMS region (USFWS 2004, 2005, 2006a).

WS has conducted BDM for a few overabundant resident Canada Geese, primarily in urban areas where they were causing excessive damage. However, several projects have also been done for migratory Canada/Cackling Geese, all but a few at airports where they were a wildlife hazard. Other projects involved associated damage at a water treatment plant and human safety where nesting geese were attacking pedestrians/bicyclists when they neared the nest. WS averaged the take of 143 from FY06 to FY10, a minimal number that would not impact the population. These mostly came from the "resident" population. WS has also hazed Canada Geese from FY06 to FY10, more than any other species except Red-winged Blackbirds (75,000 annually), primarily at airports.

Of all waterfowl, WS anticipates that BDM could be conducted most for "resident" Canada Geese with WS possibly taking up to 2,000 in the future (many WS programs have been requested to cull a few thousand as the populations have increased exponentially). Following a similar pattern to other areas where geese were introduced or transplanted, WS could be requested to conduct "culling" to reduce populations considered overabundant, especially in parks and at golf courses with considerable damage.

The estimated population of "resident" Canada Geese in Colorado is 18,000 (USFWS 2011) and found mostly in cities along the Front Range, though they are increasingly common in western Colorado (Figure 17). Canada geese have 1 nest per year, average 5.6 eggs per nest, start breeding as 2 year olds (3rd year), with 2 year olds having 0.58 goslings fledge/female and 4 year olds or older having 2.1 goslings fledge/female (Mowbray et al. 2002). Data was unavailable on age structure, but assuming that 20% of the population are nonbreeding first year geese, 10% of the population are second year geese, and 70% of the population are 3+ years (Canada Geese are long-lived with the oldest banding record at just over 30 years old (Klimkiewicz 2008)), and that third year geese have similar gosling numbers as fourth year geese, then a breeding population of 18,000 Canada Geese would recruit 13,700 goslings into the population annually. This would be about 43% and 57% goslings and adults in the population. In Nevada, a translocation program captured 11,400 geese from 1986 to 2001 comprised of 40% goslings and 60% adults captured (Hall and Groninger 2002). However, data from Nevada showed that as the population of geese was reduced in urban areas, the number of goslings in the population increased to over 50% (T. Hall, WS, *unpubl. data*). Thus, the take of 2,000 geese would represent 15% of the annual mortality or 6% of the total population which is not expected to impact the population. WS would coordinate removal efforts with CPW to determine if they wanted to translocate the Canada Geese to a wildlife management area as this has been shown to be successful (Hall and Groninger 2002), but could move problems to other areas of the state (*e.g.*, Canada Geese damage urban landscaping could be moved to a wildlife management area where close by crops would become damaged). However, WS believes that it will take relatively few geese to resolve problems, but could in urban areas where their population is abundant; most of these projects are conducted in June and early July when geese are flightless.

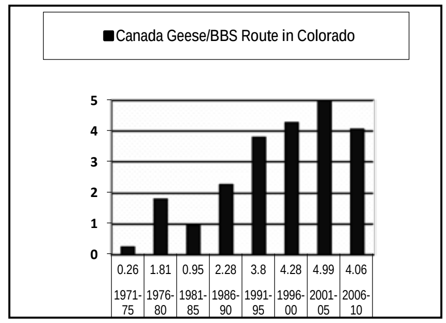

Figure 17. The average number of Canada Geese found on BBS routes in Colorado for 5 year intervals from 1971 to 2010 (USGS 2011).

Cumulative take for Canada and Cackling Geese in the Central Flyway appears high at 51% of the breeding population (Table 21), but the population estimate does not include resident Canada Geese or production. Population estimates are made from surveys conducted from South Dakota and parts of Montana north. This excludes production in Wyoming through Nebraska and south. USFWS (2011a) had average estimates for 1998-2000 for the remaining states (CO, KS, MT, NE, NM, OK, TX, WY) in the Central Flyway of 410,000 which was projected to be 780,000 in 2010 at the current rate of growth (this does not include the Pacific Flyway, but the harvest comes from both). The "resident" geese are also harvested during the hunting season, often close to where they reside (these typically do not migrate like those that breed in northern Canada). Thus, this would reduce the percentage. Additionally, a breeding population of 681,000 would have 518,000 goslings using the population parameters from above. Thus, take in the Central and Pacific Flyways region without using the "resident" population would be 67% of the annual mortality for a stable population or 29% of the conservatively estimated post-breeding population. This would be less than what would be expected to reduce the population. BBS trend data (Sauer et al. 20011) survey-wide and in Colorado shows a significant (P<0.05) increase of 10.9%/yr. and 9.6%/yr. from 1966 to 2009, which reflects the notion that the population is conservatively estimated and harvest combined with depredation take is not significantly affecting the population. In fact, the population has grown exponentially from 1966 to 2009 (Figure 16). WS believes that take depredation could increase several fold in Colorado without impacting the population. Even the take of several thousand by WS in Colorado, most would be "resident" Canada Geese in urban area which will not have an effect on their population.

Snow, Ross's, and White-fronted Geese. The Snow and Ross's Geese are very similar in appearance and are separated by size, the Ross's Goose being smaller with a few morphological differences such as a stubby bill. These species breed primarily in the arctic or subarctic tundra in habitat that is relatively featureless (few trees). The west Central Flyway population of these geese is considered abundant, but the Mid-continent population is considered overabundant (USFWS 2004). Their populations have had serious ecological impacts on their nesting grounds, the Arctic tundra, and USFWS has instituted very liberal hunting seasons for them. WS took an average of 7 Snow Geese from FY06 to FY10. However, all Snow Geese taken were during one project where WS was to collect Snow Geese for a national interagency effort to monitor for the H5N1 avian influenza virus nationwide. Specific samples were to be collected for this effort (mainly birds that nested in the arctic and had the opportunity to intermingle with birds from Asia where the virus had been found). WS collected 34 snow geese for the disease surveillance project. No other Snow Geese were taken in this time frame. It is anticipated that WS could take some lethally, especially to reinforce hazing programs protecting crops and airplanes, but take of Snow Geese will be minimal, especially considering their overabundant population. However, the take of several thousand of either species could occur at the request of USFWS to stop irreparable damage to their breeding grounds. USFWS would determine the desired population baseline and WS take would be within the desired level of take predetermined not to impact the human environment.

The Greater White-fronted Goose is an arctic and subartic tundra breeder, but also nests in the taiga of northern Canada in areas with willow and spruce. Similar to other geese, they are most likely to cause problems at airports. Their population appears to have increased in the 1980s-90s (Ely and Dzubin 1994), but fairly stable in recent years averaging 710,000 in fall surveys from 2006-2010 in the Mid-continent area (USFWS 2011). WS has not conducted lethal control for this species, but anticipates that such could happen and would take a maximum of 10. This level of take would not have a noticeable impact on this species.

Mallards, American Wigeons, and Other Ducks. WS in the RMS area took minimal numbers of ducks. Mallards and wigeons cause similar damage to Canada Geese, primarily to landscaping, greens on golf courses, and water quality. Mallards, in particular, use swimming pools and other landscaped water features and can foul these impoundments. Generally, these are hazed from damage situations, but Mallards in particular, habituate rapidly to hazing methods without lethal reinforcement. Mallards (134) and American Wigeon (8) were the most commonly taken species in the RMS area by WS, but Mallards (492) and Common Mergansers (112) were the most under USFWS permits. This is a minimal take compared to their population and hunter harvest. WS and USFWS permitted depredation take, in comparison to hunter harvest is a relatively small percentage of the combined take. WS and permitted take in the RMS area was less than 0.1% for all species except Canada Geese (0.17%), Merganser spp. (58%), and American Coots (0.41%) (Table 21). It is doubtful that WS in the RMS area or Colorado will ever remove more than a few hundred Mallards and fewer wigeons for BDM, but it is anticipated that WS could potentially take a 1,000 Mallards and 100 wigeons (Table 21). These numbers represent a minimal percentage of their populations and, if taken, would have an unnoticeable effect on their populations. In fact, WS could take increase these maximums at least ten-fold without having an impact on the population. WS has hazed many of these species, but did not capture and release any of these species. WS activities had virtually no impact on their populations.

WS has lethally taken minimal numbers of other ducks and will have minimal impact on any of these species. For example, WS took minimal numbers of Lesser Scaups, an average of 1. This species is a bird species of management concern (USFWS 2008). This species is a year-round resident in most appropriate habitat in Colorado and much of the RMS region (most migrate south during winter, especially from northern states). During this time WS averaged the take of 2 from FY06 to FY10 with no USFWS permitted take during this time. WS in Colorado had a maximum of 5 in FY09 which represents 1.3% of the average annual harvest. This is negligible in terms of impact to the population. The same is true of the other ducks given in Table 21 and any others given in Appendix C: Tables C1 and C3 that WS did not conduct work tasks for or take such as the Canvasback or merganser species (WS expects that take would ever be minimal for these other species as reflected in none being taken in Tables 10 and 21and not likely to exceed a few). WS is more likely to haze most with taking only a minimal number. The anticipated take for the other species of ducks is expected to be a maximum between 10 and 100. This level of take will be insignificant in terms of their respective populations (Table 21). It should be noted that many species of ducks, especially those that breed in Arctic areas where some birds from Asia or Europe mingle with them, could be collected to sample for international diseases such as H5N1 highly pathogenic avian influenza. This could increase the level of take during a given year depending on the species targeted for collection. However, as possible, data would be collected from hunter harvested ducks or with capture and release methods instead of WS harvesting these as has been the methods used to take samples in the last few years.

Coots and Gallinules. WS in the RMS area took minimal numbers of coots and did not have work tasks associated with the other species. American Coots cause similar damage to Mallards, primarily to landscaping, greens on golf courses, and water quality. Generally, these are hazed from damage situations, but coots in particular, habituate rapidly to hazing methods without lethal reinforcement. American Coots (ave. 149 from FY06-FY10)) was the only species taken in the RMS area, the other gallinules were not. This is a minimal take compared to their population and hunter harvest. It should be noted that coots are not a highly sought gamebird in Colorado and the RMS area and, thus, hunters harvest relatively few coots in comparison to their population (Table 21) as compared to the ducks and geese (Brisbin and Mowbray 2002). WS and USFWS permitted depredation coot take in the RMS area was 0.4% of the cumulative take which includes hunter harvest, the most significant take (Table 21). The higher coot percentage, as compared to ducks, illustrates their minimal take as a game species. It is doubtful that WS in the RMS area or Colorado will ever remove more than a few hundred coots in BDM, but it is anticipated that WS could potentially take 1,000. This number represents a minimal percentage of their populations which would be unnoticeable to their population. In fact, WS could take could increase this maximum at least ten-fold without having an impact on the population. WS anticipates that neither of the other species will likely be taken, because they are fairly sedentary in marshes and cause minimal problems. However, WS anticipates that a few may be taken at airports, golf courses, or other areas where they have caused damage from feeding. Thus, we believe we will have no impact on their population.

Cranes. Sandhill cranes are common migrants in fall and spring in Colorado with some breeding in the mountain valleys of central-western Colorado. Cranes can be an airport hazard or damage crops. Their population survey-wide and in Colorado has significantly ($P<0.05$) increased from 1966 to 2009 at 5.3%/year and 22.6%/year (Sauer et al. 2011); the increase in Colorado only represents data for a relatively small population, thus the increase would be large. In many states, Sandhill Cranes can be hunted, including Colorado. From the 2006 to 2010 hunting seasons, about 38,000 were harvested in the Central Flyway and Rocky Mountain populations (Table 21). Harvest in Colorado by sportsmen was minimal and averaged about 0.2% of this (USFWS 2011d). WS in the RMS area took no cranes from FY06 to FY10, but could as they have been hazed at airports and crop fields during this time. WS has been able to haze them effectively. WS in the RMS area hazed many from damage situations and anticipates that hazing as the primary method to remove them from damage situations will continue; New Mexico WS hazed an average of over 100,000 annually from FY06 to FY10 in a program to protect crops in the Middle Rio Grande Valley. WS anticipates that a maximum of 100 would ever be taken by WS which is less than 1% of the cumulative take.

It must be noted that WS could always "take" a Whooping Crane. Since this is an endangered species, take includes hazing. The most likely reasons for "take" would be to haze them from an airport or contaminated site such as an oil spill. These would serve to protect this species from potentially being killed and, thus, beneficial in the long term (they would temporarily be impacted from being harassed). This would require a permit from USFWS which WS would obtain. Therefore, WS believes that it would not impact this species, but potentially provide a benefit if it is successfully hazed from a harmful situation. Additionally, Whooping Cranes, aside from the failed nonessential experimental population from Gray's Lake NWR which is now nonexistent, have only rarely been found to pass through eastern Colorado.

Corvids

All species of corvids (crows, ravens, magpies, and jays) have the potential to cause damage to resources, but only a few species do routinely in Colorado, ravens, magpies, and crows. The Common Raven, American Crow, and Black-billed Magpie are commonly found in Colorado and the species most likely to cause damage resulting in requests for assistance from WS for damage to agriculture and protection of human health safety at airports. Common Ravens cause the most consistent problems (mostly livestock predation, but also other resources) and have been the focus of several BDM projects. American Crows have also been the focus of BDM projects because they often damage crops such as nut crops and congregate in large numbers that are a nuisance or cause damage at feedlots. Periodically, crows are also responsible for livestock predation. Large numbers can be taken during a single BDM project, primarily during winter when large flocks form. The Chihuahuan Raven in southeastern Colorado also causes damage, but much less so. Jays have rarely caused problems in Colorado, but have the potential to do so. Jays include Steller's, Blue, Western Scrub, and Gray Jays and Clark's Nutcracker. WS does not anticipate that lethal take for these species will change and would only expect to take a few individuals of the different species if BDM were conducted for them. However, many corvid populations are increasing with increasing urbanization (Marzluff et al. 2001), and damage and subsequent BDM actions could increase. WS anticipates that it could take any of the corvids given in Appendix C: Table C1, but will likely be for the 3 species typically taken. .

Common Ravens. 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 1999). In Colorado, Common Ravens, are found mostly from the Front Range and west, but in winter can be seen in eastern areas. In some parts of its range, most areas of the western United States, the Common Raven population has expanded rapidly to densities much higher than historical densities (Boarman 1993, Restani and Marzluff 2001). Coinciding with their population increase has been a dramatic increase in raven damage and programs to manage such. In other parts of its range, the population declined so drastically (Appalachians) in the past that reintroduction programs were implemented. The raven is an omnivorous species known to feed on carrion, crops, eggs and birds, small mammals, amphibians, reptiles, fish, and insects. Ravens are 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, Wade and Bowns 1982). Other agriculturally related raven complaints received by WS have included eating livestock feed and feeding on grains, pecans, and other crops. Non-agricultural property damage complaints received by WS have included damage to electrical lines, power outages, buildings, landscaping, and other structures. Health related complaints have included turning garbage containers over and strewing its trash, and carrying trash from landfills into nearby residential areas. 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 (*Brachyramphus marmoratus*), and Least Tern (Boarman and Heinrich 1999, Liebezeit and George 2002), and the Gunnison's Sage-Grouse. Thus, a reduction of ravens in some areas of the country is seen as desirable to protect the T&E species such as the Sage-Grouse, a T&E species in Colorado.

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). In some areas of the West, the raven population has increased as much as 7000%. As a result, WS' Western Region has seen an increase in raven complaints over the last several decades.

In most areas, ravens are year-round residents with little evidence of migration from radio-tagged or marked populations in North America (Goodwin 1986, Boarman and Heinrich 1999). However, the species has been known to move into areas just outside its range during 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 1999). Floaters are primarily immature and non-breeding birds (i.e., fledgling, 1 and 2 year old birds) that typically will band together in flocks of 50 or more. These flocks tend to be loose-knit and wide-ranging (Goodwin 1986). Ravens do not breed until their third year, though some unsuccessful attempts to nest have been documented for 2-year old birds (Boarman and Heinrich 1999). Common Ravens have one nest per year, renesting if the first attempt fails, with a typical clutch size of 3 to 7, averaging 5.3 (Boarman and Heinrich 1999). Age structure in raven populations is unknown, but it is assumed for this analysis that "floaters" or subadult birds make up 34% of the population as with crows. Fledgling success (number fledged/egg) varied, but the lowest in a Wyoming study was found to be 31% (Boarman and Heinrich 1999). Using these parameters, an estimated breeding population of 71,000 in Colorado (Table 4; Appendix A: Table 8) would annually fledge about 30,000 ravens (Table 25).

Table 23. Cumulative impact analysis for Common Ravens killed in Colorado by WS, and private individuals and entities (estimated) from FY06 to FY10.

COMMON RAVEN IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated CO Breeding Population	71,000	71,000	71,000	71,000	71,000	71,000
% Breeding Females in Population	25%	25%	25%	25%	25%	25%
Breeding Females	18,000	18,000	18,000	18,000	18,000	18,000
Ave. Clutch	5.3	5.3	5.3	5.3	5.3	5.3
Ave. Nests	1	1	1	1	1	1
% Fledge	31%	31%	31%	31%	31%	31%
Young Fledged/Stable Pop. Ann. Mort.	30,000	30,000	30,000	30,000	30,000	30,000
Total CO Population	100,000	100,000	100,000	100,000	100,000	100,000
WS Take	61	122	36	104	65	78
WS Take % of CO Ann. Mort.	0.2%	0.4%	0.1%	0.3%	0.2%	0.3%
Private Take in TX	209	192	4	66	285	151
Total Take	270	314	40	170	350	229
% CO Post-breeding Pop.	0.3%	0.3%	0.0%	0.2%	0.4%	0.2%
% of CO Ann. Mortality	0.9%	1.0%	0.1%	0.6%	1.2%	0.8%

The numbers that might be taken by WS under the proposed action or Alternative 1 are relatively minor. WS anticipates that it could potentially take up to an estimated 2,000 annually (about 7% of the expected annual mortality) especially because the population has increased, but the take between FY06 and FY10 would likely be more realistic which averaged 78 with a high of 122 or 0.4% of the expected annual mortality (Table 25). Cumulatively, WS anticipates that private individuals would take potentially up to 1,000, but USFWS recorded an average of 151 between 2006 and 2010. In total, potential cumulative take would represent about 10% of the expected annual mortality, but averaged 0.2% between FY06 and FY10. These numbers are well within normal mortality levels for this species. It should be noted that West Nile virus has been documented in Colorado and probably caused additional mortality on the corvid population. Now that it has been in the state for a few years, it is expected that corvids will develop some resistance to the disease. WS has no way to determine the level of impact this disease has had, but looking at BBS trend data, it is believed that it has not been a significant limiting factor because the population has been increasing significantly ($P<0.05$) in Colorado from 1999 to 2009 at 2.2%/yr. and significantly ($P<0.05$) at 2.7% and 2.6%/year from 1966 to 2009 in Colorado and survey-wide (Sauer et al. 2011). WS believes that the Common Raven population has not been impacted at the population level by WS BDM in Colorado and that take will continue to be very minor portion of their expected annual mortality.

American Crows. The American Crow population has increased throughout its range, especially in more urbanized environments and western states (Marzluff et al. 2001). American Crows are year-round residents in Colorado, but migration into or out of the State during fall and winter raises and decreases the local populations in several areas of the State. They are most common along the Front Range and in southern portions of Colorado, but are found throughout. Wintering numbers are variable from year to year which is reflected in the CBCs (NAS 2011b). Winter numbers likely are affected by climatic conditions such as colder winters in states further north or in Colorado. Crows can damage a variety of resources and are a wildlife hazard at airports because of their flocking behavior and larger size. Lethal methods employed by WS include shooting, DRC-1339, and cage traps with euthanasia. Lethal strategies are intended to reduce the population of crows causing damage where they have not successfully been deterred by nonlethal measures. The damage threat from crows, along with their abundance, was significant enough that a Depredation Order was issued by the USFWS to allow the take of crows "*when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance*" with no Federal permit (50 CFR 21.43).

In addition to WS's take, crows are taken by the public as a game species by hunters and under the authority of the standing Depredation Order to protect resources. However, WS has no measure of the number of depredating crows taken under the Order by private individuals, similar to blackbirds, because the reporting of take is not required. It is expected that some are taken, but not likely a substantial number because the public uses shooting as the primary method for control. Another mortality factor for crows is hunting harvest. However, not all states collect harvest information for crows and Colorado stopped reporting harvest in FY06. From the 2000-01 to 2004-05 (corresponds with FY01 to FY05), crow harvest annually averaged 1,815. In spite of these pressures from sport hunting and for resource protection, estimated trends from 1966 to 2009 have been positive with significant ($P<.05$) increases survey-wide at 0.3%/year and 1.7%/year for Colorado (Sauer et al. 2011). Their range expansion has been credited to their adaptability to altered habitats such as urban and agricultural landscapes (Verbeek and Caffrey 2002). The BBS survey-wide population of American Crows has been estimated at 31 million based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). Recent data (2006-2010) suggests the RMS population to be estimated at 720,000 with 160,000 in Colorado (Table 4, Appendix A: Table A9). Since crows are increasing significantly survey-wide, and in Colorado, it suggests that the population is not being impacted from hunting harvest and depredation take throughout the survey area. Take would have to be estimated for depredation and hunter harvest for the RMS. Since WS in Colorado took relatively few crows from FY06 to FY10, we decided to just look at the impact in Colorado (hunting harvest is hard to determine for all states in the RMS area). Using the average from the 2000-01 through 2004-05 October to January hunting seasons and assuming 2,000 are taken for depredation and nuisance by private individuals, we can determine impacts. It is expected that the take of crows in Colorado is similar to other states in the RMS region with the exception that some states have no hunting season established for crows. The annual average number of crows taken from FY06 to FY10 in the RMS region by WS was 1,710, less than the number of crows harvested in Colorado. Thus, it can be assumed that this is a minimal impact on the population because the RMS region has many more crows than in Colorado.

American Crows breed when they are two years old (third year). A population has been found to consist of 34% juveniles, many that form flocks with other nonbreeders or assist adults in raising nestlings (Verbeek and Caffrey 2002). For the sake of estimating the population for this EA, it is assumed that 66% of the estimated population are adults, that 75% of the adult females breed, the sex ratio is 1:1 males to females, females lay 3-7 eggs with an average eggs/nest of 4.5, and the average nests/season is 1 (Verbeek and Caffrey 2002)). About 37% of the eggs hatch and fledge. Using these parameters, the Colorado breeding population of 160,000 would have about 40,000 breeding females that successfully fledge about 67,000 nestlings, raising the post-fledgling population to about 230,000 American Crows. This would be an increase in the population by a factor of 1.4.

WS take between FY06 and FY10 is likely a fairly realistic take to expect by WS, though take at airports increased in FY09-FY10. The average take by WS from FY06 to FY10 was 10 with a high of 24 in FY09 or 0.04% of the expected annual mortality in that year (Table 24). Since WS has no way of knowing what the level of take is by private individuals, we could assume that hunter harvest is about 2,000 (slightly higher than the 5 year average from 2000-01 to 2004-05 hunting seasons) and that private depredation take is a maximum of 2,000. Thus, the cumulative impact from WS and private depredation take, and hunter harvest is 6% of the expected annual mortality (Table 24). This level of take would not impact the population and would be within a level of compensatory take. Even if the potential number of crows taken by WS under the proposed action or Alternative 1 in Colorado was 2,000, the impact on the expected annual mortality would be 9%, a very minimal impact on the total population. Thus, cumulatively, take is not expected to impact the population. These numbers are within normal mortality levels for this species and expected to be a low impact. However, we believe that these are overestimated numbers to be conservative and that the actual take and harvest will be well below the maximum of 6,000.

Table 24. Cumulative impact analysis for American Crows killed in Colorado by WS, other RMS WS Programs, and private individuals and entities (estimated) from FY06 to FY10.

AMERICAN CROW IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated Colorado Breeding Population	160,000	160,000	160,000	160,000	160,000	160,000
% Breeding Females in Population	25%	25%	25%	25%	25%	25%
Breeding Females	40,000	40,000	40,000	40,000	40,000	40,000
Ave. Clutch	4.5	4.5	4.5	4.5	4.5	4.5
Ave. Nests	1	1	1	1	1	1
% Fledge	37%	37%	37%	37%	37%	37%
Young Fledged/ Stable Pop. Ann. Mort.	67,000	67,000	67,000	67,000	67,000	67,000
Total Colorado Population	230,000	230,000	230,000	230,000	230,000	230,000
Colorado WS Take	2	1	0	24	21	10
CO WS Take % of RMS Ann. Mortality	0.00%	0.00%	0.00%	0.04%	0.03%	0.01%
Depredation Take in Colorado	2,000	2,000	2,000	2,000	2,000	2,000
Estimated CO Sportsmen Harvest*	2,000	2,000	2,000	2,000	2,000	2,000
Total Take in Colorado	4,002	4,001	4,000	4,024	4,021	4,010
% Colorado Post-breeding Population	2%	2%	2%	2%	2%	2%
% of RMS Ann. Mortality	6%	6%	6%	6%	6%	6%

It should be noted that West Nile virus has been documented in Colorado since 2002 and probably had corvid mortality associated with it. Since it has been in the state for a few years, it is expected that corvids will develop some resistance to the disease. WS has no way to determine the level of impact this disease has had, but looking at BBS trend data, it is believed that it has not been a significant limiting factor.

Another note is that American Crows can experience substantial reductions to their populations and show no effect at the population level. From 1934 to 1945, in an organized effort by the Oklahoma Game and Fish Commission, 127 crow roosts were removed in Oklahoma during winter. Almost 4 million crows were killed, but no evidence was obtained indicating an influence on total population levels during the period (Dolbeer 1986). In addition to this campaign, the hunting seasons for crows continued. Despite the attitudes of early in the 20th century that encouraged the complete extirpation of the American Crow, the birds continued to thrive.

Black-billed Magpies. Magpies frequently invoke requests for assistance from WS in Colorado, similar to complaints caused by ravens including predation of livestock and poultry, but Colorado WS takes relatively few. Magpies are found throughout Colorado with the densest numbers in foothills of the Rockies. WS anticipates that take will remain fairly minimal, but possibly increase to levels in the hundreds. Private individuals can take magpies causing damage, but there is not a sport hunting season on them. USFWS has established a Depredation Order for magpies and they can be taken without a permit if they are committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance. WS has no way of knowing how many magpies are killed annually by private individuals under the Depredation Order, but estimates that it could be as high as 10,000.

Similar to other corvids, magpies are fairly abundant in those areas that they occupy in Colorado. Estimated trends from 1966 to 2009 have been significantly ($P<0.05$) negative in Colorado at -1.2%/year and survey-wide at -0.7%/year (Sauer et al. 2011). The BBS survey-wide population of Black-billed Magpies has been estimated at 3,400,000 based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). Recent data (2006-2010) for the Colorado population rendered an estimate of 190,000. Looking at the population data, WS can estimate the annual mortality. Black-billed Magpies have one nest per year, renesting if the first or second attempt fails, with a typical clutch size of 6 to 7, averaging 6.5 (Trost 1999). Female magpies breed in their first year whereas the males in their second. For the sake of estimating the population for this EA, it is assumed that 75% of the magpie females breed and the sex ratio is 1:1 males to females. Fledgling success (number fledged/egg) varied, but was found to be 55% (Trost 1999). Using these parameters, an estimated breeding population of 190,000 in Colorado would annually fledge about 250,000 nestlings, the estimated annual mortality rate. WS took an average of 5 magpies from FY06 to FY10, which is obviously insignificant in terms of their estimated annual mortality. WS could take several thousand Black-billed Magpies without an impact on the population. WS anticipates that it will not exceed the take 1% of the estimated annual mortality. WS concludes, that even with implementation of lethal control for these magpies, WS will have a minor impact on them, at most.

It should be noted that West Nile virus has been documented in Colorado since 2002 and probably had corvid mortality associated with it. Since it has been in the state for a few years, it is expected that corvids will develop some resistance to the disease. WS has no way to determine the level of impact this disease has had, but looking at BBS trend data, it is believed that it has not been a significant limiting factor because the downward trend in Colorado has been continuous since the BBS began in 1967 in Colorado. Limiting factors appear related to inadequate nesting sites from development and habitat fragmentation associated with development of lands for housing and agriculture and possibly the use of certain pesticides (Trost 1999).

Chihuahuan Ravens. 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 in southeastern Colorado. Ravens are considered migratory birds and managed under the Migratory Bird Treaty Act by USFWS. WS responds to requests from livestock operators, airports, and others who experience depredation problems from ravens and work with USFWS to resolve damage complaints. WS did not take any Chihuahuan Ravens from FY06 to FY10, but possibly could. USFWS did not report any take under permits for Chihuahuan Ravens from 2006-2010. Thus, the cumulative take of this species was nil. These ravens are often taken for similar reasons as Common Ravens. It is anticipated that WS will take them in the future in BDM activities, but probably much less or equal to that of the Common Ravens.

Similar to Common Ravens, Chihuahuan Ravens are fairly abundant in those areas that they occupy in Colorado. Estimated trends from 1966 to 2009 have been positive, but with nonsignificant ($P>0.05$) increases for Colorado at 1.8%/year and survey-wide at 1.0%/year (Sauer et al. 2011). The BBS survey-wide population of Chihuahuan Ravens has been estimated at 370,000 based on BBS data from the 1990s (Rich et al. 2004, RMBO 2007). Recent data (2006-2010) for the Colorado population rendered an estimate of 7,300, low because of its limited range. Looking at the population data, WS can estimate the annual mortality. Much is unknown about the Chihuahuan Raven natural history (Bednarz and Raitt

2002). However, Chihuahuan Ravens have one nest per year, renesting if the first attempt fails, with a typical clutch size of 3 to 7, averaging 4.9 (Bednarz and Raitt 2002). Age structure in raven populations is unknown, but it is assumed for this analysis that "floaters" or subadult birds make up 34% of the population as with crows and Common Ravens. Fledgling success (number fledged/egg) varied, but was found to be 30% (Bednarz and Raitt 2002). Using these parameters, an estimated breeding population of 7,300 in Colorado would annually fledge about 2,600 nestlings, the estimated annual mortality rate. Thus, WS could take several hundred Chihuahuan Ravens before a moderate magnitude impact would be reached. WS anticipates that it will not exceed the take 10% of the estimated annual mortality. WS concludes, that even with implementation of lethal control for these ravens, WS will have a minor impact on them, at most.

Jays. Colorado hosts 6 species of jays that are fairly common and have the potential to cause damage. Of these, the Blue Jay in eastern Colorado, Western Scrub-Jay in western Colorado, and Gray and Steller's Jays in the mountains have the highest potential to cause problems, but rarely. The estimated population of different jays in Colorado based on data for 2006 to 2010 (USGS 2012) and detectability estimates from Rich et al. (2004) are 140,000 Pinyon Jays, 130,000 Steller's Jays, 130,000 Clark's Nutcrackers, 73,000 Western Scrub-Jays, 30,000 Gray Jays, and 11,000 Blue Jays. Of these, the Pinyon Jay, Western Scrub-Jay, and Steller's Jay are showing nonsignificant declining trends in Colorado from 1966 to 2009. BBS survey-wide, the Blue Jay and Pinyon Jay have significant (P<0.05) declining trends 1966 to 2009 at -0.7%/year and -3.7%/year, and the Gray Jay, Steller's Jay, and Western Scrub-Jay nonsignificant minimal declining trends (Sauer et al. 2011). The Pinyon Jay is listed by NAS (2007) as a species of concern. These species are thought to be declining mostly to habitat modifications and losses (Greene et al. 1998, Tarvin and Woolfenden 1999, Curry et al. 2002, Balda 2002, Strickland and Ouellet 2011) and possibly impacts from predators such as ravens (Balda 2002) and global warming (Strickland and Ouellet 2011). More recently, West Nile virus impacted corvids including jays to some unknown degree.

Most species of jay could be the focus of a BDM project to protect crops such as nuts and fruits. Most occur in habitats (woodlands) not associated with airports, and thus minimal activity is expected to protect aircraft. Finally, some jays, especially the Western Scrub-Jay, are known to attack people when they near their nest; this is usually only a problem when they occur in residential areas and at businesses. WS anticipates that it could take as many as 100 of any of the jays to protect different resources, but this would have minimal impact on the population (<1% of the breeding population). However, WS has not taken any jays from FY94 to FY10, but anticipates that a request could occur because they are known to cause damage. WS did not receive any requests for assistance for these species from FY06 to FY10, but did once from FY94 to FY05 (this shows the minimal problems they are associated with in Colorado). WS could potentially be requested to assist with these species, especially at airports where they are a strike hazard, especially for airports adjacent to woodland forests. However, it is anticipated that WS would take less than 10 of any of these species, but could easily go to the maximums if necessary. Even at levels as high as 100, WS does not believe it will have more than a minimal impact on any of these species. It should be noted that USFWS did not issue permits for these species with reported take from 2006 to 2010, again reflecting the minimal potential for problems with these species.

Raptors

Colorado has many species of raptors (vultures, buteos (hawks with broad wings), falcons, kites, accipiters (forest falcons), harriers (marsh hawk), eagles, owls, and shrikes). Most species rarely cause damage with the primary exception that most are a strike risk at airports, others take livestock and poultry, and a few attack and strike people that near their nests (see Appendix C: Table C1 for a list of species and those that cause damage). The most common problem species with the highest number of work tasks associated with them (> 100 from FY06 to FY10) were Red-tailed, Ferruginous, and Swainson's Hawks, and Northern Harriers (Table 2). In addition to these, 16 other raptors have had work tasks associated with them from FY06 to FY10 (Table 2). It should be noted that some species such as screech-owls may have work tasks associated with them, but may not be a result of actual damage. Some work tasks involve receiving a call of an injured owl which is picked up by a Wildlife Specialist and transferred to a rehabilitator (owls are frequently struck and injured by passing cars while they are hunting). "Damage" for this type of activity is often recorded as human health and safety because it causes stress to the persons seeing the injured owl, but there was no damage per se.

Raptors are the most difficult birds to haze from air operating areas at airports because most pay little attention to pyrotechnics and other sound-scare devices. Often, they must be trapped and relocated or killed to minimize strike risks and the potential for a catastrophic incident involving a plane crash. Raptors are a leading hazard at airports and cause significant damage to aircraft with most raptor strikes occurring at heights less than 500 feet above the ground (Dolbeer 2006), often at or near the airfield

Of the species that breed in Colorado, no species declined significantly from 1966 to 2009, but the Northern Harrier, Golden Eagle, American Kestrel, Burrowing Owl, and Loggerhead Shrike had possible downward trends. On the other hand, the Turkey Vulture, Red-tailed Hawk, Bald Eagle, and Peregrine Falcon had significant positive trends. Of the species in the BBS survey-wide area that are found in Colorado at some time during the year, the Northern Harrier (-0.9%/year), American Kestrel (-1.4%/year), and Loggerhead Shrike (-3.0%/year) had significant ($P<0.05$) downward trends. The Northern Goshawk, Short-eared Owl, eastern and Western Screech-Owls, Great Horned Owl, and Burrowing Owl showed nonsignificant decreasing trends. Six species have increased significantly from 1966 to 2009. WS responds to requests for assistance mostly with just a few species and on a minimal basis. Declines, especially in the mid-1900s, in many species or raptors caused concern among biologists and most species became protected under state and federal laws. WS anticipates taking few raptors to abate damage situations, but will give those with the highest probability.

Buteos (Hawks with Broad Wings). Some buteos kill poultry and are problems for some T&E and sensitive species such as the Lesser Prairie-Chicken. However, most work tasks associated with buteos are related to reducing wildlife hazards at airports. Colorado has 4 regularly occurring buteos or buteo-like hawks and 5 that are rare or accidental. Of these, 2 are species of concern (Appendix C-Tables C1 and C3), the Swainson's and Ferruginous Hawks. WS has lethally taken the 4 buteos in Colorado and conducted nonlethal hazing or trapping with relocation for them. The Swainson's Hawk and Red-tailed Hawk consistently caused most problems.

Figure 18. Just prior to landing at 50 feet above ground level, this aircraft struck a Red-tailed Hawk damaging the radome which disabled the navigation system. The passengers and crew experienced significant vibrations during landing. The pilot landed the aircraft safely, but emergency vehicles responded to ensure that mishaps did not occur.

Red-tailed Hawks. Red-tailed Hawks are one of the most abundant raptors in the United States, expanding their range, often replacing Ferruginous and Swainson's Hawks in their respective ranges of western United States. Contrary to many raptors, Red-tailed Hawks are able to thrive in the open, patchily wooded landscapes created by urban and exurban sprawl of human communities, if adequate prey is available (Preston and Beane 2009). This species preys on small mammals, some birds, reptiles, and insects. Red-tailed Hawks will kill native upland game birds, including prairie-chickens and quail, as well as poultry, a potential source of concern at times. However, much of the work that is conducted by WS personnel for Red-tailed Hawks has been associated with airports. Of the raptors, they are struck frequently and cause significant damage to aircraft (Dolbeer and Wright 2008). They are common in grass-dominated habitat with sparse shrubs or trees, including cultivated lands, which often describes the air operating area at an airport. Red-tailed Hawks, as with other hawks, can cause significant damage to aircraft (Figure 18), especially because they are abundant. BBS data indicates that the Red-tailed Hawk population from 1966 to 2009 increased significantly (P<0.05) at 1.8%/year survey-wide, and at 2.5%/year in Colorado (Sauer et al. 2011). WS has conducted more work at airports for the Red-tailed Hawk than any other raptor. From FY06 to FY10, WS annually averaged 409 work tasks associated with them, took 61 lethally and 13 by trapping and relocating, and hazed an average of 1,674. For an estimated population of 56,000 in Colorado, using BBS data from 2006 to 20010 (USGS 2012), this would be an unnoticeable take, or a very minor impact. However, to illustrate the impact of WS BDM on this and other buteos, life history information will be used as above for other species to determine an impact level where WS could expect that an impact may start to occur. At a very minimum, it would be expected that an impact would be low level until cumulative take (WS and USFWS permitted take) surpassed 50% of the expected annual mortality, allowing for other mortality factors (*e.g.,* collisions with objects such as vehicles, planes, and wind turbines, predation, starvation due to drought and prey-base population crashes, and disease) to also occur. This level, then compared to the breeding population would give a good indication at what level an impact could be expected to start to occur with only knowing the breeding population. If WS take is compared to this, it could be determined whether or not an impact was likely.

To consider the impacts of WS, the Red-tailed Hawk population in Colorado has been estimated at 56,000 from data for 2006 to 2010 (USGS 2012), an increase of 17,000 from the 39,000 estimated by RMBO (2007) from 1990 data. Females were not found to breed until they were mostly 3 years old, with some 2 year olds breeding. If 60% of the population were adult and 80% of the estimated adults bred (13,000 breeding females) with females averaging 2.5 eggs that fledge 1.3 fledglings/nest (Preston and Beane 2009), annual production could be conservatively estimated at 17,000. Of this, it would be unlikely for an impact to occur until cumulative take by WS and USFWS permitted take surpassed 50% of the expected annual mortality for a stable population or 8,500 Red-tailed Hawks (a level equal to 15% of the breeding population) which would possibly be a low impact on this species. Obviously, an average of 61 taken lethally by WS from FY06 to FY10 (Table 25) is a minor percentage, less than 1% of the expected annual mortality. Cumulatively, USFWS reported the take of an average of 63 annually from 2006 to 2010. The highest take was in FY10 when an estimated 2% of the annual mortality was taken. Thus, WS's impact on the Red-tailed Hawk population has been minimal. WS anticipates that cumulative take by WS and USFWS permitted take will not surpass 20% of the expected annual mortality.

Table 25. Cumulative impact analysis for Red-tailed Hawks killed by WS and USFWS permitted private individuals and entities in Colorado from FY06 to FY10.

RED-TAILED HAWK IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated CO Breeding Population	56,000	56,000	56,000	56,000	56,000	56,000
% Breeding Females in Population	24%	24%	24%	24%	24%	24%
Breeding Females	13,000	13,000	13,000	13,000	13,000	13,000
Ave. Clutch	2.5	2.5	2.5	2.5	2.5	2.5
Ave. Nests	1	1	1	1	1	1
% Fledge	54%	54%	54%	54%	54%	54%
Young Fledged/Stable Pop. Ann. Mort.	18,000	18,000	18,000	18,000	18,000	18,000
Total CO Population	74,000	74,000	74,000	74,000	74,000	74,000
WS Take	4	3	73	85	145	61
WS Take % of CO Ann. Mort.	0.0%	0.0%	0.4%	0.5%	0.8%	0.3%
Private Take in CO	0	33	2	105	174	63
Total Take	4	36	75	190	319	124
% CO Post-breeding Pop.	0.0%	0.0%	0.1%	0.3%	0.4%	0.2%
% of CO Ann. Mortality	0.0%	0.2%	0.4%	1.1%	1.8%	0.7%

Swainson's Hawk. The Swainson's Hawk, once abundant in the western United States, declined from shooting and other problems. In recent times, habitat degradation, the loss of their summertime prey in many areas, especially the Richardson's ground squirrel (*Spermophilus richardsonii*), and deaths associated with organophosphate insecticide use in Argentina have been cited as the primary cause of mortality (Bechard et al. 2010). As a result of these findings and an earlier negative trend in BBS data, the Swainson's Hawk was listed by NAS (2007) on their Watchlist. Swainson's Hawks are common in Colorado only during the breeding season as they winter in South America. They are common in grass-dominated habitat with sparse shrubs or trees, including cultivated lands. During the nesting season, Swainson's Hawks hunt for field rodents, reptiles, and some birds, but are primarily insectivorous at most other times of the year (Bechard et al. 2010). Almost all work tasks conducted by WS (ave. 157 annually from FY06 to FY10) have been associated with Swainson's Hawks on airports and reducing their hazards. BBS data indicates that the Swainson's Hawk population from 1966 to 2009 has a nonsignificant (P>0.05) increasing trend in Colorado at 0.3%/year, but a significant (P<0.05) survey-wide at 0.5%/year. This suggests that habitat conditions and possibly other factors enabled them to increase.

To consider the impacts of WS, the Swainson's Hawk population in Colorado has been estimated at 55,000. Reproduction has been found to be highly variable, mostly influenced by prey availability. Females were not found to breed until they were usually 3 years old, but some bred at 2 year old. If 60% of the population were adults and 80% of the estimated adults bred (13,000 breeding females) with females averaging 2.4 eggs with 71% fledging (Bechard et al. 2010), annual production could be conservatively estimated at 22,000. However, in years of poor prey availability, production can drop considerably and fledgling success could be as low as 31% fledging, but more realistically about 1 per successful nest or about 42% of the eggs would have a successful fledgling (Bechard et al. 2010). Thus, production would equal the number of breeding females or 13,000. Of this, WS took an average of 16 Swainson's Hawks annually from FY06 to FY10 with a high of 39 in FY10, or less than 1% of the expected annual mortality. This level of take would have no noticeable impact on the population. WS could take hundreds to a few thousand before a noticeable impact would likely begin to occur, but WS only anticipates taking a maximum of 200 or less than 2% of the expected annual mortality. USFWS permitted take (Table 11) averaged 19 from 2006-2010 with 41 taken in 2010, giving the highest cumulative take of 80 (0.6% of the expected annual mortality). Thus, the cumulative impact was minimal at less than 1% of the expected annual mortality which was calculated for years with low prey availability. Cumulative impact is anticipated to be no more than 5% of the expected annual mortality. However, take levels in FY10 approximate the levels of take that are likely to occur and this would have an imperceptible impact on the Swainson's Hawk population in Colorado. In addition to lethal take during these years, WS annually averaged hazing 526 and trapping and relocating 7 Swainson's Hawks at airports in Colorado with no known resulting impacts on their population.

Ferruginous Hawk. The Ferruginous Hawk is an open-country species that inhabits grasslands, some shrublands, and deserts, avoiding forests and habitats recently altered by cultivation. Their primary prey includes rabbits and rodents. In years when prey is down, production appears to also go down (Bechard and Schmutz 1995). All work tasks conducted by WS (ave. 135 annually from FY06 to FY10) have been associated with Ferruginous Hawks on airports and reducing their hazards. BBS data indicates that the Ferruginous Hawk population from 1966 to 2009 has a nonsignificant (P>0.05) increasing trend in Colorado at 0.3%/year and a significant (P<0.05) survey-wide at 0.5%/year (Sauer et al. 2011). This suggests that habitat conditions and possibly other factors enabled them to increase. RMBO (2007) estimated their population to be 2,600 from data used in the 1990s. Data from 2006 to 2010 (USGS 2012) using a conservative detectability factor (0.670[12]) from Rich et al. (2004) renders a population

[12] We believe this is an overly conservative detectability factor because it assumes that the area covered by a BBS count is 4 times greater than what is actually surveyed because birds fly into the area counted. However, this assumes that the entire area surveyed is covered and that there are no obstructions which is rarely the case with BBS counts because hills, trees, structures and other barriers do not allow observers to see the entire area. It also assumes that all birds are flying and fly into and out of the area surveyed (the area surveyed at 50 stops is a quarter mile from the observer and observers are to count only those birds seen in the quarter mile area). We believe that this should be 1 instead of the assigned

estimate of 2,400. We believe that Rich et al. (2004) used an overly conservative detectability factor to estimate Ferruginous Hawks (it is less than 1 meaning that for every bird seen, on the survey, it only represents 0.67 birds). However, to be conservative, their detectability parameter will be used for the population impact analysis. We believe the population in Colorado is between 4,900 and 9,800.

Females breed when they are two years old, have an average of 2.8 eggs and fledge an average of 2.2 nestlings (Bechard and Schmutz 1995). An average of 17% of pairs, ranging from 5% to 40%, does not breed in a given season which depends mostly on prey availability (Bechard and Schmutz 1995). Assuming that 80% of the population are breeders and that only 60% of those breed (low prey availability year), an estimated population of 2,400 Ferruginous Hawks in Colorado would have 1,300 nestlings fledge. WS took an average of 14 Ferruginous Hawks from FY06 to FY10 with a high of 47 in FY10 or 3.6% of the expected annual mortality. Cumulatively, WS and USFWS permitted take averaged 25 with a high in FY10 of 98 or 7.5% of the expected annual mortality. We believe this to be very conservative and actually believe that the population is at least twice as high because the detectability factor as discussed. Even so, the mortality from WS and permitted take could increase at least five-fold in years with poor prey-base before the impact would increase to a moderate magnitude.

Table 26. Cumulative impact analysis for Ferruginous Hawks killed by WS and USFWS permitted private individuals and entities in Colorado from FY06 to FY10.

FERRUGINOUS HAWK IMPACT ANALYSIS						
	FY06	FY07	FY08	FY09	FY10	Ave.
Estimated CO Breeding Population	2,400	2,400	2,400	2,400	2,400	2,400
% Breeding Females in Population	24%	24%	24%	24%	24%	24%
Breeding Females	580	580	580	580	580	580
Ave. Clutch	2.8	2.8	2.8	2.8	2.8	2.8
Ave. Nests	1	1	1	1	1	1
% Fledge	54%	54%	54%	54%	54%	54%
Young Fledged/Stable Pop. Ann. Mort.	1,300	1,300	1,300	1,300	1,300	1,300
Total CO Population	3,700	3,700	3,700	3,700	3,700	3,700
WS Take	0	0	10	12	47	14
WS Take % of CO Ann. Mort.	0.0%	0.0%	0.8%	0.9%	3.6%	1.1%
Private Take in CO	0	0	0	4	51	11
Total Take	0	0	10	12	98	25
% CO Post-breeding Pop.	0.0%	0.0%	0.3%	0.3%	2.6%	0.7%
% of CO Ann. Mortality	0.0%	0.0%	0.8%	0.9%	7.5%	1.9%

Other Buteos. Colorado hosts one other buteo species regularly, the wintering Rough-legged Hawk, and 5 species accidentally (Appendix C: Table C-3). WS in Colorado has taken Rough-legged Hawks in BDM, but none of the accidental buteos. Of the accidental species, the Broad-winged Hawk seems to be an increasingly common occurrence in eastern Colorado and may be taken. WS could encounter other buteos as 4 other species have been documented in Colorado. None of the other 4 species are sensitive species and the likelihood of having an encounter with one is minimal as they rarely occur in Colorado.

Rough-legged Hawks breed in arctic and subarctic regions of Canada and Alaska in tundra and taiga habitats. Since this species breeds north of the BBS limits, this species is not accounted for in the BBS data, but has an estimated North American population 300,000 (RMBO 2007). The Rough-legged Hawk primarily winters in southern Canada and the United States excluding the Southeast. CBC data for Colorado has decreased from 1971 to 2010, but has increased in the RMS region (Figure 19). Numbers in the northern tier of States (ID, MT, WY) in the RMS region are much higher and have increased with higher numbers suggesting that birds are not wintering as far south as historically. It is unknown what age they breed, but likely similar to Red-tailed Hawks. They nest once per season, have an average of 3.4 eggs (*n*=194), and fledge 17.4% in poor prey abundance years to 59.2% in high prey years (Bechard and

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0.25. We believe that they may be correct in part, but that at most a factor of 0.5 should be used for distance (one third of the detectability factor – also time and pair). Thus we believe that the population is actually somewhere between 4,900 and 9,800. However, to be conservative, their detectability parameter will be used for the population impact analysis.

Swem 2002). Assuming 60% of the population is adults and 80% of the estimated adults breed (72,000 breeding females), annual production in North America could be conservatively estimated at 43,000 in poor prey availability years and 140,000 in good prey availability years. WS nationwide took an average of 14 Rough-legged Hawks from FY06 to FY10, with a high of 23 in FY10. This is less than 0.1% of the expected mortality in a stable population and would have no noticeable effect on the population. WS in Colorado has taken an average of 6 Rough-legged Hawks from FY06 to FY10 with a high of 23 in FY10 (Table 7). USFWS reported that an annual average of 9 was taken under permits in Colorado from 2006 to 2010 with a high of 27 in 2010 (Table 8). The cumulative impact in Colorado has averaged 15 from FY06 to FY10 with a high of 50 taken. Using CBC data (NAS 2011b) without detectability factors and assuming areas covered are representative of the State's habitats where Rough-legged Hawks are found would result in an average of 2,211 Rough-legged Hawks wintering in Colorado from FY06 to FY10. This would be a conservative estimate. Thus, the cumulative impact from WS and USFWS permitted take would be 2% of the wintering population in Colorado, a minimal impact to the population. Nationally, cumulative take could easily reach 10,000 Rough-legged Hawks without an impact.

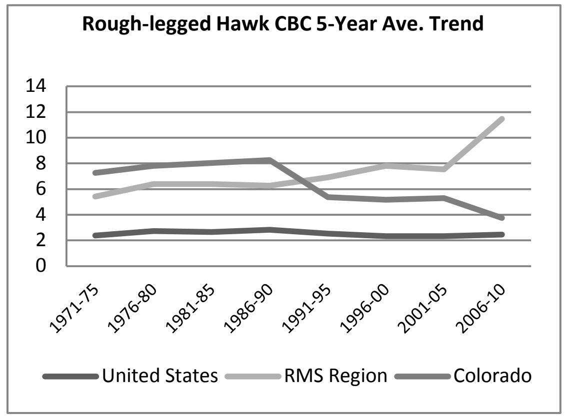

Figure 19. Rough-legged Hawks per CBC count averaged for 5 years for all CBC circles in Colorado, the RMS region, and the United States from 1971 to 2010 (NAS 2011b). The data show a flat trend for the U.S., an increasing trend for the RMS region, and a decreasing trend for Colorado. The northern states (ID, MT, WY) in the RMS region show much higher numbers per CBC and an increasing trend.

Harriers and Kites. Colorado regularly hosts the Northern Harrier statewide and Mississippi Kite in the extreme southeast corner of the State, though it has been found in many eastern Colorado Counties (Table C-1), and has had the Swallow-tailed Kite accidentally found in a few counties of the eastern part of the State (Table C-3). These species primarily 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 hazardous to aircraft. From August 1991 to July 2011, Northern Harriers caused 14 airstrikes at Colorado airports, but kites did not cause any which is reflected by their distribution (FAA 2011). 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 is easily resolved by removing the nest and has occurred in southeast Colorado. In Colorado, only the Northern Harrier caused problems from FY06 to FY10 with 189 work tasks associated with them annually (Table 1).

The Northern Harrier has shown a significant ($P<0.05$) negative trend BBS survey-wide at -0.9%/year and a nonsignificant declining trend in Colorado from 1966 to 2009 (Sauer et al. 2011). Harriers declined early in the 20th century from shooting, egg-shell thinning from DDT, and habitat degradation; however, habitat degradation is believed to be the primary cause for their decline more recently (Smith et al. 2011). Recent data from USGS (2012) gives an estimated population of 8,800 harriers in Colorado, down from the 9,900 estimated by RMBO (2007) with 1990s data, reflecting the downward trend. CBC data (NAS 2011) show a similar number in winter at 6,300 without using any detectability factors. Thus, Northern Harriers can be found in Colorado year-round in at least similar numbers (probably more in winter), though some probably migrate out of the State, while others migrate into the State from northern areas. WS in Colorado has taken an average of 12 Northern Harriers annually from FY06 to FY10 with a high of 35 in FY10 (Table 7). USFWS reported that an annual average of 11 was taken under permits in Colorado from 2006 to 2010 with a high of 38 in 2010 (Table 8). The cumulative impact in Colorado has averaged 23 from FY06 to FY10 (0.3% of the breeding population) with a high of 73 taken in FY10 (0.8% of the breeding population). Thus, the cumulative impact from WS and USFWS permitted take would be 1% of the breeding population in Colorado, a minimal impact to the population. Cumulative take could easily reach 1,000 Northern Harriers without an impact.

Populations of kites have mostly been showing positive trends from 1966 to 2009 BBS survey-wide (Sauer et al. 2011). The Mississippi Kite has not been found on BBS routes in Colorado (USGS 2012), thus they do not have a trend or a population estimate (RMBO 2007). However adjacent states, Kansas, Oklahoma, and Texas have an estimated population of 150,000. Some of these could easily wander across into eastern Colorado, especially during migration. WS has not worked on projects involving kite species in Colorado, but could. If WS did work on a BDM project involving a kite and WS lethally took one or a few, it would have no effect on their population overall.

Vultures. One species of vulture, the Turkey Vulture, inhabits Colorado and are abundant with the Black Vulture being accidentally seen. WS conducted an average of 86 work tasks from FY06 to FY10 for this species (Table 1). Turkey Vultures are common throughout the continental United States including Colorado in the summer, but migrate out of the State for winter. Turkey Vultures are common in most habitats of the State including open plains, desert, woodlands, and human settlements. Turkey Vultures are very good at detecting carrion by smell when soaring. They periodically will kill injured or newborn livestock, but are a much lesser target of control than Black Vultures where the two species are found together because the latter often kills livestock. Much of the BDM conducted for Turkey Vultures is conducted at airports, for property protection because their roost is in an undesirable location such as an electrical substation or residential neighborhood. BBS data indicates that the Turkey Vulture population from 1966 to 2009 increased significantly ($P<0.05$) at 2.3%/year survey-wide and 3.1%/year in Colorado (Sauer et al. 2011). This suggests that habitat conditions benefit the Turkey Vulture allowing their population to expand in the United States. This alone also suggests that Turkey Vulture control and other mortality over the past several years throughout the United States did not have more than a minimal impact on their population.

To further consider the impacts of WS, the population in Colorado has been estimated at 9,900 (Table 4), but we believe that the population is closer to 20,000 (Appendix A, Table A14) because the RMBO (2007) uses a detectability of 4 times greater than the area actually surveyed to account for birds flying in and out of count circles. However, looking at a population analysis of black vultures in Virginia (Runge et al. 2009) a similar estimate would be used by using 1 instead of 0.25 as used in RMBO (2007). However, we will use the lower number for this analysis. If 60% of the population were subadult (vultures exhibit delayed-onset breeding) and 80% of the estimated adult Turkey Vulture population bred (1,600 breeding females) with the average number of eggs at 1.9 and fledglings at 0.95 per nest (Kirk and Mossman 1998), annual production could be conservatively estimated at 1,500 in Colorado. WS took an annual average of 8 Turkey Vultures from FY06 to FY10 with a high of 16 in FY10. The high equates to 1% of the expected annual mortality. Private take under USFWS permits averaged 45 in Colorado from 2006-2010 with a high of 178 in 2009 (WS take in FY09 was 11). The average cumulative take from FY06 to FY10 (61) was 4% of the expected annual mortality and the high in FY09 (189) was 13% of the expected annual mortality or 2% of the breeding population. This would be expected to have minimal impact on the population in Colorado. In fact, it is expected that take could increase at least four-fold without an impact on the population. In addition to lethal take, WS hazed an average of 44 Turkey Vultures annually from FY06 to FY10 from damage situations and this had no known impact on their population.

Falcons and Accipiters. 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 Colorado. Most are adapted to capture birds or insects while flying. Colorado commonly hosts 4 falcons (American Kestrel, Merlin (in winter), and Prairie and Peregrine Falcons) and 3 accipiters (Sharp-shinned and Cooper's Hawks, and Northern Goshawk) (Table C-1). Additionally, another species of falcon (Gyrfalcon) and the related Crested Caracara have also been documented in Colorado (Table C-3). Most, in general, cause few problems with the exception that occasionally the accipiters and larger falcons will occasionally take poultry. These species, especially the accipiters, also take birds at bird feeders, a common complaint (usually handled by telling people to quit feeding birds for a time). All of these species, but especially the falcons which are adapted to hunting in open areas, are airstrike hazards. Falcons were responsible for 38% of all raptor strikes and 5% of all known bird species strikes recorded by FAA from 1990 to 2007 with the American Kestrel responsible for 88% of the falcon strikes (Dolbeer and Wright 2008). The accipiters were only responsible for 1% of all known raptor strikes illustrating their preference for hunting in more forested areas. In Colorado from August 1991 to July 2011, American Kestrels caused 45 strikes, Prairie Falcons 4, Peregrine Falcons 3, unknown falcons 3, and Sharp-shinned Hawks 1 (FAA 2011). Falcons were only responsible for about 20% of the raptor strikes. Finally, a typical occurrence associated with these species, but especially the accipiters, is that they often become entrapped in buildings when they chase their prey, birds, into warehouses and other structures through open doorways; often they cannot find their way back out and are often caught with nets and released back outdoors.

Populations of falcons and accipiters are mostly showing increasing trends. The Peregrine and Prairie Falcons are species of concern and the Peregrine is a State listed species. However, their populations are increasing rapidly following the banning of DDT, a chemical pesticide that caused egg-shell thinning and the decline of the species (White et al. 2002, Steenhof 1998). BBS data (Sauer et al. 2011) indicates that the American Kestrel is currently the only species showing a significant negative trend survey-wide at -1.4%/year from 1966 to 2009, but the Northern Goshawk shows a slight negative trend that is nonsignificant. All other species are showing increasing trends survey-wide and in Colorado, the exception being a nonsignificant decreasing trend for the kestrel in Colorado similar to the survey-wide trend. In the RMS region and North America north of Mexico, RMBO (2007) has 340,000 and 4.3 million American Kestrels, 720 and 400,000 Merlins, 1,400 and 30,000 Prairie Falcons, 70 and 300,000 Peregrine Falcons, 15,000 and 600,000 Sharp-shinned Hawks, and 59,000 and 500,000 Cooper's Hawks. Many of these species breed outside the RMS region as can be seen (*e.g.*, most peregrine falcons breed north of the BBS limits). RMBO (2007) also has populations of 200,000 Aplomado Falcons globally and 200,000 North American Northern Goshawks. Most of these populations have increased since the estimates of the 1990s. RMBO (2007) recorded populations in Colorado of 65,000 American Kestrels, 60 Prairie Falcons, 6,000 Sharp-shinned Hawks, and 27,000 Cooper's Hawks in the 1990s. However, falcons and accipiter taken by WS occurred from September until April when birds would be expected to migrate into or through the State. It would be expected that the populations of these species would rise during this time. With no detectability parameters used, NAS (2009) CBC data, assuming all species are counted in each of the average 100 count circles surveyed from 2003-04 to 2007-08 gives populations of 65,000 American Kestrels, 6,000 Cooper's Hawks, and 5,000 Sharp-shinned Hawks during winter. These numbers would be wholly conservative because of the assumption that all birds are seen in the count circles.

WS took 3 of these species lethally from FY06 to FY10, the American Kestrel, Sharp-shinned Hawk, and Cooper's Hawk averaging 9, 3, and 1 with a maximum of 20, 11, and 2, respectively. USFWS reported an average of 1 American Kestrel and 2 Cooper's Hawks taken annually from 2006 to 2010 (Table 11). The cumulative take was less than 1% of their Colorado population in winter and summer. WS could easily take a magnitude higher without impacting any of these species' populations. Thus, WS believe that the take of these species has been minimal and not had more than a minimal impact on their populations.

Owls. Colorado is home to 12 species of owls (Tables C-1 and C-2) with 5 species that have a high potential to be strike hazards at airports, the Great Horned, Barn, Short-eared, Long-eared, and Burrowing Owls (Table C-1). Additionally, 2 species of owls have been accidentally found or are rare in Colorado

(Table C-3). The Great Horned Owl is the primary species that causes damage to poultry and property. The Barn Owl causes damage primarily to structures where they nest; they nest in cracks and crevices often in structures such as barns. The other 3 species (Appendix C: Table C1) are mostly a strike risk at airports. Owls that are strike risks at airports often frequent open fields for hunting, but often use woodlands or tall grasslands for nesting and roosting. However, the Burrowing Owl lives among burrowing rodents where it will occupy a burrow which can be within an air operating area. In Colorado from Aug 1991 to July 2011, FAA (2011a) documented 79 aircraft strikes with owls: 35 Great Horned Owls, 14 Burrowing Owls, 13 Short-eared Owls, 10 Barn Owls, 1 Western Screech-Owl, and 6 unidentified species of owls. Four of the five damaging species of owls are found year-round in Colorado and the Burrowing Owl only breeds in Colorado and migrates to the southern U.S. and Mexico for winter. RMBO (2007) gives breeding populations of 150,000 Burrowing Owls, 70,000 Great Horned, 10,000 Barn, 500 Short-eared, and no Long-eared Owls. Long-eared Owls are highly cryptic during daytime hours and were not detected on any BBS counts during the 1990s in Colorado. Using BBS data from 1968 to 2010 (USGS 2012) and detectability parameters from Rich et al (2004), a population of Long-eared Owls would be estimated at 3,200 in Colorado. Species of conservation concern are the Burrowing and Short-eared Owls. BBS data (Sauer et al. 2011) in Colorado a show nonsignificant negative trend for the Burrowing Owl, and nonsignificant trends for Barn, Great-Horned, and Short-eared Owls; BBS survey-wide shows a nonsignificant positive trend for the Barn Owl, but declining trends for the other three species. Long-eared Owls were not found during BBS surveys in sufficient numbers to determine a trend.

Many owls were shot in great numbers in the early 20th century and DDT and other pesticides probably took their toll, but habitat loss and low prey base probably are the biggest factors in these species declines. The Great Horned Owl declining trend could be linked to a variety of reasons, but has a robust population with no conservation concerns at this time (Houston et al. 1998). It adapts well to new habitats. The biggest reason for decline is often starvation of nestlings during years with few rodents. The authors noted that Great Horned Owls were extensively shot in an area of Saskatchewan with little to no impact on the population, thus they believed that take was not a primary factor in causes for decline. Additionally, Houston et al. (1998) note that the Great Horned Owl can be detrimental to other species, including T&E species such as the Spotted Owl where forests become fragmented. They have been noted to prey on the Attwater's Greater Prairie-Chicken (*Tympanuchus cupido attwateri*) and therefore, may do the same with the lesser Prairie Chicken. Like many other grassland species, the Short-eared Owl's decline is linked particularly to grassland habitat loss as they need extensive areas for nesting (Wiggins et al. 2006). Burrowing Owls declined with the loss of habitat, particularly prairie dog (*Cynomys* spp.) colonies where they nest; they have also declined have also been linked to habitat modification, primary and secondary poisoning from some pesticides, and abundance of prey species (Poulin et al. 2011).

WS lethally took an average 6 Great Horned Owls and 1 Barn Owl in Colorado from FY06 to FY10 with highs of 13 and 4 in FY10, minimal numbers considering their population sizes in Colorado. USFWS permitted the take 4 Great Horned Owls and 45 Barn Owls from 2006 to 2010 with a high 16 Great Horned Owls in 2010 and 224 Barn Owls in 2009. Thus, cumulative take for these two species averaged 10 Great Horned Owls with a high of 29 in FY10 or <0.1% of their breeding population, and 49 Barn Owls with a high of 226 in FY09 or 2% of their breeding population. WS could take up to 1% of the 5 species breeding populations in Colorado without impacting their viability. However, WS anticipates taking fewer numbers. It should be noted that WS hazed an annual average of 15 Great Horned Owls, 9 Short-eared Owls, and 6 Barn Owls from airfields from FY06 to FY10.

Eagles and Osprey. Golden Eagles are distributed at low densities across much of the western United States. In Colorado, the greatest densities of golden eagles during summer months occur in western Colorado, but they will winter out onto the Plains of eastern Colorado. Bald Eagles are mostly winter visitors in Colorado with some breeding mostly in mountainous areas of western Colorado near lakes and rivers. USFWS has management responsibility for these species which are protected under the Bald and

Golden Eagle Protection Act. Under an MOU with USFWS, WS responds to complaints involving Bald and Golden Eagles. Most work conducted by WS is to reduce strike hazards. Five eagles, 2 Bald, 2 Golden, and 1 unknown, were killed at airports in Colorado from August 1991 to July 2011 (FAA 2011a). Ospreys primarily breed in Colorado, and migrate out of the State for winter. They were not struck in Colorado, but were nationally (USGS 2012). Current BBS data from 2006 to 2010 in Colorado gives breeding population estimates of 2,100 Golden Eagles, 440 Bald Eagles, and 620 Ospreys (USGS 2012) based on detectability factors from Rich et al (2004). RMBO (2007) had estimates of 2,100 Golden Eagles, 60 Bald Eagles and 190 Ospreys for data from the 1990s in Colorado which reflects the eagles' BBS trends for Colorado, although the Osprey did not have one. BBS survey-wide trends for these species were positive with the Golden Eagle having a nonsignificant (P>0.05) trend of 0.2%/year, and the Bald Eagle and Osprey having significant (P<0.05) trends of 5.0%/year and 2.7%/year which also reflects the growth in Colorado. RMBO (2007) estimated the North American (north of Mexico) populations of Golden Eagles at 80,000, Bald Eagles at 300,000, and Osprey at 200,000.

Golden Eagles are typically found in open mountainous or hilly terrain where they hunt for small mammals, snakes and carrion. Golden Eagles will take lambs, kid goats, and other small livestock. They nest mostly on cliffs, but sometimes in trees and on power lines. Eagles and Ospreys have large bulky nests sometimes 8 feet across and 4 feet deep. Nestlings fledge at 9-10 weeks, but are dependent on their parents for another 30 days or more. Golden Eagles breed at about 5 years of age, mate for life, and a pair needs up to 35 square miles of territory in which to hunt (range 12-110 mi^2, and high as 400 mi^2 in eastern Canada), and average about 2 eggs/nest with 0.83 eaglets fledge/nest (Kochert et al. 2002). Percentages of ages is not known, but it can be assumed that about 50% of the population is of breeding age or older (Good et al. (2007) found adults comprised 67% of the population in their study). While some Golden Eagles may migrate into the State during winter, we will just look at the resident population. If 80% of the adult breeding population bred and 50% of the population was breeding age (420 breeding females), then a population of 2,100 eagles would have 350 fledglings. If WS took up to 10% of the expected annual mortality for eagles (35), it would likely result in a minimal impact on the population. However, WS anticipates that it would take few, if any, Golden Eagles annually and would only conduct such an activity with the appropriate eagle permit from USFWS. WS did not take any Golden Eagles from FY06 to FY10, but anticipates that it would be possible to take a few Golden Eagles annually to abate severe livestock depredation problems and remove them from airfields where they did not respond to harassment. However, limited take of Golden Eagles (up to 10) would be a very low magnitude impact on their population and not significant. WS hazed an average of 32 Golden Eagles from air fields in Colorado from FY06 to FY10, illustrating a need to curb their strike hazards.

Bald Eagles damage problems include killing livestock, causing damage at aquaculture facilities, and representing a significant strike risk (size) at airports. They are mostly found in Colorado in winter, but the nesting population continues to climb. The species has made a remarkable recovery from precariously low numbers to numbers currently surpassing 7,000 nesting pairs in North America. During the winter, the average number of Bald Eagles seen in Colorado from FY06 to FY10 CBC surveys was 390 (NAS 2011b), suggesting a fair number of wintering birds. If extrapolated for the State, the CBC data suggests that there are 5,400 wintering Bald Eagles in Colorado, using no detectability factors. Most requests for assistance have resulted from a loss of livestock or potential to cause problems at airports. WS has had few requests for livestock, but could get more for airports as their population increases. Of the 34,000 known bird species strikes from 1990 to 2007, 101 were Bald Eagles with 45 of those causing damage (Dolbeer and Wright 2008). WS did not take any Bald Eagles in Colorado from FY06 to FY10, but anticipates that such could occur with the current trend in their population. However, if this occurred it would be conducted with the appropriate permit from USFWS. WS hazed an average of 72 Bald Eagles from airports in Colorado from FY06 to FY10. Permits have been obtained to conduct such activities. A lethal take permit would likely only be issued by USFWS for severe ongoing depredation problems, and likely only following an intensive hazing program. The take of a few Bald Eagles (up to 10) by WS in Colorado would not impact their population.

Ospreys damage includes taking fish at aquaculture facilities and representing a strike risk (135 of the 34,000 known bird species strikes were Ospreys from 1990 to 2007 (Dolbeer and Wright 2008)), however none occurred in Colorado from Aug 1991 to July 2011. They have only rarely been encountered at airports by WS in Colorado. In fact, only one work task (Table 1) was performed for an Osprey in Colorado from FY06 to FY10 where an Osprey was hazed from an airfield. No other take or hazing has occurred even though the population is growing steadily. This virtually had no impact on their population considering their population estimate. Because the population is growing rapidly, WS anticipates that take may occur in the future. WS could take several during the nesting season (up to 10) to protect aquaculture fish and human health and safety at airports. WS anticipates that this level of take would have no noticeable effect on the population.

We conclude that we will have no noticeable effect on the three populations because we will not impact the eagles' and osprey's habitat or their viability in Colorado.

Shrikes. Two species of shrikes are found in Colorado, the Loggerhead Shrike breeds throughout Colorado and winters in southern areas of the State and further south and the Northern Shrike winters in Colorado throughout most of the State, but breeds in northern Canada and Alaska above the BBS limits (Appendix C: Table C1). The only problem associated with these 2 species is that they are bird strike hazards at airports as they are often found in grasslands. Problems with these species occur infrequently and are typically very minor. Dolbeer and Wright (2008) reported 3 strikes with Loggerhead Shrikes from 1990 to 2007. However, from August 1991 to July 2011, no strikes with shrikes were reported in Colorado. The Northern Shrike does not breed in the BBS area and thus has no trend associated with it. The Loggerhead Shrike has an insignificant downward trend in Colorado, but significant (P<0.05) downward trend of -3.0%/year BBS survey-wide (Sauer et al. 2011). Its decline is actually a mystery not fully explained by habitat loss, but mostly linked to it (Yosef 1996). Their population in Colorado and the RMS region is estimated at 120,000 and 970,000, respectively (RMBO 2007). The Northern Shrike has an estimated continental population of 210,000 (RMBO 2007). CBC data (NAS 2011b) give an estimate of 1,700 Northern Shrikes and 350 Loggerhead Shrikes in Colorado during winter without using detectability parameters. It is doubtful that WS will conduct much hazard management with these species, but averaged 1 work task annually (Table 1) with Loggerhead Shrikes from FY06 to FY10 where an average of 3 were hazed from airfields. The take of less than 0.1% of the Loggerhead Shrikes population in Colorado (120) or 0.001% of the Northern Shrike's population continentally (200) would have no impact on their populations, especially considering they have high reproductive potential (Yosef 1996). However, WS has had no impact on the Loggerhead Shrike population in Colorado other than hazing a few birds from airfields and no impact on the Northern Shrike population. WS anticipates that the take of a few birds is a potential, but likely will be very minimal with no noticeable impact on the population.

Shorebirds

Colorado hosts 34 species of shorebirds regularly, 7 accidentally, and the Eskimo Curlew which is likely extinct (Appendix C: Table C1 and C3). Only ten of these species breed in Colorado with the remainder migrating through the State for a short period during spring and late summer-fall. Shorebirds are mostly only a concern at airports as they are commonly struck by aircraft. Twenty seven strikes were reported at Colorado airports with shorebirds from FY01 to FY10 with 19 being Killdeer. Most shorebirds are hazed from airfields, but some such as the Upland Plover and Killdeer are difficult to haze out of an area because they will nest in grassland habitat such as that found at airports. Therefore, some are taken lethally. WS also monitors shorebirds for disease, primarily monitoring for human pathogens such as HP H5N1 AI. Samples are collected from shorebirds because they often breed in areas where they can intermingle with birds from other regions, especially those species that breed in areas such as Alaska where other species of shorebirds and waterfowl breed that wintered the prior year in areas where a disease such as HP H5N1 AI had been discovered (Asia). It is known that many diseases can spread from infected wild birds to other animals and humans through contact. As a result of this intermingling with birds of other regions of the world, samples were collected from species most likely to come into contact with other birds from around the world. Of high interest were many species of shorebirds because they breed in the arctic where they have that opportunity. Most disease work, though, involves the use of nonlethal methods such as mist nets and cannon nets followed by release after sampling and most airport work involves the use of pyrotechnics, thus minimal lethal take occurs. In FY06 and part of FY07, many species were collected lethally because of logistics. Soon thereafter, most samples were collected from birds trapped and released with cannon nets, mist nets, or noose mats. From FY06 to FY10, WS in Colorado lethally took 6 species of shorebirds (5 for disease work only – Table 9), captured, sampled, and released 15 species (Table 11), all for disease work, and hazed 4 species at airports (Table 10).

Several shorebirds are T&E or BCC species (13 of the 33 commonly found in Colorado and 2 of the 7 accidental or rare species), including the federally threatened Piping Plover and USFWS (2008a) birds of conservation concern, the Snowy Plover, Upland Sandpiper, and Long-billed Curlew, most because they have relatively low global population estimates (Morrison et al. 2006). The Eskimo Curlew is a federally listed species, but is most likely extinct or has a population less than 50 (Morrison et al. 2006) as it has not been seen in many years (it is listed in the accidental species table, but not included in counts because it is likely extinct - Appendix C: Table C3). Tables C1 and C3 also list Audubon Watchlist species (NAS 2007). WS is aware of these species and adjusts methods to avoid take. A consultation was conducted with USFWS on the Piping Plover for conducting disease monitoring because this species could be caught in mist nets and noose mats during sampling. WS follows the Reasonable and Prudent Measures and Alternatives and Terms and Conditions of that consultation to protect the Plover. All of the species that breed in Colorado (Wilson's Phalarope, American Avocet, Wilson's Snipe, Upland Sandpiper, Spotted Sandpiper, Long-billed Curlew, Killdeer, and Mountain Plover) have decreasing trends in Colorado from 1966 to 2009 with the Upland Sandpiper, Long-billed Curlew, and Killdeer being significant ($P<0.05$) at -6.0%/year, -5.0%/year, and -2.9%/year, relatively high rates of decline (Sauer et al. 2011). Species seeing significant ($P<0.05$) declines BBS survey-wide include the Lesser Yellowlegs (-5.4%/year), Spotted Sandpiper (-1.3%/year), and Killdeer (-1.1%/year) (Sauer et al. 2011). Six other species have nonsignificant downward trends while 2 have upward trends. The Black-necked Stilt has a significant ($P<0.05$) increasing trend of 3.0%/year and the Wilson's Snipe has a flat trend (0).

Of the shorebirds, only the Killdeer has been taken (Table 7) and hazed (Table 9) to any extent at airports in Colorado, but American Avocets, Long-billed Curlews, and an Upland Sandpiper have also been hazed at airports (Table 9). With the exception of these 4 species, WS anticipates that no more than 50 shorebirds of any of the other regularly occurring species, 5 of the 5 SMC species not federally listed discussed above with low population estimates, and no federally listed species (the Piping Plover) will be targeted with lethal methods. An occasional species accidental in Colorado may also be taken. From FY06 to FY10, WS did not surpass this. This is a minimal take and would not impact any of these species populations. To determine impacts, it must be noted that the BBS does not quantify shorebird populations because they are difficult to assess with point counts such as the BBS. Morrison et al. (2006) used a variety of sources to determine populations of shorebirds in North America and these will be used to determine the impacts, at the national level since there is no estimate for Colorado (Table 31). WS nationally has not impacted any species at a level higher than 0.1% of their population with the exception of Killdeer (0.13%), a species commonly controlled at airports because they prefer the habitat found at airports and are a significant strike risk.

Table 27. WS BDM conducted throughout the United States involving the lethal take of shorebirds that are found in Colorado. However, there are no estimates of populations in Colorado, only for North America (Morrison et al. 2006). Looking at lethal take by WS nationwide gives a good indication of impacts to shorebirds from BDM at airports and for disease surveillance since population numbers are available for the continental area. The highest impact for any shorebird was 0.13% of their estimated population. This is minimal. WS take at airports is reflected in the number of birds struck by planes in the same time period (i.e., Killdeer and then the Upland Sandpiper were taken the most by WS at airports and killed by planes).

Species	North American Population Est.*	FY06	FY07	FY08	FY09	FY10	Ave.	% of Pop	U.S. Ave. Annual Strikes FY06-FY10
Black-bellied Plover	200,000	4	35	13	12	15	16	0.01%	7.2
American Golden Plover	200,000	0	1	0	2	61	13	0.01%	9.4
Snowy Plover	18,000	-	-	-	-	-	-	-	0
Semipalmated Plover	150,000	47	15	1	2	3	14	0.01%	7.2
Piping Plover	5,900	-	-	-	-	-	-	-	0.4
Killdeer	1,000,000	736	943	1,412	1,530	1,844	1,293	0.13%	334.6
Mountain Plover	12,500	-	-	-	-	-	-	-	0
Black-necked Stilt	175,000	10	0	45	47	83	37	0.02%	0.4
American Avocet	450,000	29	1	10	18	8	13	0.00%	0.4
Greater Yellowlegs	100,000	54	17	4	18	24	23	0.02%	0.4
Lesser Yellowlegs	400,000	91	72	2	10	8	37	0.01%	0.4
Solitary Sandpiper	150,000	2	1	0	0	1	1	0.00%	0.2
Willet	250,000	-	0	3	9	6	5	0.00%	0.2
Spotted Sandpiper	150,000	3	5	2	8	-	5	0.00%	0.6
Upland Sandpiper	350,000	53	233	385	155	295	224	0.06%	13.6
Whimbrel	66,000	14	13	15	6	2	10	0.02%	1.0
Long-billed Curlew	55,000	0	2	1	2	5	2	0.00%	0.6
Marbled Godwit	174,000	-	0	-	0	-	0	0.00%	0.2
Ruddy Turnstone	245,000	1	6	1	0	0	2	0.00%	0.4
Sanderling	300,000	1	0	1	1	2	1	0.00%	2.2
Semipalmated Sandpiper	2,000,000	25	3	3	0	6	7	0.00%	4.0
Western Sandpiper	3,500,000	10	0	0	0	1	2	0.00%	7.4
Least Sandpiper	700,000	51	49	9	7	49	33	0.00%	5.8
White-rumped Sandpiper	1,120,000	-	0	-	-	-	0	0.00%	0.8
Baird's Sandpiper	300,000	10	0	0	-	-	3	0.00%	2.2
Pectoral Sandpiper	400,000	40	16	0	0	20	15	0.00%	1.8
Stilt Sandpiper	820,000	1	0	0	-	-	0	0.00%	0
Dunlin	1,300,000	10	15	5	115	0	29	0.00%	2.8
Buff-breasted Sandpiper	30,000	2	1	0	0	1	1	0.00%	3.4
Short-billed Dowitcher	153,000	1	2	0	0	1	1	0.00%	1.2
Long-billed Dowitcher	400,000	71	30	1	1	0	21	0.01%	1.0
Wilson's Snipe	2,000,000	31	54	15	17	13	26	0.00%	4.6
Wilson's Phalarope	1,500,000	-	-	0	-	-	0	0.00%	0.4
Red-necked Phalarope	2,500,000	16	0	0	2	1	4	0.00%	0.6
Accidental Species in Colorado									
Hudsonian Godwit	70,000	-	-	-	-	-	-	-	0
Red Knot	120,000	-	1	-	-	-	1	0.00%	0.2
Sharp-tailed Sandpiper	160,000	2	4	2	1	0	2	0.00%	0
American Woodcock	3,500,000	-	-	-	2	-	2	0.00%	5.2
Red Phalarope	1,250,000	-	1	-	-	0	1	0.00%	0

*Estimates from Morrison et al. 2006 Minus (-) = no activity incl. hazing (0) = nonlethal activity, but no lethal take
^=Sensitive species (USFWS 2011(T&E spp.), 2008 (Birds of conservation concern), NAS 2007 (Audubon Watchlist)

Killdeer. The Killdeer is found throughout North America and quite common. Much like the Upland Sandpiper, they can be found well away from wetland habitats, including short grass and human altered habitats such gravel roads and gravel rooftops. They are often found around airports and their hazards to aircraft are the only problem associated with them. Killdeer were responsible for 1,107 strikes from 1990 to 2007, 5th among all species struck (Dolbeer and Wright 2008). However, Killdeer were the number two species struck, following Mourning Doves, at airports in the United States from FY01 to FY10 (Appendix D, Table D1), indicating their preference to use airport habitat. They typically are found in sparsely vegetated areas near some source of water including lawn sprinklers. They often nest in open or sparsely vegetated areas on the ground and young are precocial (capable of independent activity when they hatch). They can be found year-round in Colorado, but most migrate south for the winter. Their population is mostly limited by nest and hatchling destruction from predation and other known sources such as vehicles, and possibly impacts from pesticides (Jackson and Jackson 2000). Their population likely increased substantially with the spread of people in the United States. However, BBS data indicates that populations are declining significantly ($P<0.05$) at -1.1%/year survey-wide and -2.9%/year in Colorado from 1966 to 2009 (Sauer et al. 2011). The North American breeding population has been estimated at 1 million (Morrison et al. 2006), but has not been estimated for Colorado. BBS data for Colorado (USGS 2012) found 3.53 birds/route and using no detectability parameters indicate a population of 37,000. Detectability for Killdeer would likely be in the mid-range of most species or about 3-4. Thus, the population is probably higher than this estimate by a factor of 3 to 4.

Killdeer are abundant in ideal breeding areas. Killdeer have one nest per year, but may renest if the first attempt fails. They have a clutch of 4 to 8 eggs, but almost always have 4 (Jackson and Jackson 2000). They breed when they are 1 year old and the sex ratio may be slightly skewed to males (Houston and Bowen 2001). However, for the sake of analysis, it is assumed that the sex ratio is 1 male: 1 female for the analysis and that 75% of the females breed. Estimates of nest success ranged from 0.16 to 1.6 fledglings/nest, but averaged 0.5 fledglings/nest, a 12.5% egg to fledgling success, reflecting their nest vulnerability to predators and other factors (Jackson and Jackson 2000). Using these parameters, a population of 37,000 (no detectability parameters used) would fledge 7,000 young in Colorado. WS in Colorado averaged the take of 6 from FY06 to FY10 with a high of 12 in FY10. USFWS permitted take in Colorado from 2006 to 2010 averaged 24 with a high of 99 in 2009. WS took 7 in FY09, thus cumulative take was 106, or 0.3% of the expected annual mortality. WS could increase take substantially without impacting the population, easily to 500 or 14% of the conservatively estimated population, which combined with private depredation take assuming it increased to 500, would be expected to be less than 15% of the expected annual mortality or 3% of the conservatively calculated breeding population. WS concludes, that even with implementation of more lethal control of Killdeers on airfields in Colorado, WS will have a minor impact on them, at most.

WS nationwide took an average of 1,293 Killdeer from FY06 to FY10 with a high of 1,844 in FY10 (Table 31) or 0.2% of the estimated population of 1,000,000 (Morrison et al. 2006). A breeding population of 1,000,000, based on the above nesting parameters, would have, at a minimum, 190,000 fledglings. WS took about 1% of the estimated annual mortality, a minimal take that would be expected to have, at most, a negligible effect on the population. Thus, at the local and nationwide level, WS has not had an impact on the Killdeer population.

Other Shorebirds. From FY06 to FY10, Colorado WS took minimal numbers of 5 other species of shorebirds, the Long-billed Dowitcher, Greater Yellowlegs, and Baird's, Least, and Semipalmated Sandpipers, for disease surveillance in a nationwide interagency effort to determine the prevalence of avian influenza. Their estimated North American populations, respectively, are 400,000, 100,000, 300,000, 700,000 and 2,000,000 (Morrison et al. 2006). Take by WS in Colorado (Table 7) and nationally (Table 31) has been minimal and less than 0.1% of their populations which would have no noticeable effect on their populations. The take for these other species of shorebirds occurred in FY06 and FY07 for disease monitoring. However, many of these species are taken at airports across the country, but in minimal numbers that would have a negligible impact on other shorebirds (Table 31). Colorado WS did not take any of these species at airports, but could.

Many other species of shorebirds inhabit Colorado commonly (28) and accidentally (7). WS anticipates taking mostly a few of any of these species and mostly with nonlethal methods. Of these, the Piping Plover and Eskimo Curlew are T&E species that will be avoided by WS unless they are present at airports or contaminated sites (*e.g.,* oils spills). WS would only "take" (includes harassment and other nonlethal methods for T&E species) these species with the appropriate permit from USFWS and nonlethally, primarily for their protection at airports and contaminated sites. WS does not expect that either species will be taken, especially the Eskimo Curlew which is likely extinct. As discussed, WS expects not to ever take more than 5 SMC species (USFWS 2008a and NAS 2008) with low population estimates or declining trends including Snowy Plovers, Mountain Plovers, Long-billed Curlews American Golden-Plovers, Marbled Godwits, Sanderlings, Semipalmated Sandpipers, Western Sandpipers, White-rumped

Sandpipers, Stilt Sandpipers, or Buff-breasted Sandpipers. WS does not expect to more than 50 of any other regularly occurring species in Colorado and will never likely reach this threshold with the exception of those discussed above. This level of take will not impact any or their populations. However, as seen in the last 15 years, WS will likely take none of these species except potentially with nonlethal methods or for disease surveillance.

Wading Birds

Eight species of wading birds, herons, egrets, and bitterns are regularly found in Colorado with an additional 9 that are rare or accidental including the Roseate Spoonbill and Wood Stork in addition to the others (Appendix C: Tables C1 and C3). The most common requests for assistance involving these species in Colorado are from airports to reduce their strikes. Wading birds, including cranes and rails, were responsible for an annual average of 79 strikes at U.S. airports with 31% of those causing damage (Appendix D, Table D1). Wading birds also cause damage at aquaculture facilities (individual wading birds preying on fish at an aquaculture facility) and property in urban residential areas where they are a human health and safety concern (roosts). These conflicts may require the take of some individuals to reinforce hazing efforts, but often do not involve the take of any. Thus, the impact to these species populations is typically negligible under the proposed action. WS in Colorado conducts minimal BDM for wading bird problems. To illustrate the small scope of the conflicts with wading birds in Colorado, WS received only conducted an average of 36 work tasks annually, with most for Great Blue Herons, from FY06 to FY10. WS took an average of 9 Great Blue Herons annually from FY06 to FY10, all at airports. Cumulatively, USFWS permitted the take of 9 Great Blue Herons in Colorado for a total of 18 taken annually, a minimal number. No other species of wading birds were taken from FY06 to FY10, but damage requests were received for Snowy Egrets, Black-crowned Night-Herons, and White-faced Ibises.

The 8 wading birds regularly found seasonally in Colorado are relatively common in North America. Most of these, except the Green Heron and American Bittern which are generally fairly cryptic, could be the focus of BDM. Any of the 8 species are relatively abundant; the estimated global breeding population for the Great Blue Heron is 83,000, Snowy Egret 143,000, Cattle Egret 1.2 million (Kushlan et al. 2002), American Bittern 3 million, Great Egret 270,000, Green Heron 1.2 million, Black-crowned Night-Heron 2 million, and White-faced Ibis 1.2 million (NAS 2011). Survey-wide BBS data (Sauer et al. 2011) from 1966 to 2009 shows a significant (P<0.05) decrease for the Green Heron at -1.5%/year, shows significant increases (P<0.05) for the Great Blue Heron at 1.0%/year, the Great Egret at 2.7%/year, and the White-faced Ibis at 4.5%/year, shows nonsignificant decreases for the American Bittern, Black-crowned Night-Heron, Cattle Egret (a self-introduced species into North America in the 1950s starting from Africa (Telfair 2006); Cattle Egrets rapidly expanded their range throughout the southern tier of States and the Mississippi River Valley States and are regular visitors to Colorado), and show a nonsignificant increase for the Snowy Egret. Similar trends in Colorado are seen for those species that breed in the State (Great Blue Heron, Snowy Egret, Black-crowned Night-Heron, and White-faced Ibis), but the Great Blue Heron shows the only significant upward trend (Sauer et al. 2011); the American Bittern is a cryptic species that breeds in the State and has been found at a relatively high rate of 0.054 birds/count from 1968 to 2009, but does not have a trend in Sauer et al. (2011). A hierarchal trend model was used on the dataset from 1968 to 2009 and gave an index of -7.8%/year from 1968 to 2009 (Sauer et al. 2011) which appears to be significant.

WS anticipates that some wading bird species in Appendix C: Table C1 will be taken lethally. This would likely be conducted for a significant problem that developed at an airport or a significant urban roost that created a nuisance or health and safety concerns. Lethal shooting is generally used to reinforce harassment methods and is conducted at airports where very damaging strikes could occur or in residential areas where a roost has formed. Urban roosts are mostly relocated prior to nesting using hazing devices (lasers have proven successful in some situations). WS believes that few wading birds will ever be taken and that WS will have no impact on any species' population. Wading birds, their nests, eggs and young are protected by the Migratory Bird Treaty Act; any form of take requires a permit from the USFWS.

Great Blue Herons. The Great Blue Heron is commonly found throughout much of North America, but does not extend into northern Canada and Alaska. They tend to be found in wetlands with emergent vegetation or along banks, and sometimes in drier upland sites. They feed on fish, invertebrates, and small mammals such as mice. They are strongly territorial and therefore, typically found singly. They were responsible for 193 strikes from 1990 to 2007 (Dolbeer and Wright 2007), indicating some preference to be found around airport habitats (they often "mouse" in open fields). They nest in the tops of trees among fairly large breeding colonies. They can be found year-round in Colorado. It is unknown what limits their population, but territoriality in feeding and a limited feed supply may keep populations at low levels (Vennesland and Butler 2011). BBS data indicates that the Great Blue Heron population increased significantly in Colorado and survey-wide (Sauer et al. 2011). Its North American population has been estimated at 120,000 (NAS 2009). BBS data (USGS 2012) in Colorado and the RMS area indicate breeding populations of 6,300 in Colorado and 32,000 in the RMS States using no detectability parameters. Using a detectability parameter of 2, as in Appendix A, would double the population, a much more realistic population level. But to be conservative, no detectability parameter is used.

Table 28. Cumulative impact analysis for Great Blue Herons killed in Colorado by WS and USFWS permitted private individuals and entities from FY06 to FY10.

GREAT BLUE HERON IMPACT ANALYSIS						
	FY06	FY07	FY06	FY09	FY10	Ave.
Estimated Colorado Breeding Population	6,300	6,300	6,300	6,300	6,300	6,300
% Breeding Females in Population	25%	25%	25%	25%	25%	25%
Breeding Females	1,600	1,600	1,600	1,600	1,600	1,600
Ave. Clutch	3.2	3.2	3.2	3.2	3.2	3.2
Ave. Nests	1	1	1	1	1	1
% Fledge	62.5%	62.5%	62.5%	62.5%	62.5%	62.5%
Young Fledged/ Stable Pop. Ann. Mort.	3,200	3,200	3,200	3,200	3,200	3,200
Total Colorado Population	9,500	9,500	9,500	9,500	9,500	9,500
WS Take	6	1	8	23	8	9
WS Take % of Ann. Mort.	0.19%	0.03%	0.25%	0.72%	0.25%	0.28%
Private Take in Colorado	4	7	6	8	20	9
Total Colorado Take	10	8	14	31	28	18
% Post-breeding Pop.	0.11%	0.08%	0.15%	0.33%	0.29%	0.19%
% of Ann. Mortality	0.31%	0.25%	0.44%	0.97%	0.88%	0.56%

Great Blue Herons are abundant in ideal breeding areas. Great Blue Herons are known to have one and possibly two nests per year, renesting if the first attempt fails (Vennesland and Butler 2011). Their clutch is 2 to 6 eggs, averaging 3.2/nest that hatch 2.3 young/nest. Great Blue Herons breed when they are 2 year old, thus, for this analysis the nonbreeding population is estimated to be 33% of the population. The sex ratio is assumed to be 1 male: 1 female for the analysis and that 75% of the adult females breed. A small study found that nests fledged 62.5% of the number of eggs or about 2/nest (Vennesland and Butler 2011). Using these parameters, a population of 6,300 (no detectability parameters used) would fledge 1,600 young in the Colorado. WS averaged the take of 9 from FY06 to FY10 with a high of 23 in FY09. USFWS permitted take from 2006 to 2010 averaged 9, with the highest in 2010 (20). As a result of permitted take, the highest cumulative take in Colorado occurred in FY09, 31 or 1.0% of the expected annual mortality. WS could increase take substantially without impacting the population, easily into the hundreds, before a low level of impact would occur. It is anticipated that cumulative take will remain below 15% of the expected annual mortality (240) or 4% of the conservatively calculated breeding population. WS concludes, that even with implementation of increased take of Great Blue Herons, the population is not expected to be impacted.

Other Wading Birds. WS did not take any other wading bird from FY06 to FY10, and expects that minimal numbers, or none, of the other 7 species of wading birds commonly occurring in Colorado will be taken and most all to reduce wildlife hazards to aircraft and their passengers at airports. From FY06 to

FY10, WS averaged hazing 21 White-faced Ibis from airfields, thus have no lasting impact. USFWS did not permit the take of any additional species of wading birds in Colorado. Thus, no additional wading birds were killed in Colorado.

Six of the other 7 species breed in Colorado and their populations could be estimated without detectability parameters for FY06 to FY10 BBS data (USGS 2012). The estimates would be minimal and not likely represent their population because most are difficult to see as some are cryptic and few call (much of the BBS depends on hearing birds call to determine numbers in an area during a given count). The continental population estimates would be 540 American Bitterns (continental population 3.0 million), 140 Great Egrets (270,000), 600 Snowy Egrets (1.4 million), 620 Black-crowned Night-Herons (*unknown*), and 8,000 White-faced Ibis (150,000). However, we believe that these would be extremely conservative estimates, especially considering their continental populations given in parentheses and would estimate the populations higher, especially for the more cryptic and smaller species. Thus, it is likely that the any take would have minimal potential to affect their populations.

The BBS trend information for these species was discussed above. The Green Heron's significantly decreasing trend is difficult to interpret because of its cryptic nature and, thus, the validity of its BBS trend is difficult to determine (Davis and Kushlan 1994). Stochastic climatic events, nest predation, and loss of large wetland habitats may be primary reasons for their decline (Davis and Kushlan 1994). The American Bittern has also decreased which is linked almost entirely to the loss of large wetlands with emergent vegetation (Lowther et al. 2009). The Cattle Egret potential decline may be due to contact with agricultural chemicals or normal fluctuations given the fact that they only colonized North America in the 1950s (Telfair 2006). The Black-crowned Night-Heron also shows a nonsignificant decline that may be related to precipitation cycles, habitat destruction, recreational disturbance, predation, and food availability at nest sites (Hotham et al. 2010). On the other hand, the Great Egret and White-faced Ibis show significant increasing trends survey-wide and the Snowy Egret a nonsignificant increase. This alone suggests that these species are not being impacted by any BDM activities. In fact, WS could increase take for all of the species discussed in this section with the exception of Green Herons and American Bitterns to 100 without impacting their populations. However, WS believes that few will ever be taken. WS concludes that these other wading bird species' populations will not be impacted by WS BDM individually or cumulatively with private depredation take. WS will have no more than a negligible impact to any wading bird species populations.

<u>Larids</u>

Larids are comprised of gulls, kittiwakes, noddies, terns, jaegers, and skimmers. The first two of the larid subgroups are discussed under gulls while the last four under terns.,

Gulls. Five species of gulls commonly migrate through or winter in Colorado coming from their northern breeding grounds. Additionally, 16 species of gulls have been found in Colorado, a few vagrants being found annually in minimal numbers. They are often struck by aircraft which can cause extensive damage to the aircraft because of their size and flocking behavior (Dolbeer 2006). They have been found to be quite attracted to airports for loafing and feeding, especially on earthworms on runways following heavy rains. From FY01 to FY10, an annual average of 4,282 strikes occurred at U.S. airports with 20% of the strikes causing damage (Appendix D, Table D1).

The Franklin's Gull, Bonaparte's Gull, Ring-billed Gull, California Gull, and Herring Gull, are the species that would most likely be encountered in Colorado during migration and winter. Few gull colonies, primarily California Gulls, are found breeding in north-central Colorado. Survey-wide BBS trends from 1966 to 2009 for Franklin's Gulls showed a significant ($P<0.05$) at -5.0%/year (Sauer et al. 2011). The Herring Gull and California Gull have seen a nonsignificant decrease of -2.7%/year and -0.4%/year. The Ring-billed Gull has had a significant increase ($P<0.05$) of 3.3%/year. The Bonaparte's

Gull primarily nests in areas north of the BBS limits, thus limited data is available for them, but CBC data from 1966 to 2010 for winter populations in the United States appear to have been fairly stable around 1 gull/party hour observed (Burger and Gochfeld 2002, NAS 2011b). The Herring Gull population, decimated in the early 1900s, is believed to have increased beyond their historical numbers by the 1960s (Pierotti and Good 1994). Ring-billed Gulls increased significantly earlier in the century which was attributed to their ability to use supplemental food sources and expand their breeding habitat (Pollet et al. 2012). From BBS data in 2006, the population was estimated at 2.6 million which included immature gulls, but this is not the best data for estimating the colonial waterbird populations (Pollet et al. 2012). Kushlan et al. (2002) estimated the population at 1.7 million breeders. For the Franklin's Gull, the population BBS survey-wide (Sauer et al. 2011) has increased from about 4/count in 1966 to 40/count in 2005, a ten-fold increase. The continental breeding populations of Ring Billed, Bonaparte's and Herring Gulls have been estimated at 2.6 million, 390,000, and 370,000 (NAS 2008b). Franklin's and California Gulls are also abundant (Burger and Gochfeld 1994). Kushlan et al. (2002) estimated the breeding populations (less than the total population) of Ring-billed, California, Herring and Franklin's Gulls to be 1.7 million, 410,000, 250,000, and 320,000-900,000.

Throughout the United States, gulls are primarily taken for depredation management primarily at airports, landfills, and aquaculture facilities with WS nationally responsible for much of the depredation take. WS nationally took an annual average of 4,500 Ring-billed Gulls, 3,200 Herring Gulls, 1,700 California Gulls, 480 Franklin's Gulls, and 50 Bonaparte's Gulls (<1% of their populations) from FY06 to FY10. Nationally, for the same 5 species during FY06 and FY10, respectively, WS nationally hazed an annual average of 770,000, 1.8 million, 150,000, 64,000 and 13,000 illustrating the wide difference between hazing and take for gulls (gulls are typically conducive to being hazed except where the problem is ongoing). Colorado WS take, though, was only a very small fraction of the national take with 4 California Gulls, 2 Ring-billed Gulls, and 1 Franklin's Gulls taken. This number of gulls taken would have no noticeable effect on the population. USFWS in Colorado permitted the take of an average of 146 California Gulls, 28 Ring-billed Gulls, and 7 Franklin's Gulls, again very minimal numbers. Available data reflect stable to increasing populations of gulls in the BBS region and, thus, it appears that the limited take from WS and other permitted activities elsewhere, have not had a negative impact on these species' populations. WS anticipates possibly taking larger numbers of gulls in Colorado, but it would not be more than a few hundred of any one these species and just a few of any of the other species found in Appendix C: Table C3. This take would be a minor percentage of their expected annual mortality and within a level that would have an unnoticeable effect on their populations. It is anticipated that WS would haze many more gulls than would be taken lethally. It is concluded that the minor take by WS has and will not have an effect on the gull populations and WS does not believe that, from looking at the best available data, even the take of a few hundred gulls would cause declines in their populations.

Terns. Colorado hosts 4 tern species regularly (Appendix C: Table C1) and has had 8 species seen accidentally including the closely related Black Skimmer and jaegers. Terns are smaller than gulls, often sporting a forked tail, and differ largely in feeding technique (dive and plunge). In addition, terns, other than at the nesting colonies, are often solitary, form small groups, or fly in loose-knit flocks rather than groups in large flocks like gulls. Thus, they are not quite as much of a problem at airports. Airstrikes as a whole are much less likely to occur with terns than gulls; terns were responsible for 80 of the 4,372 larid airstrikes (2%) with known species reported to FAA from FY01 to FY10 (Appendix D); 6% of tern strikes caused damage. Additionally, some species can be a problem at aquaculture facilities as noted in Table C1 because they have a diet of fish. Skimmers are like large terns but do congregate in larger flocks and often loaf on beaches which could be near an airport. They feed by dragging their lower mandible along the water in search of small fishes and invertebrates in the water. They are typically confined to coastal waters, though, and only accidental in Colorado. The jaegers look like a combination between gulls and terns. However, they too fly in smaller flocks than gulls and are accidental in Colorado.

Of the species, the most common species seen yearly are the breeding Forster's Tern and Black Tern, and the migratory Common Tern and Caspian Tern. Their breeding populations have been estimated in North America, north of Mexico, to be 47,000-51,500, 100,000-500,000, 300,000, and 66,000-70,000, respectively. Additionally, a population of the federally threatened Least Terns may be breeding along the Arkansas River and some are found during migration. A few jaegers are also found almost annually during migration. Most of the remaining accidental species have only been seen once to only occasionally in the state. None of the terns winter in Colorado, all migrating further south. Any one of these species has the potential to be a problem should they be encountered at an airport. BBS survey-wide trend data (Sauer et al. 2011) from 1966 to 2009 for these species show nonsignificant ($P>0.05$) decreasing trends for Black, Forster's, and Least Terns and increasing trends for Caspian and Common Terns. None of the regularly occurring species in Colorado are especially rare. However, the Interior Least Tern is federally endangered and the Black Skimmer is species of concern. Declines in the Least Tern population have been tied to habitat availability, nest predation, and human activity at nest sites (Thompson et al. 1997). WS would require a special permit to harass or take this species, even though hazing at airports or contaminated sites would be beneficial for the tern, the two areas where WS would likely control them. Human disturbance at the nest site including vandalism of the nests has had the biggest impact on the Black Skimmer (Gochfeld and Burger 1994); this species is only expected to be found in Colorado rarely.

From FY06 to FY10, WS in Colorado did not take any terns, and nationally only took an annual average of 21 Black Terns, 1 Forster's Tern, 2 Common Terns, and 8 Caspian Terns. USFWS did not permit the take of any Terns in Colorado, and minimal numbers in the RMS area. WS did not surpass the take of 0.1% of any of these species which would have no noticeable effect on the tern populations. WS in Colorado anticipates that, at most, 25 of any of these species could be taken, but this would be expected to have no noticeable effect on the population. WS would not take any Least Terns in Colorado, but would contact USFWS if one becomes persistent at an airport to obtain a harassment permit.

Waterbirds

Several waterbirds are present in Colorado, most present in varying numbers year-round, though many migrate out of the State for winter. Breeding water birds in Colorado include the Double-crested Cormorants, American White Pelicans, Belted Kingfishers, and Pied-billed, Eared, and Western Grebes and, to a lesser extent, Clark's Grebes. Additionally, these species, the Common Loon, and the Horned Grebe migrate through or winter in Colorado. Additionally, 8 other species of water birds have been found accidentally in Colorado. BBS trend data (Sauer et al. 2011) suggest that most grebe populations are decreasing survey-wide, the Horned Grebe significantly ($P<0.05$) at -2.7%/year and the Pied-billed Grebe, Eared Grebe, and Western/Clark's Grebes nonsignificantly ($P>0.05$) from 1966-2009; the Belted Kingfisher is also decreasing significantly ($P<0.05$) at -1.5%/year; and three larger water birds are increasing, the American White Pelican and Common Loon nonsignificantly ($P>0.05$), and Double-crested Cormorant significantly at 4.7%/year. In Colorado, all breeding water birds are increasing except the kingfisher, the Pied-billed Grebe, Eared Grebe, and Western/Clark's Grebes nonsignificantly ($P>0.05$), and the American White Pelican and Double-crested Cormorant significantly ($P<0.05$) at 15.3%/year and 15.2%/year (Sauer et al. 2011); the Belted Kingfisher shows a nonsignificant ($P>0.05$) decline.

The typical damage associated with these birds is aircraft strikes, especially the larger ones such as pelicans and cormorants. Waterbirds were responsible for 228 strikes from FY01 to FY10 with a high percentage (59%) of them causing damage (Appendix D); only 1 of these water bird strikes was recorded in Colorado during this time with an American White Pelican and it caused significant damage. Where populations are especially abundant, damage can also occur to aquaculture facilities and sport fisheries. From FY06 to FY10, WS had lethal take of only an average of 0.6 Double-crested Cormorants and 0.2 American White Pelicans. Private persons targeted Double-crested Cormorants (ave. 57) and American

White Pelicans (ave. 36) under the appropriate USFWS depredation permits, and no other water birds. These were the only 2 species of water birds lethally taken in Colorado. It is possible that WS could target other water birds lethally should the need arise.

Double-crested Cormorants. While relatively few Double-crested Cormorants nest in Colorado, an estimate of 11,000 was made with 2006 to 2010 BBS data using no detectability parameters (USGS 2012). The U.S/Canada population has been estimated to have >740,000 breeders (Kushlan et al. 2002). Few cormorants winter in the State (estimated directly from CBC data using no detectability parameters at 410 (NAS 2011). BBS data indicate that the population increased survey-wide and in Colorado from 1966 to 2009 as discussed above (Sauer et al. 2011). As a result of the increased Double-crested Cormorant population, USFWS issued a depredation order in the eastern U.S., but not including Colorado, where people can take them without going through the normal permitting procedures "…*to reduce depredation of aquaculture stock at freshwater commercial aquaculture facilities and State/Federal fish hatcheries*.". However, USFWS must be notified of intentions to take cormorants.

WS provided assistance with cormorant depredation problems from FY06 to FY10 and averaged the take of 0.6 annually with a high of 2 in FY06. USFWS permitted individuals took an annual average 57 Double-crested Cormorants from 2006 to 2010 in Colorado with a high of 99 in FY06. Thus, the cumulative average was 58 with a maximum in FY06 of 101. Using the above population of 11,000, using no detectability parameters, the maximum take was estimated to be almost 1% of the breeding population, a negligible impact on the population. Take could easily increase ten-fold without impacting the population. If 25% of the population were breeding females (breed when 4 years old, though most breed when 3 years old (78%), and some 2 and 1 year olds), then an estimated 11,000 cormorants would fledge 4,900 young (the expected annual mortality) using an average of 1.8 nestlings fledged per nest and only one nest per season, though one study found that 1 in 3 nest double-clutched (Hatch and Weseloh 1999). In FY06, WS would have taken about 0.04% of the expected annual mortality of the conservatively estimated population and the cumulative impact in Colorado would have been 2% of the expected annual mortality. This level of take by WS and private permitted individuals would have a negligible impact on the population. Take would have to increase into the thousands before a moderate impact would occur.

Other Water Birds. WS does have the potential to take a few of the other water birds found in Colorado, especially the American White Pelican, because their population is abundant (>120,000 breeders nationwide and increasing at a fairly rapid rate (Kushlan et al. 2002), and they are very large and flocking. WS took 1 American White Pelican at an airport from FY06 to FY10, which is a minimal impact. USFWS permitted the take of 36 annually from 2006-2010, again a minimal take. Cumulative impacts would be less than those discussed for Double-crested Cormorants. WS anticipates that this species will be taken primarily because they can inflict serious damage to aquaculture and planes and will take no more than 100. WS anticipates that the cumulative impact for this species would no more than 5% of their conservatively estimated breeding population of 10,000 would be taken. The Grebes and loons could become a problem, but these mostly inhabit larger bodies of water, are not as abundant, and are fairly solitary. Thus, it is not likely that they will be encountered at airports in Colorado because few are adjacent to areas with large water. WS anticipates that it could take a few of each of these species, but that take will remain relatively low, under 10 of each. Thus, taking 10 from these species populations would have no more than a negligible impact on the population.

Woodpeckers

WS is requested to assist with woodpecker damage, most always for damage to structures, and averaged 72 work tasks annually from FY06 to FY10 for all woodpecker species (Table 1), but these requests only involved the Northern Flicker and Hairy Woodpecker. They can also damage crops and can be a strike risk at airports. Risks of woodpecker strikes at airports, though, are minimal with an average of 6 annually nationwide and only 1 in Colorado from FY01 to FY10 (Appendix D, Table D1). Some woodpeckers are abundant in Colorado (RMBO 2007, USGS 2012). Those with populations numbering over 50,000 include Northern Flicker, Hairy Woodpecker, and Red-naped Sapsucker. Those with populations from 10,000-50,000 are Lewis's Woodpecker, Williamson's Sapsucker, Downy Woodpecker, and American Three-toed Woodpecker. Those with populations under 10,000 are the Red-headed Woodpecker and Yellow-bellied Sapsucker, which are on the edge of their range in Colorado with higher populations in the East. Additionally, three species have been found accidentally in Colorado, though, the Acorn Woodpecker seems to have a colony in the southwestern part of the state.

Most woodpecker species are solitary (Acorn and possibly Lewis's Woodpeckers may live in colonies) and requests usually involve individual birds or nesting pairs. To illustrate potential impacts of BDM, the Lewis's Woodpecker (a more conservative breeder) will be used. Most woodpeckers breed at 1 year of age and have more than 1 brood per season, but a few, such as the Lewis's Woodpecker have only 1 brood. Most have 4 or more eggs per nest and fledge 1 or more young (Lewis's averages 5.88 eggs/nest and 0.59-2.9 (1.2 will be used) fledglings/nest). RMBO (2007) used a corrective factor for detectability of 11.52 and estimated their population in the 1990s at 20,000, but current BBS data (Sauer et al. 2011) reflects the non-significant ($P>0.05$) downward BBS trend for Colorado (-0.5%/year) from 1966 to 2009 and suggests a population of 13,000. The downward trend for local populations of Lewis's Woodpeckers has mostly been determined to be loss of nesting habitat and competition for nest sites with European Starlings (Tobalske 1997). Survey-wide BBS data shows a significant decrease from 1966 to 2009 (0.8%/year at $P=0.80$). The current annual mortality, assuming 80% females breed in a 50:50 male: female population, could be estimated at 6,200. Thus, if WS were to take 10% of the expected annual mortality of Lewis's Woodpeckers, 620 would be taken. WS does not anticipate taking any Lewis's Woodpeckers, but the take of few in any given year would not significantly impact their population. Similarly, the take of other woodpeckers is expected to be, at most, a minimal percentage of their expected annual mortality and will not likely surpass 1% of this number.

WS in Colorado did not lethally take any woodpecker from FY06 to FY10, and even since FY92. However, USFWS issued permits to private individuals in Colorado for the take of an annual average of 13 Northern Flickers and less than 1 Downy and Hairy Woodpecker. This level is minimal and take would not be noticeable at the population level. WS will continue to conduct limited BDM for woodpeckers, mostly technical assistance, and will not cause a significant impact to any of their populations. However, WS does anticipate that it could take some, especially flickers, but take would remain below 100, or less than 1% of their breeding population.

Gallinaceous Birds

Colorado has 13 species of gallinaceous birds with the most abundant and likely to be involved in BDM the Ring-necked pheasant (200,000), Wild Turkey (35,000), Scaled Quail (25,000), Northern Bobwhite (3,500), Gunnison's Sage-Grouse (13,000), and Greater Sage-Grouse (5,200) (population numbers from USGS (2012) with detectability parameters for RMBO (2007)); Populations for the other species are 1,000 Chukar, 2,000 White-tailed Ptarmigan, 34,000 Dusky Grouse, 17,000 Greater Prairie-Chickens, 210 Lesser Prairie-Chicken, and 1,100 Gambel's Quail. The Sharp-tailed Grouse is found in Colorado, but were not seen on BBS routes. Gallinaceous birds are primarily ground-dwellers with short, rounded wings and short strong bills. Flight is usually very brief for these species, as they prefer to walk. The primary damage that these species cause is damage to crops and safety hazards at airports. In the United States, gallinaceous birds were involved in an average of 11 strikes/year with 39% of those being damaging (Appendix D, Table D-1) from FY01 to FY10. The most common species struck were Wild Turkeys, Greater Sage-Grouse, and Ring-necked Pheasants. During that time, only one strike was recorded in Colorado and that was with a pheasant. The only species involved in BDM in Colorado from FY06 to FY10 was the Scaled Quail at an airport. None were taken, but they were hazed from an airfield annually averaging 32.

WS would need to get a permit from CPW to work on these species as they are monitored by the State. All of them have hunting seasons for them in Colorado. The 2010 harvest for these species was72,000 pheasants, 3,500 turkeys, 4,500 Scaled Quail, 4,300 Bobwhites, 450 Greater Sage-Grouse, 230 White-tailed Ptarmigan, 12,000 Dusky Grouse, 430 Sharp-tailed Grouse, and 320 Gambel's Quail. Some harvests are above the breeding population, and while that may seem impossible, gallinaceous birds tend to have large clutches and therefore, harvest can be higher than the actual breeding population. However, a few of the population estimates (*e.g.*, Bobwhite) are likely low. Since WS did not take any of these species lethally, WS had no long-term impact on any of them. WS expects not to take more than 1% of any of the breeding populations, which will have minimal potential to impact any of these species and be far less than harvest. WS concludes that it will have no effect on these species.

Frugivorous Birds

Several flocking fruit and seed eating birds are found in Colorado that can cause damage. The most notable of these, other than those discussed above such as starlings, are the American Robin, Northern Mockingbird, Cedar Waxwing, Bohemian Waxwing, Northern Cardinal, and House and Cassin's Finches. These species can damage fruit crops, but are the biggest problem for grape and berry growers. These species, especially the American Robin, can be strike threats at airports. In fact, from FY01 to FY10, these 6 species were involved in 529 strikes at airports in the United States with the robin responsible for 70% of these (13% of their strikes are damaging) (Appendix D, Table D-1). In Colorado, they were responsible for only 5 strikes (3 American Robins and 2 House Finches). American Robins, House and Cassin's Finches, and Northern Cardinals are found in Colorado year-round. The mockingbird is the only species that mostly leaves for the winter whereas the Bohemian Waxwings only winter in Colorado. Cedar Waxwings are here mostly during migration and winter, but do have a small breeding population. Breeding populations of the 6 species found here during nesting are 5.1 million robins, 340,000 mockingbirds, 7,600 Cedar Waxwings, 79,000 Cassin's Finches, and 240,000 House Finches (USGS 2012, detectability parameters from RMBO 2007).

The robin is most abundant and WS hazed an average of 70 annually from airports (Table 9), but did not take any. However, USFWS permitted the take of an average of 6 in Colorado from 2006-2010. This take would not be noticeable considering their population. The only other species to cause damage in Colorado was the House Finch. WS took an average of 2 from FY06 to FY10 (all 10 in FY10). USFWS permitted the take of an average of four. Again, a cumulative effect of 6 would have no noticeable effect on the population. WS in Colorado does not anticipate the take of many of any of these species because the fruit crop is not as big in Colorado as it is in other States and the biggest airports have little habitat for these species in comparison to other areas of the country. WS expects to take no more than 100 of any of these species, except the Bohemian Waxwing, which would not impact their populations. Bohemian Waxwings are only sporadically found in Colorado in the winter and they typically are not associated with damage; they could be hazed from an airport. WS does not expect to have more than an imperceptible impact on any of these species.

Other Birds

WS did not take or haze any other birds during BDM in Colorado. WS personnel did record an average of 2 work tasks annually from FY06 and FY10 for damage caused by White-breasted Nuthatches. Additionally, several sparrows, bluebirds, and thrushes were struck by aircraft in Colorado (Appendix D, Table D-1), but did not include these. It is possible that WS could work with other species given in Appendix C: Table C-2, primarily at airports, but does not expect to take any of these species. In fact, WS did not take any other species from FY93 to FY05 that were not discussed in this EA. The species of most concern in Table C-2 are the T&E and sensitive species. The only T&E species are the Spotted Owl and Southwestern Willow Flycatcher. The owl is found mostly in remote areas of Colorado and not near human habitations, thus it is not anticipated that WS will encounter them. The flycatcher is found along watercourses in western Colorado where WS work very little. Thus, neither species is expected to be encountered during BDM.

Impacts to T&E, and Sensitive Species Targeted in BDM

WS did not lethally or nonlethally target any federally or state listed T&E species from FY06 to FY10 (Tables 9 and 11), nor did private persons under a USFWS permit (Table 10). WS anticipates that encounters with these species could occur (Table 5 summarizes the potential), but that such requests would be rare. WS works with Bald and Golden Eagles (as discussed under raptors) and potentially the Piping and Mountain Plovers, Interior Least Terns, and Sprague's Pipit at airports hazing them from airfields because they have the potential to cause a catastrophic incident and be killed by aircraft. Hazing of these species from the air operating area of an airport would be beneficial, but can only be conducted after obtaining the necessary permit to haze eagles or T&E species for such an activity. Of the T&E and other sensitive birds listed in Table 5, but not including USFWS (2008) and Audubon (2007) sensitive species, 3 Scaled Quail, 26 Greater Sage-Grouse, 1 Sharp-tailed Grouse, 95 Bald Eagles, 15 Ferruginous Hawks, 132 Peregrine Falcons, 57 Sandhill Cranes, 1 Whooping Crane, 4 unknown cranes, 1 Snowy Plover, 2 Piping Plovers, 6 Long-billed Curlews, 24 Yellow-billed Cuckoos, 86 Burrowing Owls, and 4 Sprague's Pipits have been struck and killed in the United States by aircraft from FY01 to FY10 (Appendix D: Table D-1). Of these, 2 Bald Eagles, 8 Ferruginous Hawks, 2 Peregrine Falcons, 2 Sandhill Cranes, 2 Long-billed Curlews, 15 Burrowing Owls, and 1 Sprague's Pipit were struck at airports in Colorado.

WS took 6 Species of Management Concern (USFWS 2008b, NAS 2007), the Swainson's and Ferruginous Hawks (14), Prairie and Peregrine Falcons, Semipalmated Sandpiper, and Lark Bunting from FY06 to FY10. Additionally, some species such as the bald and Golden Eagles were hazed from air operating areas. As discussed above, take associated with these species was minimal and would not impact their populations. Thus, WS concludes that impacts to T&E and sensitive species by WS have been minor to nonexistent and it is expected to continue.

On another note, WS is conducting BDM for the protection of nesting Gunnison's Sage-Grouse from depredating Common Ravens. Common Ravens have increased beyond historical numbers and suppress the rare sage-grouse population from depredating eggs and nestlings. The Common Raven population is supplemented by anthropogenic food sources such as wildlife killed on highways and food at landfills. WS also has been asked to protect nesting Least Terns and Snowy Plovers along the Arkansas River from avian and mammalian predators.

4.1.1.2 Alternative 2 - Nonlethal BDM by WS Only. Under this alternative, WS would not lethally take any target species because lethal methods would not be used. CPW could provide some level of professional BDM assistance for lethal activities, but this would be limited by resources such as personnel available and funding and conducted without federal assistance. It is not likely that they would give a great deal of assistance because most are federally managed birds. Nonlethal activities conducted by WS would likely intensify, but result in similar levels of nonlethal activities as conducted under Alternative 1 with similar numbers of birds hazed or captured and released or relocated (Tables 9 and 10). Nonlethal harassment, could be ineffective for some bird species, in particular pigeons and raptors, and some birds would quickly become habituated to harassment techniques (*e.g.,* Canada Geese), and, thus, where lethal techniques would be implemented, such as to reinforce hazing efforts, WS would continue to conduct nonlethal control but with less success. This could be ineffective, especially at airports and for crop and property protection, and resource owners could become frustrated by WS's apparent lack of success. Therefore, private entities would conduct BDM, more than under Alternative 1, but resulting in, at most, similar levels of take of target species. Additionally, many nonlethal techniques cannot be used in certain situations (use of pyrotechnics in some residential areas to move roosts and at livestock feeding facilities such as dairies where their use can cause agitation of the livestock and loss of production). The primary difference between BDM under the current program and that conducted by private entities would be the use of chemicals and a reduced take of migratory birds requiring a depredation permit from USFWS. Private entities would rely on Avitrol and potentially Starlicide Complete which contains the chemical in DRC-1339, to control starlings, feral pigeons, and blackbirds. Technical grade DRC-1339 and A-C are currently available for use only by WS and could not be used by the public. This would likely lead to less species being taken under this alternative with chemical BDM methods. Additionally, not all private individuals would want to obtain a depredation permit from USFWS because of the application fee, and, thus, less migratory birds requiring a permit would likely be taken. As a result, this alternative would likely lead to private entities having somewhat less impacts to target bird species populations as described under Alternative 1, especially the species controlled with A-C (Canada Geese, and feral ducks and geese) and DRC-1339 (starlings, blackbirds, crows, and ravens). For the same reasons shown in the population impacts analysis in section 4.1.1.1, it is unlikely that introduced commensal birds, native doves, blackbirds, or other target bird populations would be impacted significantly by implementation of this alternative. Impacts and hypothetical risks of illegal chemicals and other methods under this alternative as described in Sections 2.1.3 and 2.2.3 would probably be greater than the proposed action, similar to Alternative 3, but less than Alternative 4. The use of illegal methods would lead to unknown risks to target species populations. For example, the nestlings and eggs in a nesting colony of 3,000 American White Pelicans and 1,458 nests were all killed (~2,400 chicks and eggs), except 1, because a man was frustrated with pelican damage (he had suffered $20,000 in losses to crops from trampling). The Minnesota Natural Resources Department had given him little support in trying to resolve the problem. So one day when he was at his wits end, he decided to take matters into his own hands. These types of problems will continue to occur without sufficient support.

4.1.1.3 Alternative 3 - WS Provides Technical Assistance Only for BDM. Under this alternative, WS would have no impact on any bird species population in Colorado because the program would not conduct any operational BDM activities. WS would offer advice to the public and other agencies on the BDM techniques that could be used to resolve different damage problems. CPW would likely provide some level of professional BDM assistance, but this would be limited by resources (i.e., personnel, funding, etc.) without federal assistance. Private efforts to reduce or prevent bird damage and perceived disease transmission risks would increase under this alternative and take would be similar to, but likely less than, the proposed action which would result in similar impacts on bird populations. DRC-1339 and A-C could not be used by private individuals or entities, and thus, take with these chemicals would be nil, but other BDM methods, primarily Starlicide Complete and Avitrol, would likely be used to make up for this loss. However, take would likely be much less for starlings because the efficacy of bait used by WS are much higher than the other potential methods that would be used. For the same reasons shown in the population impacts analysis in section 4.1.1.1, however, it is unlikely that starlings, feral pigeons, blackbirds, or other target bird populations would be significantly impacted by implementation of this alternative. Under this alternative, the hypothetical use of illegal methods for BDM would be high because frustrations from the inability of resources owners to reduce losses would be higher than under the proposed action because WS would not provide assistance in many situations. The use of illegal chemicals and other methods under this alternative as described in Sections 2.1.3 and 2.2.3 could lead to real but unknown impacts on target bird populations. Impacts and hypothetical risks of illegal chemical toxicant use under this alternative would probably be more than under Alternative 2 and less than under Alternative 4.

4.1.1.4 Alternative 4 - No Federal WS BDM. Under this alternative, WS and other federal agencies would have no impact on any bird species populations in Colorado. CPW would likely provide some level of professional BDM assistance, but this would be limited by the available resources (i.e., personnel, funding, etc.) without federal assistance. Private efforts to reduce or prevent depredations would increase which would result in impacts on target species populations similar to those, but likely less in some categories (*e.g.*, starling take at feedlots), but more in others (*e.g.*, bird take at airports) that would occur under Alternative 1. Thus, impacts on target species under this alternative could be the same, less, or more than those of the proposed action depending on the level of effort expended by private persons and the available tools. For the same reasons shown in the population impacts analysis in section 4.1.1.1 it is unlikely that any target bird populations would be impacted significantly by implementation of this alternative with the exception of T&E species at airports. Technical grade DRC-1339 and A-C are currently only available for use by WS employees and therefore, take with these chemicals would be nil. Use of Avitrol and Starlicide Complete (contains the same chemical that is in DRC-1339) would likely increase, but it is expected that the individuals implementing BDM with these methods would not be as effective as WS. Thus, some species take would likely be less. Under this alternative, the hypothetical use of illegal methods for BDM would be greatest of the alternatives because frustrations from the inability of resources owners to reduce losses would be highest and the State is not obligated to handle depredations because most species are federally controlled. The use of illegal chemicals and other methods under this alternative as described in Sections 2.1.3 and 2.2.3 could lead to real but unknown impacts on target bird populations.

4.1.2 Effects of BDM on Nontarget Species Populations, Including T&E Species

Nontarget species can be impacted by BDM whether implemented by WS, other agencies, or the public. Impacts can range from direct take while implementing BDM methods to indirect impacts resulting from implementing BDM methods (*e.g.*, birds entangled in netting meant only to keep them out of an area) and reduction of a bird species in a given area (positive impact on nesting song birds from the removal of brow-headed cowbirds where nest parasitism is high as discussed in Section 1.3.7). Measures are often incorporated into BDM to reduce impacts to nontarget species. Various factors may, at times, preclude use of certain methods, so it is important to maintain the widest possible selection of BDM tools for resolving bird damage problems. However, the BDM methods used to resolve damage must be legal and biologically sound. Often, but not always, impacts to nontarget species can be minimized. Where impacts occur, they are mostly of low magnitude in terms of nontarget species populations. Following is a discussion of the various impacts under the alternatives.

4.1.2.1 Alternative 1 - Continue the Current Federal BDM Program. From FY06 to FY10, WS lethally took 1 Killdeer, 1 Semipalmated Sandpiper, and 1 Least Sandpiper during disease monitoring for an average of 0.6 birds killed per year, a minimal take. It should be noted that these birds were target species in the operation, but accidentally died during mist-netting. Additionally, WS released an annual average of 18 Scaled Quail, 3 Mourning Doves, 1 Great-tailed Grackle, and 0.2 Northern Flickers for an average of 22 birds caught, but released from FY06 to FY10. The annual average was 23 unintentional targets/nontargets from FY06 to FY10. From FY95-FY05, WS did not lethally take any other species in BDM.

Nontarget take by WS has been minimal compared to target take, 0.01% of total take for FY06 to FY10, and would not impact any of these species populations. Take was analyzed in Section 4.1.1.1 for most of these species and none would be noticeably be impacted because all of the species populations are relatively abundant. Although it was possible that some nontarget birds were unknowingly killed by use of DRC-1339 for starling, blackbird, and pigeon control, the method of application is designed to minimize or eliminate that risk. For example, during projects where DRC-1339 was used, the appropriate type and size of bait material was selected to be the most acceptable to the target species. The treated bait is only applied after a period of prebaiting with untreated bait material and observation in which nontarget birds are not observed coming to feed at the site. In some cases, DRC-1339 is applied on elevated stands, platforms, or other restricted locations to further minimize potential impacts to ground feeding birds or any other animals. While every precaution is taken to safeguard against taking nontarget birds, at times changes in local flight patterns and other unanticipated events can result in the incidental take of unintended species. This is particularly true for bait substrates preferred by nontarget species such as rice which is not used in Colorado. However, even hazards to nontarget species with rice baits were found to be low (Cummings et al. 2003). These occurrences are rare and should not affect the overall populations of any species under the current program.

WS has the potential to provide unintended beneficial impacts to species by conducting BDM for bird species that impact other wildlife species. The take of starlings and Brown-headed Cowbirds, as discussed in Section 1.3.7, could be beneficial at a very local level, but as described in Section 4.1.1.1, WS does not anticipate that populations of either species has been affected by BDM. BDM for these species would have to be focused during the nesting period when and where WS could reduce these species breeding populations during a critical time period, for example during the nesting season of the Southwestern Willow Flycatcher. Thus far, BDM has not been done to protect these species, thus any benefit to other species was unintentional.

***T&E Species Impacts*.** WS has not had an impact on any federally listed T&E or candidate species (Table 7) in Colorado from FY93 to FY10. T&E species and potential impacts were discussed in Section 2.1.2 and SOPs to avoid T&E impacts were described in Section 3.5 and, specifically, in Section 3.5.2.2. The inherent safety features of most BDM methods such as DRC- 1339 has precluded or minimized hazards to listed species. A formal risk assessment was conducted on the use of DRC 1339 and other methods used in BDM and found minimal hazards to nontarget species (USDA 1997, Appendix P). Those measures and characteristics should assure there would be no jeopardy to T&E species or adverse impacts on mammalian or non-T&E bird scavengers from the proposed action. None of the other control methods described in the proposed action alternative pose any hazard, other than potentially the short term harassment or capture, to nontarget or T&E species. WS completed a Section 7 consultation with USFWS in 2011 and USFWS concurred with the SOPs that WS has in place to avoid the take of T&E species. USFWS and WS did not anticipate affecting T&E species other than potentially inadvertently hazing them at an airport while WS personnel were hazing other species. Raptor traps, mist nets, noose mats, and toxicants could have the potential for also taking other species, but SOPs are in place to avoid take. On the other hand, BDM could unintentionally benefit T&E species. Examples of potential benefits to a listed T&E species would be the reduction of local cowbird populations which could reduce nest parasitism on the endangered Southwestern Willow Flycatcher or the management of birds that could directly predate on adult Interior Least Terns or Snowy Plovers, their nests, eggs or young, as discussed above. And finally, birds accidentally hazed from airfields would be beneficial because they have the potential to be struck by aircraft and killed.

4.1.2.2 Alternative 2 - Nonlethal BDM by WS Only. Under this alternative, WS would kill few nontarget animals because lethal methods would not be used. Some nonlethal BDM methods have the potential to take nontarget species such as entanglement and death in netting, but even so, nontarget take would be minimal and less than under the proposed action. However, all of WS lethal and nonlethal take of nontarget species from FY06 to FY10 were with methods considered nonlethal, and therefore, nontarget take would not differ substantially from the current program. Under this alternative, CPW might provide some level of professional BDM assistance with lethal control activities, but this would be limited by resources (i.e., personnel, funding, etc.) without federal assistance. CPW take of nontarget species would likely be similar to WS's and be minimal, if it occurred. On the other hand, individuals and organizations whose bird damage problems were not effectively resolved by nonlethal control methods alone would likely resort to other means of lethal control such as use of shooting by private persons or use of chemical toxicants. This could result in less experienced persons implementing control methods and could lead to greater take of nontarget wildlife than the proposed action. For example, shooting by persons not proficient at bird and damage identification could lead to killing of nontarget birds. It is hypothetically possible that frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could lead to unknown impacts on local nontarget species populations, including T&E species. Hazards to raptors, including Bald Eagles and falcons, could therefore be greater under this alternative if chemicals, that are less selective or that cause secondary poisoning, are used by frustrated private individuals. Therefore, it is likely that nontarget take under this alternative would be greater than under the proposed action and could include T&E and sensitive species.

4.1.2.3 Alternative 3 – WS Provides Technical Assistance Only for BDM. Alternative 3 would not allow WS to conduct any direct operational BDM in Colorado and therefore, WS would not have an impact on nontarget or T&E species. CPW might provide some level of professional BDM assistance, but this would be limited by resources (i.e., personnel, funding, etc.) without federal assistance, but being mostly species federally managed, they likely would not respond, except with technical assistance. Any BDM efforts offered by CPW would likely result in similar levels of nontarget species take as that of WS which has been minimal. WS would provide technical assistance or self-help information at the request of producers and others. This technical support might lead to selective use of control methods by private parties, more than that which might occur under Alternative 4, but private efforts to reduce or prevent depredations could still result in less experienced persons implementing control methods leading to greater take of nontarget wildlife than under the proposed action. The take of nontarget species would likely be more than under Alternative 2 because WS would not provide any operational support to resolve damage problems. It is hypothetically possible that, probably to a greater extent than under Alternative 2, frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants which could lead to unknown impacts on local nontarget species populations, including some T&E species. Hazards to raptors, including Bald Eagles, fish, aquatic species, and other nontarget species could therefore be greater under this alternative if chemicals are used by frustrated private individuals that cause secondary poisoning, leach into wetlands, and kill indiscriminately.

4.1.2.4 Alternative 4 - No Federal WS BDM. Alternative 4 would not allow WS or any other federal agency to conduct BDM in Colorado and therefore, no impact would occur to nontarget or T&E species by WS BDM activities. CPW might provide some level of professional BDM assistance, but this would be limited by resources (i.e., personnel, etc.) without federal assistance. Individuals and organizations with bird damage problems would likely conduct control themselves and use methods such as use of shooting more often or increase the use of available toxicants, thereby increasing nontarget take over that which already occurs. Since private efforts to reduce or prevent depredations would increase and less experienced persons would likely implement control methods, nontarget take of wildlife would likely be greater than under the proposed action or the other 2 alternatives. This is partially due to the lack of using SOPs to minimize nontarget take such as WS's self-imposed restrictions and policies to minimize or nullify nontarget take. It is hypothetically possible that frustration caused by the inability to reduce losses could lead to illegal use of chemical toxicants as described in Sections 2.1.3 and 2.2.3 which could impact local nontarget species populations, including some T&E and sensitive species. Hazards to raptors, including Bald Eagles, could therefore be greater under this alternative if chemicals, that are less selective or that cause secondary poisoning, are used by frustrated private individuals suffering damage that they cannot abate. USDA (1997) demonstrated that under the no federal program alternative, more nontarget animals would be affected. The hypothetical use of chemical toxicants and illegal BDM methods could impact nontarget species populations, including T&E species, under this alternative. It is, therefore, likely that the most impacts to nontarget species would occur under this alternative than under the current program and the other alternatives. Use of illegal chemicals and other methods could lead to significant, but unknown, impacts, especially to sensitive species.

4.1.3 Effects of BDM on Public and Pet Safety and the Environment

The public, pets, and the environment can be impacted by BDM whether implemented by WS, other agencies, or the public. Impacts can range from direct injury while implementing BDM methods to indirect impacts resulting from implementing BDM methods (*e.g.*, impacts to water quality from chemicals used in BDM leaching into the system). SOPs are often incorporated into BDM to minimize or nullify risks to the public, pets, and the environment. Various factors may, at times, preclude use of certain methods, so it is important to maintain the widest possible selection of BDM tools for resolving bird damage problems. However, the BDM methods used to resolve bird damage must be legal and biologically sound. Following is a discussion of the various impacts under the Alternatives.

4.1.3.1 Alternative 1 - Continue the Current Federal BDM Program. BDM methods that might raise safety concerns include the use of firearms, pyrotechnics for hazing, traps, cage traps, and chemical repellents, toxicants, drugs, and reproductive inhibitors. WS poses minimal threat to people, pets and the environment with BDM methods such as shooting, hazing with pyrotechnics, trapping, and use of chemicals (USDA 1997-Appendix P). All firearm and pyrotechnic safety precautions are followed by WS when conducting BDM and WS complies with all applicable laws and regulations governing the lawful use of firearms. Shooting with shotguns or rifles is used to reduce bird damage when lethal methods are determined to be appropriate. Shooting is selective for target species. Firearms are only used by WS personnel who are experienced in handling and using them. Firearm use is very sensitive and a public concern because firearms can be misused. To ensure safe use and awareness, WS employees who use firearms to conduct official duties "*will be provided safety and handling training as prescribed in the WS Firearms Safety Manual and continuing education training on firearms safety and handling will be taken biennially by all employees who use firearms*." (WS Directive 2.615). WS personnel, who use firearms as a condition of employment, are required to certify that they meet the criteria as stated in the Lautenberg Amendment. WS also follows safety precautions and WS Policies when using pyrotechnics. WS uses a variety of traps for birds such as decoy cage traps. These are strategically placed to minimize exposure to the public and pets. Appropriate signs are posted on all properties where traps are set to alert the public of their presence. WS in Colorado has had no accidents involving the use of firearms, pyrotechnics or traps in which a member of the public or a pet was harmed. A formal risk assessment of WS' operational management methods found that risks to human safety were low (USDA 1997, Appendix P). Therefore, no significant impact on human safety from WS' use of non-chemical BDM methods is expected.

WS personnel that use avian toxicants are certified through CDA. One toxicant is currently used in BDM, DRC-1339. Immobilization and euthanasia drugs are used only by WS personnel trained and certified to use them per WS policy. WS personnel abide by WS policies and SOPs, and federal and state laws and regulations when using BDM methods that have potential risks. The same would apply to immunocontraceptives should they become registered for use in Colorado.

<u>DRC-1339 (3-chloro-p-toluidine hydrochloride)</u>. DRC-1339 is the primary lethal chemical BDM method that would be used under the current program alternative. WS used an average of about 1.9 pounds of DRC-1339 from FY06 to FY10 with a high of 4.1 pounds used in FY08 (Table 6). There has been some concern expressed by a few members of the public that unknown but significant risks to human health may exist from DRC-1339 used for BDM.

DRC-1339 is one of the most extensively researched and evaluated pesticides ever developed in the field of wildlife management. Over 30 years of studies have demonstrated the safety and efficacy of this compound. USDA (1997, Appendix Q) provides detailed information on this chemical and its use in BDM. Factors that virtually eliminate any risk of public health problems from use of this chemical are:

- Federal label and State law requires that the chemical be applied only by an individual trained and certified in its use; that the chemical be applied under strict guidelines in regard to suitable locations and bait materials to be used.

- DRC-1339 is highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation. The half-life is about 25 hours, which means that the chemical on treated bait material generally is nearly 100% broken down within a week.

- The chemical is more than 90% metabolized in target birds within the first few hours after they ingest the bait. Therefore, little material is left in bird carcasses that may be found or retrieved by people.

- The application rates are extremely low (< 0.1 lb. of active ingredient per acre) (EPA 1995).

- People or pets would need to ingest the internal organs of birds found dead from DRC-1339 to have any chance of receiving even a minute amount of the chemical or its metabolites into their system. This is highly unlikely to occur with people and pets could not likely eat enough dead birds to receive a lethal dose.

- EPA concluded that, based on studies of mutagenicity (the tendency to cause gene mutations in cells), this chemical is not a mutagen or a carcinogen (i.e., cancer-causing agent) (EPA 1995). Regardless, however, the extremely controlled and limited circumstances in which DRC-1339 is used would prevent any exposure of the public to this chemical.

The above analysis indicates that human health risks from DRC-1339 use would be virtually nonexistent under any alternative.

Other BDM Chemicals. Other nonlethal BDM chemicals that might be used or recommended by WS include repellents such as methyl anthranilate (MA is the artificial grape flavoring used in foods and soft drinks sold for human consumption), which has been used as an area repellent and is researched as a livestock feed additive, methiocarb (used in eggs), tactile polybutene repellents, nicarbazin (OvoControl™ G) reproductive inhibitor, and A-C (WS only used a minimal amount of A-C from FY06 to FY10 in Colorado, but these have the potential for use). Such chemicals must undergo rigorous testing and research to prove safety, effectiveness, and low Environmental risks before they would be registered by EPA or FDA. Any operational use of these chemicals would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations which are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions are a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on human health.

Based on a thorough Risk Assessment, APHIS concluded that, when WS program chemical methods are used in accordance with label directions, they are highly selective to target individuals or populations, and such use has negligible impacts on the environment (USDA 1997, Appendix P). WS did not have any known incidents involving the public or pets conducting BDM from FY06 to FY10.

Thus, WS poses minimal risks to public and pet health and safety when implementing BDM. In fact, WS can reduce public safety hazards. Many WS BDM projects have been to reduce the potential for bird strikes with aircraft at airports and a reduction in roosting birds that pose a threat to people from disease. Several BDM projects have been conducted to remove roosting birds such as pigeons from residential areas where the birds and their droppings are a potential disease source. Thus, this alternative would reduce threats to public health and safety by removing birds from sites where they pose a potential strike hazard to aircraft or have the potential of transmitting a disease.

4.1.3.2 Alternative 2 - Nonlethal BDM by WS Only. Alternative 2 would not allow for any lethal methods use by WS. WS would only implement nonlethal methods such as harassment with shooting firearms and pyrotechnics, live traps followed by relocation, repellents (*e.g.,* methiocarb, MA, and polybutene tactile repellents), tranquilizing drugs (A-C), and reproductive inhibitors (nicarbazin). As discussed under Alternative 1, use of these BDM devices is not anticipated to have more than minimal risks to the public, pets, and the environment. The public is often especially concerned with the use of chemicals. The nonlethal chemicals that could be used by WS in BDM, excluding toxicants, were discussed above and not expected to impact the public, pets, or the environment. Such chemicals must undergo rigorous testing and research to prove safety, effectiveness, and low Environmental risks before they would be registered by EPA or FDA. Any operational use of chemical repellents and tranquilizer drugs would be in accordance with labeling requirements under FIFRA and state pesticide laws and regulations and FDA rules which are established to avoid unreasonable adverse effects on the environment. Following labeling requirements and use restrictions is a built-in mitigation measure that would assure that use of registered chemical products would avoid significant adverse effects on human health.

CPW would likely provide some level of professional BDM assistance with lethal control activities, but this would be limited by resources (i.e., personnel, funding, etc.) without federal assistance. The impact on human and pet health and safety from CPW activities would likely be similar to WS's and be minimal. Excessive cost or ineffectiveness of nonlethal techniques could result in some individuals or entities to reject WS's assistance and resort to lethal BDM methods. Private efforts to reduce or prevent damage would be expected to increase, resulting in less experienced persons implementing lethal BDM methods such as use of firearms and leading to greater risks than under Alternative 1. However, because some of these private parties would be receiving advice and instruction from WS, concerns about human health risks from firearms and chemical BDM methods use should be less than under Alternative 3 or 4. Commercial pest control services would be able to use Starlicide Complete (where available) which contains the chemical in DRC-1339, and Avitrol, and such use would likely occur more often in the absence of WS's assistance than under Alternative 1. Use of these chemicals in accordance with label requirements should avoid any hazard to members of the public. It is hypothetically possible that frustration caused by the inability to alleviate bird damage could lead to illegal use of certain methods such as toxicants that, unlike WS's controlled use of DRC-1339 and A-C, could pose secondary poisoning hazards to pets and to mammalian and avian scavengers. Some chemicals that could be used illegally would present greater risks of adverse effects on humans, pets, and the environment than those used under the current program alternative.

4.1.3.3 Alternative 3 - WS Provides Technical Assistance Only for BDM. Alternative 3 would not allow any direct operational BDM assistance by WS in the State. WS would only provide advice and, in some cases, equipment or materials (i.e., by loan or sale) to other persons who would then conduct their own damage management actions. Concerns about human health risks from WS implementing BDM under this alternative would be nullified. Additionally, DRC-1339 and A-C are only registered for use by WS personnel and would not be available for use by private individuals; Starlicide Complete and Avitrol may be available to private pesticide applicators in some areas. CPW would likely provide some level of professional BDM assistance with BDM and use methods that have risks associated with them. The impact on human and pet health and safety from CPW activities would likely be similar to WS's and be minimal. Private efforts to reduce or prevent damage would be expected to increase, resulting in less experienced persons implementing damage management methods and leading to a greater risk than the Proposed Action Alternative. However, because some of these private parties would be receiving advice and instruction from WS, people, pets, and the environment may not be as at great a risk compared to persons using hazardous BDM methods with no instruction, similar to that discussed under Alternative 4. CPW may provide some services and risks from BDM method use would be similar to the proposed action for projects they completed. Commercial pest control services would be able to use Avitrol and such use would likely occur to a greater extent in the absence of WS's assistance. Use of Avitrol in accordance with label requirements should avoid any hazard to members of the public. It is hypothetically possible that frustration caused by the inability to alleviate bird damage, as discussed in Sections 2.1.3 and 2.2.3, could lead to illegal use of certain toxicants that, unlike WS's controlled use of firearms, pyrotechnics, traps, and chemicals, could pose secondary poisoning hazards to pets and to mammalian and avian scavengers. Some chemicals that could be used illegally would present greater risks of adverse effects to humans and the environment, than those used under the Current Program Alternative. Therefore, risks to people, pets, and the environment would be expected to be greater under this alternative than the proposed action, but similar and possibly greater than Alternative 2. Risks, though, would be less than under Alternative 4.

4.1.3.4 Alternative 4 - No Federal WS BDM. Alternative 4 would not allow WS or any other federal agency to conduct BDM in the State. Therefore, concerns about risks to people, pets, and the environment from WS would be nullified. DRC-1339 and A-C, registered for use only for WS personnel, would not be available for use by private individuals. CPW might provide some level of professional BDM, and their actions and associated risks would be similar to Alternative 1. Private efforts to reduce or prevent damage would be expected to increase, resulting in less experienced persons implementing BDM methods and potentially leading to greater risks to people, pets, and the environment as has been described under the alternatives. Commercial pest control services would be able to potentially use Starlicide Complete and Avitrol, and other available pesticides and requests for such use would likely be greater than present in the absence of WS's assistance. However, use of Starlicide Complete or other BDM chemicals in accordance with label requirements should avoid any hazard to members of the public. It is hypothetically possible that frustration caused by the inability to alleviate bird damage could lead to the use of illegal methods such as certain toxicants that could pose risks to people, pets, and the environment and these risks would likely be highest under this alternative compared to the other three. Therefore, BDM methods and their associated risks, and illegal activities would be greater under this alternative than under Alternatives 1, 2, and 3.

4.1.4 Effects of BDM on Aesthetics

Aesthetics is the philosophy dealing with the nature or appreciation of beauty. Therefore, aesthetics is truly subjective in nature and wholly dependent on what an observer regards as beautiful. On the one hand, birds are often regarded as being aesthetic. In addition, birds can provide economic and recreational benefits (Decker and Goff 1987), and the mere knowledge that they exist is a positive benefit to many people. Wildlife populations provide a range of social and economic benefits (Decker and Goff 1987). These include direct benefits related to consumptive and non-consumptive use (i.e. wildlife-related recreation, observation, harvest, sale), indirect benefits derived from vicarious wildlife related experiences (i.e., reading, television viewing), and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (i.e., ecological, existence, bequest values) (Bishop 1987). These positive traits of wildlife generally become incorporated into their overall aesthetic value.

On the other hand, aesthetics also includes the environment in which people live including public and private lands. The same wildlife populations that are enjoyed by many also create conflict with a number of land uses and human health and safety. The activities of some wildlife, such as starlings and blackbirds, result in economic losses to agriculture and damage to property. Human safety is jeopardized by wildlife collisions with aircraft, and wild animals may harbor diseases transmissible to humans. Damage by, or to, wildlife species that have special status, such as T&E species, is a public concern. Certain species of wildlife are regarded as nuisances in certain settings. Some people do not enjoy viewing the local environment with excessive bird excrement covering walkways, lawns and structures. These are negative values associated with birds and damages they can inflict.

Public reaction is variable and mixed because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts and problems between humans and wildlife. The population management (capture and euthanasia) method provides relief from damage or threats to human health or safety to urban people who would have no relief from such damage or threats if nonlethal methods were ineffective or impractical. Many people directly affected by problems and threats to human health or safety caused by birds insist upon their removal from their property or public location when the wildlife acceptance capacity is exceeded. Some people have the view that birds should be captured and relocated to a rural area to alleviate damage or threats to human health or safety. Some people directly affected by the problems caused by birds strongly oppose the removal of the birds regardless of the amount of damage. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of birds such as pigeons from specific locations or sites. Some of the totally opposed people want to teach tolerance for bird damage and threats to human health or safety, and that birds should never be captured or killed. Some of the people who oppose removal of birds do so because of human-affectionate bonds with individual birds such as pigeons or magpies. These human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment.

Human dimensions of wildlife management include identifying how people are affected by conflicts between them and wildlife, attempting to understand people's reactions, and incorporating this information into policy and management decision processes and programs (Decker and Chase 1997). Wildlife acceptance 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. Wildlife acceptance capacity is also known as the cultural carrying capacity. This primarily involves wildlife aesthetics and acceptance of their management. These terms are important in urban areas because they define the sensitivity of a local community to a specific wildlife species. For any given damage situation, thresholds for those directly and indirectly affected by the damage will vary. This damage threshold is a primary factor in determining the wildlife acceptance capacity. Once this wildlife acceptance capacity is met or exceeded, people will begin to implement population control methods, including capture and euthanasia, to alleviate property damage and human health or safety threats related to the accumulation of fecal droppings.

4.1.4.1 Alternative 1 - Continue the Current Federal BDM Program. Some people who routinely view or feed individual birds such as feral domestic pigeons or urban waterfowl would likely be disturbed by removal of such birds under the current program. WS is aware of such concerns and considers this issue seriously prior to implementing BDM. In some projects, mitigation measures can be incorporated into BDM to reduce or nullify impacts. For example, in urban situations where waterfowl are damaging resources, WS could selectively capture the target species (coots, ducks, geese, etc.) utilizing A-C or trapping without disturbing the other waterfowl species that are present and deemed enjoyable to the public. This strategy could also be utilized on individual birds that could be creating a damage problem. This type of consideration can help to mitigate adverse effects on local peoples' enjoyment of certain individual birds or groups of birds.

Some people have expressed opposition to the killing of any birds during BDM activities. Under the current program, lethal and nonlethal control of birds would continue and these persons would continue to be opposed. However, many persons who voice opposition have no direct connection or opportunity to view or enjoy the particular birds that would be killed by WS's lethal control activities. Lethal control actions would generally be restricted to local sites and to small, unsubstantial percentages of overall populations. Therefore, the species subjected to limited lethal control actions would remain common and abundant and would, therefore, continue to remain available for viewing by persons with that interest.

Some people do not believe that geese, herons, and egrets or nuisance feral pigeon, blackbird, or starling roosts should even be harassed to stop or reduce damage problems. Some people who enjoy viewing birds could feel their interests are harmed by WS's nonlethal bird harassment activities. Mitigating any such impact, however, is the fact that overall numbers of birds in the area would not be diminished by the harassment program and people who like to view these species could still do so on State wildlife management areas, National Wildlife Refuges, or on numerous private property sites where the owners are not experiencing damage to the birds and are tolerant of their presence.

Under this alternative, operational assistance in reducing nuisance pigeon and other bird problems in which droppings from the birds cause unsightly mess would improve aesthetic values of affected properties in the view of property owners and managers.

Relocation of nuisance roosting or nesting populations of birds (*e.g.*, blackbird/starling roosts, vulture roosts) with harassment can sometimes result in the birds causing the same or similar problems at the new location. If WS is providing direct operational assistance in relocating such birds, coordination with local authorities to monitor the birds' movements is generally conducted to assure they do not reestablish at other undesirable locations.

Therefore, we believe that bird populations will not be impacted under this alternative and people will have continued opportunities to see and enjoy wildlife. At the same time, those that find wildlife undesirable at specific locations (*e.g.*, geese on golf courses) would be able to enjoy the site without specific types of damages (*e.g.*, excrement on walkways and fairways). Thus, the broadest satisfaction would likely be available under this alternative.

4.1.4.2 Alternative 2 - Nonlethal BDM by WS Only. Under this alternative, WS would not conduct any lethal BDM but would still conduct harassment of birds that cause damage. Some people who oppose lethal control of wildlife by government but are tolerant of government involvement in nonlethal BDM would favor this alternative. Persons who have developed affectionate bonds with individual wild birds would not be affected by WS's activities under this alternative because the individual birds would not be killed by WS. However, other private entities would likely conduct similar BDM activities as those that would no longer be conducted by WS which means the impacts would then be similar to the current program alternative.

Under this alternative, WS would be restricted to nonlethal methods only. Nuisance pigeon problems would have to be resolved by nonlethal barriers and exclusion methods. Assuming property owners would choose to allow and pay for the implementation of these types of methods, this alternative would result in nuisance pigeons and other birds relocating to other sites where they would likely cause or aggravate similar problems for other property owners. Thus, this alternative would most likely result in more property owners experiencing adverse effects on the aesthetic values of their properties than the current program alternative. Many of the current materials used for barriers (netting, metal flashing, wire, etc.) could, in some cases, reduce the aesthetic property value.

Thus, it is anticipated that bird populations would not be impacted under this alternative, but some people may have more problems with bird damage than under the proposed action.

4.1.4.3 Alternative 3 - WS Provides Technical Assistance Only for BDM. Under this alternative, WS would not conduct any direct operational BDM but would still provide technical assistance or self-help advice to persons requesting assistance with bird damage. WS would also not conduct any lethal take or harassment of birds such as geese, blackbirds, starlings, and other birds that were causing damage. Some people who oppose direct operational assistance in BDM by the government but favor government technical assistance would favor this alternative. Persons who have developed affectionate bonds with individual wild birds would not be affected by WS activities under this alternative because the individual birds would not be killed or harassed by WS. However, other private entities would likely conduct similar BDM activities as those that would no longer be conducted by WS which means the impacts would then be similar to the current program alternative.

Under this alternative, the lack of operational assistance in reducing nuisance pigeon and other bird problems would mean aesthetic values of some affected properties would continue to be adversely affected but this would not occur to as great a degree as under the No Program Alternative. This is because some of these property owners would be able to resolve their problems by following WS's technical assistance recommendations.

Relocation of birds at airfields or those that damage and nuisance roosting or nesting population of birds (*e.g.*, blackbird/starling roosts, vulture roosts) through harassment, barriers, or habitat alteration can sometimes result in the birds causing the same problems at the new location. If WS has only provided technical assistance to local residents or municipal authorities, coordination with local authorities to monitor the birds' movements to assure the birds do not reestablish in other undesirable locations might not be conducted. In such cases, limiting WS to technical assistance only could result in a greater chance of adverse impacts on aesthetics of property owners at other locations than the current program alternative.

4.1.3.4 Alternative 4 - No Federal WS BDM. Under this alternative, WS would not conduct any lethal removal of birds nor would the program conduct any harassment of blackbirds, geese, raptors, herons and other birds. Persons who have developed affectionate bonds with individual wild birds would not be affected by WS under this alternative. However, other private entities would likely conduct similar BDM activities as those that would no longer be conducted by WS which means the impacts would then be similar to the current program alternative. If frustrated individuals could not stop damage, they may cause more harm to birds and therefore, could impact aesthetics for some individuals.

Under this alternative, the lack of WS support in BDM in reducing nuisance pigeon and other bird problems where droppings cause unsightly messes would mean aesthetic values of some affected properties would continue to be adversely affected if the property owners were not able to achieve BDM some other way. In many cases, this type of aesthetic "damage" would worsen because property owners would not be able to resolve their problems and bird numbers would continue to increase.

4.2 SUMMARY AND CONCLUSION

The Environmental effects of implementing BDM correspond with those raised and discussed in detail in Chapter 4 of USDA (1997). Impacts associated with activities under consideration here are not expected to be "significant." Based on experience, impacts of the BDM methods and strategies considered in this document are very limited in nature. The addition of those impacts to others associated with past, present, and reasonably foreseeable future actions, as described in USDA (1997), will not result in cumulatively significant environmental impacts. Monitoring the impacts of the program on the populations of both target and nontarget species will continue. All bird control activities that may take place will comply with relevant laws, regulations, policies, orders, and procedures, including the Endangered Species Act, Migratory Bird Treaty Act, and FIFRA. A summary of the overall effects of the BDM alternatives relative to the issues is given in Table 29. The current program alternative provides the lowest overall negative environmental consequences combined with the highest positive effects.

Table 29. A summary of the Environmental consequences of each program alternative relative to each issue.

ISSUE	POTENTIAL IMPACT	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
Target Spp.	Non-Sensitive	0	0	0	0
	Sensitive	0	0	0	-/0
Nontarget Spp.	Non-Sensitive	0	0	0	0
	Sensitive	0/++	-/+	-/0	-/0
Risks – Adverse	People & Pets	-/0	--/0	--/0	--/0
	Environment	-/0	--/0	--/0	--/0
- Beneficial	People & Pets	++	+	+	0/+
Aesthetics	Enjoyment	-	-	-	-
	Damage	++	+	+	0/+

Ratings: "- -" = High Negative; "-" = Low Negative; "0" = None; "+" = Low Positive, and "++" = High positive.

Note: While a control action or removal might have a negative effect on that individual animal or issue, removing the individual bird could also have a positive effect on a T&E species.

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APPENDIX A: BIRD POPULATION ESTIMATES

Population estimates for species taken lethally by WS BDM with an average of 10 or more from 2006-2010) in Colorado for the more migratory species in the Rocky Mountain States (RMS) of Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming. The final Table gives estimates for only Colorado for the more resident species taken lethally and any other species that had a take of greater than 10 in any year from 2006 to 2010.

Table A1. Breeding Mourning Dove population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	40.835	10.48	4,967,820
Colorado	104,100	36.649	10.48	4,071,162
Idaho	83,574	15.097	10.48	1,346,379
Montana	147,046	16.273	10.48	2,553,444
New Mexico	121,598	25.088	10.48	3,255,353
Utah	84,904	13.324	10.48	1,207,170
Wyoming	97,818	17.631	10.48	1,840,354
Population Estimate for Rocky Mountain States				19,241,682

Table A2. Breeding Red-winged Blackbird population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	42.954	9.04	4,507,586
Colorado	104,100	30.360	9.04	2,909,144
Idaho	83,574	21.863	9.04	1,681,875
Montana	147,046	20.885	9.04	2,826,835
New Mexico	121,598	5.320	9.04	595,458
Utah	84,904	8.923	9.04	697,352
Wyoming	97,818	27.228	9.04	2,451,587
Population Estimate for Rocky Mountain States				15,669,837

Table A3. Breeding Common Grackle population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	0	11.12	0
Colorado	104,100	11.059	11.12	1,303,514
Idaho	83,574	0.023	11.12	2,176
Montana	147,046	2.059	11.12	342,814
New Mexico	121,598	0.507	11.12	69,805
Utah	84,904	0.003	11.12	288
Wyoming	97,818	6.503	11.12	720,247
Population Estimate for Rocky Mountain States				2,438,844

Table A4. Breeding Cliff Swallow population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	9.962	10.46	1,209,624
Colorado	104,100	19.928	10.46	2,209,482
Idaho	83,574	21.416	10.46	1,906,275
Montana	147,046	15.660	10.46	2,452,567
New Mexico	121,598	16.331	10.46	2,115,023
Utah	84,904	23.836	10.46	2,155,448
Wyoming	97,818	19.963	10.46	2,079,795
Population Estimate for Rocky Mountain States				14,128,214

Table A5. Breeding Horned Lark population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	40.853	10.80	5,121,766
Colorado	104,100	36.649	10.80	4,195,473
Idaho	83,574	15.097	10.80	1,387,490
Montana	147,046	16.273	10.80	2,631,412
New Mexico	121,598	25.088	10.80	3,354,753
Utah	84,904	13.324	10.80	1,244,030
Wyoming	97,818	17.631	10.80	1,896,548
Population Estimate for Rocky Mountain States				19,831,472

Table A6. Breeding Western Meadowlark population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	4.366	2.47	125,185
Colorado	104,100	72.465	2.47	1,897,231
Idaho	83,574	41.809	2.47	878,784
Montana	147,046	77.854	2.47	2,879,224
New Mexico	121,598	29.438	2.47	900,277
Utah	84,904	27.806	2.47	593,756
Wyoming	97,818	67.534	2.47	1,661,432
Population Estimate for Rocky Mountain States				8,935,889

Table A7. Breeding Western Kingbird population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	5.525	12.4	795,291
Colorado	104,100	12.998	12.4	1,708,414
Idaho	83,574	4.695	12.4	495,419
Montana	147,046	3.126	12.4	580,374
New Mexico	121,598	14.902	12.4	2,287,900
Utah	84,904	4.740	12.4	508,127
Wyoming	97,818	3.779	12.4	466,726
Population Estimate for Rocky Mountain States				6,842,251

Table A8. Breeding Lark Bunting population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	0	8.72	0
Colorado	104,100	22.631	8.72	2,091,776
Idaho	83,574	0.038	8.72	2,820
Montana	147,046	23.071	8.72	3,012,176
New Mexico	121,598	0.389	8.72	41,999
Utah	84,904	0.027	8.72	2,035
Wyoming	97,818	29.148	8.72	2,531,561
Population Estimate for Rocky Mountain States				7,682,367

Table A9. Breeding American Crow population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	1.034	3.10	37,210
Colorado	104,100	4.739	3.10	155,720
Idaho	83,574	4.420	3.10	116,600
Montana	147,046	4.194	3.10	194,665
New Mexico	121,598	1.824	3.10	70,010
Utah	84,904	1.061	3.10	28,435
Wyoming	97,818	3.862	3.10	119,244
Population Estimate for Rocky Mountain States				721,884

Table A10. Breeding Red-tailed Hawk population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	1.979	3.22	73,973
Colorado	104,100	1.645	3.22	56,146
Idaho	83,574	2.286	3.22	62,639
Montana	147,046	1.826	3.22	88,035
New Mexico	121,598	1.464	3.22	58,367
Utah	84,904	1.560	3.22	43,426
Wyoming	97,818	1.674	3.22	53,688
Population Estimate for Rocky Mountain States				436,274

Table A11. Breeding Swainson's Hawk population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	0.374	2.52	10,941
Colorado	104,100	2.075	2.52	55,426
Idaho	83,574	1.256	2.52	26,934
Montana	147,046	0.625	2.52	23,582
New Mexico	121,598	2.350	2.52	73,323
Utah	84,904	0.340	2.52	7,407
Wyoming	97,818	0.530	2.52	13,303
Population Estimate for Rocky Mountain States				210,916

Table A12. Breeding Ferruginous Hawk population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust*	Est. Breeding Population
Arizona	114,006	0	1.33	0
Colorado	104,100	0.344	1.33	4,850
Idaho	83,574	0.328	1.33	3,712
Montana	147,046	0.439	1.33	8,742
New Mexico	121,598	0.144	1.33	2,371
Utah	84,904	0.143	1.33	1,644
Wyoming	97,818	0.379	1.33	5,021
Population Estimate for Rocky Mountain States				26,340

* PIF=s adjustment included a count area that was 4 times the area counted during a BBS point count and was adjusted – first population estimate is with PIF adjustment and second for 2 times the count area (BBS observers only count everything in a quarter mile radius circle), a more reasonable adjustment.

Table A13. Breeding Northern Harrier population estimate for the RMS region from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

State	Size (mi^2)	2006-2010 Ave Count	PIF Adjust	Est. Breeding Population
Arizona	114,006	0.029	2.58	869
Colorado	104,100	0.324	2.58	8,861
Idaho	83,574	0.710	2.58	15,588
Montana	147,046	1.269	2.58	49,021
New Mexico	121,598	0.082	2.58	2,619
Utah	84,904	0.674	2.58	15,033
Wyoming	97,818	0.906	2.58	23,282
Population Estimate for Rocky Mountain States				115,273

Table A14. Breeding population estimates for selected species in Colorado from BBS surveys conducted between 2006 and 2010 (USGS 2012) with adjustment factors based on Rich et al. (2004) and RMBO (2007).

Species	Size (mi^2) Colorado	2006-2010 Ave Birds/Count	PIF Adjust	Est. Breeding Population
European Starling	104,100	16.083	9.52	1,622,927
Rock Pigeon	104,100	2.364	12.72	318,735
House Sparrow	104,100	14.845	8.48	1,334,354
Eurasian Collared-Dove	104,100	1.075	10.56	120,328
Canada Goose*	104,100	4.059	1.00	43,024
Mallard*	104,100	3.489	2.00	73,965
Common Raven**	104,100	5.173	0.65	35,641
	104,100	5.173	1.30	71,282
Black-billed Magpie	104,100	7.347	2.46	191,576
Turkey Vulture**	104,100	0.717	1.31	9,956
	104,100	0.717	2.61	19,836
Great Horned Owl	104,100	0.237	22.00	55,267
Killdeer*	104,100	3.528	2.00	74,792
Great Blue Heron*	104,100	0.597	2.00	12,656
California Gull	104,100	1.768	2.00	37,481
House Finch	104,100	2.675	8.32	235,908

* These species are waterbirds and PIF did not have detectability parameters for these species. The detectability is equal to 2 – assume that one is not seen for every one that is (this is quite conservative for these particular species) except for Canada Geese (used 1.00).

** PIF=s adjustment included a count area that was 4 times the area counted during a BBS point count and was adjusted – first population estimate is with PIF adjustment and second for 2 times the count area (BBS observers only count everything in a quarter mile radius circle), a more reasonable adjustment.

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APPENDIX B - ESTIMATED BIRD TAKE IN COLORADO AND THE RMS AREA BY WS

Precise information on bird mortality due to WS control operations involving toxicants is not available. The MIS requires WS Specialists to record only the dead birds found following a control operation which may only be a small percentage of the birds actually taken, especially for projects involving the use of DRC-1339. However, some WS State Directors or District Supervisors may require Specialists to estimate the number of birds such as starlings and blackbirds taken during a control operation. Since recording data in the MIS has been variable from one operation to another and one state to the next, MIS data for birds taken with toxicants are not used for determining total take, unless take has been estimated for all projects. However, potential take can be estimated with a basic knowledge of the toxicant used, bait type (*e.g.*, cracked corn), and basic bird species biology for those birds targeted. This appendix provides estimates of birds taken with DRC-1339 and Avitrol by WS in Colorado for species being analyzed at the statewide level. Additionally, take in the Rocky Mountain States (RMS) including Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming will be analyzed for the more migratory species with more than a few taken lethally.

Most bird mortality by WS operations involving toxicants in Colorado has been limited and conducted almost entirely with the use of DRC-1339 treated baits. Glahn and Avery (2001) described methods to estimate bird mortality from using assessments of bait consumption and calculations. Homan et al. (2005) developed an empirical model based on bioenergetics for starlings at feedlots and the model predicted that 93 starlings would be killed for every pound of treated cattle ration pellet baits used (116 starlings/g DRC-1339). However, field studies testing the model found that the baits only killed an average of 67 starlings per pound used (72.5% of the "ideal" model). This would equate to 84 starlings taken for every gram of DRC-1339 used. Packham (1965) found that an average of 57 starlings were killed per pound of DRC-1339 treated French fries (a larger bait size) used at feedlots or 71 starlings taken per gram of DRC-1339. Thus, a difference exists between what models predict for results to that which actually occurs under field conditions and take with different baits. Most models predict the maximum number of target species that can be taken or the "ideal." However, ideal conditions rarely exist in the field and take is typically only a fraction of the expected results (Glahn and Avery 2001).

Part of the problem with predicting take with DRC-1339 treated baits is that breakdown of the chemical starts relatively quickly once baits are prepared. Within hours to several days after baits are prepared and once the baits are exposed to environmental conditions (*e.g.,* precipitation, heat, and sunlight), baits degrade, lose potency, and discolor turning dark gray which are often not selected by the target species. Thus, baits may be consumed and not be toxic (degraded) or discolored and not selected making them less effective. Additionally, baits may be made for a set number of birds seen during prebaiting operations and this number may not return when baits are placed out. Thus, baits may remain following treatments which then are disposed according to the label. The MIS system does not capture this "wastage" (bait placed in the field and not consumed, and, hence, disposed), but only the amount placed in the field. These factors (degradation, discoloration, and wastage) inherently would increase the estimated target species take using WS MIS data because all DRC-1339 used in operations is recorded whether or not it was successful. Homan's et al. (2005) field trials, compared to the empirical model, accounted for most problems with discoloration and degradation (72.5% efficacy from predicted to actual field trial take), but did not account for wastage including loss to precipitation because the amount of bait consumed was recorded for each field trial by subtracting the baits picked up after treatment from the amount set out. For WS projects using DRC-1339, wastage likely averages between 10% and 25% of the baits placed. Thus, realistically the baits used that are successful in typical field conditions (from preparation to take of the target species) are probably closer to 60% of the estimated "ideal" or modeled take for the grams of DRC-1339 used, instead of the 72.5%. To conservatively estimate the number of target starlings taken for a given project, the Homan et al. (2005) field trial data multiplied by a factor of 90% to account for wastage, assuming wastage at 10%, or 76 starlings taken per gram of DRC-1339 used.

WS also targets blackbirds in the family Icteridae in Colorado mostly at feedlots. Take would be different for each species of blackbird, as well as sex, with most males weighing much more than females, based on the target species weight and daily feed consumption. Average weights for a species, averaging female and male weights assuming a 1:1 sex ratio, are 54 grams for Red-winged Blackbirds, 76 grams for Yellow-headed Blackbirds, 66 grams for Brewer's and Rusty Blackbirds, 107 for Common Grackles, 169 for Great-tailed Grackles, 40 grams for Brown-head Cowbirds, and 63 grams for Bronzed Cowbirds. It is expected that these species, respectively, would consume an average of 11g, 13g, 12g, 12g, 18g, 24g, 23 g, 9g, and 12 g of baits when feeding. DRC-1339 treated baits for feedlots are not broadcast, but put in feeding lanes and so birds have easier access to large quantities of baits whereas more searching is required for baits that are broadcast. It is estimated that blackbirds will get 12.5% of their daily intake needs from baited sites. Take for each species is estimated for feedlot baits in Table B1. For blackbirds, because of varying weights, Table B1 estimates the number taken with the different baits and formulations based on their daily consumption. Blackbirds move around in feedlots and fallow fields and, thus, could get much of their diet from non-baited areas. It is assumed that blackbirds get an eighth of their daily dietary needs from treated areas whereas starlings, pigeons, and House Sparrows, also discussed herein, which are much more sedentary in feedlots than blackbirds, would probably get at least 25% (likely much higher for these species). These are likely conservative estimates, but adequate for determining impacts.

Cummings et al. (unpubl data, NWRC, pers. comm. 2006) found that treated baits at feedlots would take an estimated 400 blackbirds per gram of DRC-1339 used. Table B1 estimates that take would range from 163 per gram of DRC 1339 used for baits used in feedlots or similar areas (take for rice baits are higher) for Great-tailed Grackles to 434 for Brown-headed Cowbirds. Estimates in Table B1 included an assumed 10% wastage loss which would make the estimates very close to those found by researchers (species composition in treated feedlots for Cummings et al. (unpubl data, NWRC, pers. comm. 2006) had high percentages of Red-winged Blackbirds and Brown-headed Cowbirds). The predicted take estimates from Table B1 will be used to calculate the take of each species taken in Table B3.

WS in Colorado also uses DRC-1339 to target feral pigeons. Per label directions, WS uses whole kernel corn for these projects with 1.7 g DRC-1339 for 1 pound of treated bait which once prepared is cut at 1:5 treated to untreated. Baits can be cut up to 1:1 treated to untreated depending on the needs of the project and the length of time birds are observed feeding during prebaiting. The standard average number of whole corn kernels in a pound is 1,300 (Ontario Corn Producer Association 2007), but this is variable depending on variety of corn (1,600 by J. Homan, NWRC Bismarck, ND, pers. comm. 2007 and 1,700 by M. Marlow, Okla. WS, pers. comm. 2007). However, lower or higher weights for kernels would not change the outcome. Assuming that 1,300 kernels equals one pound and are treated, each kernel (350 mg) would have about 1.3 mg DRC-1339 (prior to being cut with untreated baits). The oral LD_{50} for pigeons is 18 mg/kg (Timm 1994, Eisemann et al. 2003). Thus, it would take more than 18 mg for 100% efficacy (acute doses for all) and only 50% of the pigeons would be killed at this level. At an estimated average weight of 310 g (270 g (Sibley 2000) or 350 g (Johnston 1992) equals 4.9 mg to 6.3 mg – website searches came up with similar weights), it would take 5.6 treated baits to kill 50% or 6 baits (rounded up). Pigeons eat about 36 gm. of feed per day (British Columbia Ministry of Environment 2001) or, with whole corn, about 103 kernels at 1,300/pound. It is likely that when feed is put out, pigeons will consume between a quarter and half their daily consumption (depending on the number of pigeons feeding, the distribution of baits, and the length of time the pigeons are exposed to the baits), or about 26 to 52 kernels. This would be enough for about half of the birds to get a lethal dose averaging about 4 to 9 treated baits for cut baits (1:5 treated to untreated). Assuming pigeons feed on whole kernel corn baits that have 1,300 kernels per pound and consume a third of their daily intake (34 kernels) while baits are placed out, one pound of cut bait would take 19 pigeons (each pigeon would get an average of 5.7 treated baits – the level for 50% to be killed). This would equate to taking 67 pigeons per gram of DRC-1339. Using a similar factor to account for wastage in field use (10%) as above, would result in a conservatively estimated 60 pigeons taken with each gram of DRC-1339 used. It should be noted that baits can be cut at 1:1 to 1:5 for pigeons depending on how much bait is required at a site for the number of pigeons present; WS Specialists use the 1:1 treated to untreated baits for projects with very few pigeons or when there are a lot of pigeons present to ensure they get enough toxicant. A lower ratio of treated to untreated would reduce the number of birds that could be taken. However, for the purposes of this EA, it is assumed that all baits are cut at the 1:5 rate which would increase the number of birds taken, but be a more conservative estimate for the purposes of analysis. Additionally, baits are often left out for pigeons as long as they are feeding. It is likely that pigeons would consume at least half their dietary needs, if not 100%. If pigeons consumed 100% of their daily consumption requirements and this reached a level of LD100, then 13 pigeons would be killed per pound of bait or 40 per gram of DRC-1339 (taking wastage into account). It is likely that the latter is closer to the estimate. However, to be conservative, the first estimate will be used in the EA.

Avitrol® is another toxicant used that has been infrequently used by WS in Colorado and other states (WS in Colorado has not used Avitrol for many years) for House Sparrows, starlings, pigeons, and blackbirds, and comes prepackaged by the pound formulated at 0.5% 4-aminopyridine (the active ingredient) on mixed grain or corn chops. WS then mixes the bait with the same untreated bait at 1:9. The number of birds taken with an ounce of bait depends on the species targeted, the ratio of treated to untreated baits in the formulation (WS almost always cuts treated baits at the suggested 1:9 ratio, but this can be lowered to 1:5 for House Sparrows), and precipitation. WS uses mostly the mixed grain bait, but also uses some corn chops. The number of grain particles per pound varies by type and size of the bait, but would likely be from 6,000 to 23,000 particles per pound for mixed grain and cracked corn. Cracked corn sifted for particle sizes between 40mg to 50mg results in about 9,000 to 12,000 particles per pound (between #5 and #7 U.S. Standard Sieves). House Sparrows eat at least 6 grams of feed per day based on kilocalorie requirements of 20 Kcal/day to 28 Kcal/day assuming that 3.5 Kcal are produced from a gram of grain (Cabe 1993). Starlings, with a high caloric diet, eat on average 23 grams/day (Twedt 1985) and pigeons likely require about 36 grams of feed per day (British Columbia Ministry of Environment 2001). Assuming that these 3 species eat at least 25% of the necessary daily intake at one feeding before other individuals react to the Avitrol (House Sparrows and starlings, especially, would likely stop feeding after a few individuals reacted to the chemical because of their vocalizations), that the bait is mixed at 1:9 treated to untreated which is WS's standard application rate, and each pound of bait has 10,000 treated particles, then House Sparrows would eat about 33 particles (3 treated), starlings 127 particles (13 treated), and pigeons 198 particles (20 treated). It takes 20 minutes or more before a bird reacts to Avitrol. Avitrol is formulated at 0.5% which would mean that at these consumption rates, House Sparrows would get 7 mg of Avitrol, starlings 29 mg, and pigeons 45 mg. The acute oral LD50 for House Sparrows is 3.00-7.70 mg/kg and for starlings is 4.90-6.00 mg/kg. The acute oral LD50 for hydrochloride salt of 4-aminopyridine for pigeons is 20 mg/kg. The oral LD50 for the average weight House Sparrow would be met with 0.2 mg Avitrol, for starling 0.5 mg, and for pigeons 7.1 mg. Therefore, all species would likely receive a toxic dose by consuming the estimated amounts. These amounts would then dictate the number that could be taken with an ounce of Avitrol treated baits (the MIS records the ounces of Avitrol used and does not include the added untreated baits). Thus, it would be theoretically possible to take 189 House Sparrows, 49 starlings, and 32 pigeons. It is likely that fewer issues such as degradation and discoloration would occur with the use of Avitrol because it is more stable than DRC-1339. Using 10% loss or wastage, similar factor as discussed for DRC-1339, would result in the take of 170 House Sparrows, 44 starlings, and 28 pigeons per ounce of Avitrol used. Blackbird take with Avitrol is given in Table B1. Take of blackbirds with Avitrol ranged from 85 to 226 depending on the consumption rates of the different species.

The calculations of take can be used to estimate the number of target birds taken by WS with DRC-1339 and Avitrol. However, the MIS allows WS Specialists to use a code, "Mixed Blackbirds," for sites where several species of blackbirds (starlings, blackbirds, cowbirds, and grackles) are present. Thus, species composition at operation sites also needs to be estimated where this code was used.

Starlings are the most prevalent species at feedlots in the United States. Starlings require a high protein, high calorie diet, and livestock feed such as cattle ration, pelleted feed are a great source. Unlike most blackbirds, starlings eat little grain due to their poor assimilation efficiency (turning feed into energy) for grain (Twedt 1985). Starlings prefer insects and eat them as available. As insects wane in cold weather, starlings turn to feedlots to acquire the necessary energy to survive. Thus, starlings can be found in abundance at feedlots during winter which is the case in the Great Plains and Rocky Mountain states. On the other hand, blackbirds efficiently assimilate grains into energy and have more opportunity to find them in harvested and fallow fields (spillage) and rangeland (weed seeds), and therefore, may forage more in these areas rather than in feedlots (Twedt 1985).

In States where WS used DRC-1339 and Avitrol®, the percentage of starlings at feedlots was estimated by the WS Specialists or combined in the category of "Mixed Blackbirds." WS Specialists at feedlots in the RMS region have estimated that in general the composition of starlings in RMS could be estimated at 30% for Arizona, 40% for New Mexico, 85% for Colorado, and 90% for Idaho, Montana, Utah, and Wyoming. The actual numbers of starlings in the last 4 states is likely over 95%, but to be conservative for the native species, the lower percentage of starling will be used with the remaining percentages distributed to blackbird percentages found in the states at different times of the year using BBS and CBC data. Homan (NWRC, pers. comm. 2007) stated that during his research in Kansas, starling flocks in feedlots constituted 99% or more of the birds in feedlots with few other species ever present. He also stated that a graduate student trapping birds in feedlots in the winter and spring of 2006-2007 caught only starlings in traps and no other bird species. Kansas would typify feedlots in northern states where starlings are prevalent and blackbirds migrate further south. Thus, an estimate of 90% would be considered conservative for blackbird species, but believed to be within reason for starlings. The composition of starlings in the Rocky Mountain States (RMS) was not determined for all states because WS did not conduct BDM at feedlots in several.

Table B1. Estimated blackbird take with DRC-1339 and Avitrol treated baits for blackbirds in the RMS area and Central Plains States. These estimates will be used to determine impacts.

Species	**RWBB**	**YHBB**	**BRBB**	**RUBB**	**CGRK**	**GTGK**	**BTGK**	**BHCB**	**BRCB**
Spp. Ave. Weight (g)	54	76	66	66	107	169	157	40	63
Daily Ave. Consumpt.(g)	11	13	12	12	18	24	23	9	12
% Daily Ave. Cons. Eaten	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Wastage	10%	10%	10%	10%	10%	10%	10%	10%	10%
DRC-1339 Feedlot Baits									
Std. g DRC Used for Bait	92	92	92	92	92	92	92	92	92
Pounds bait made	110	110	110	110	110	110	110	110	110
Lbs. bait/1 g DRC	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
# birds/g DRC	355	300	325	325	197	163	170	434	325
Avitrol Baits									
Std. Pounds Avitrol Mixed	1	1	1	1	1	1	1	1	1
Pounds Bait Made	10	10	10	10	10	10	10	10	10
Lbs. bait/1 oz. Avitrol	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625	0.625
# birds/oz. Avitrol	185	157	170	170	113	85	89	226	170

RWBB = Red-winged Blackbird, YHBB = Yellow-headed Blackbird, BRBB = Brewer's Blackbird, RUBB = Rusty Blackbird, CGRK = Common Grackle, GTGK = Great-tailed Grackle, BTGK = Boat-tailed Grackle, BHCB = Brown-headed Cowbird, BRCB = Bronzed Cowbird

Table B2. WS used DRC-1339 to take "Mixed Blackbirds" in 3 states, Arizona, Idaho, and New Mexico, from FY06 to FY10. Species composition of blackbirds in these states, used to estimate take for BDM projects using chemical toxicants where WS Specialists recorded "Mixed Blackbirds" as the target species, is given in the following table. The percentage of starlings was estimated at 30% in Arizona, 40% in New Mexico, and 90% in Idaho of the species composition at flocks in feedlots and will be used to determine take. These 3 states in the RMS region were the only States that recorded "Mixed Blackbirds" for take and used DRC-1339 where blackbirds were targeted with starlings.

State	Species	BBS ave. adjusted birds/count 2006-2010	BBS %	CBC Ave. Total 2006/7-20010/11	CBC %	Winter Factor	BBS/CBC ave.	Migrating Factor
Arizona	RWBB	42.954	70.401%	45,475	46.938%	32.857%	58.670%	41.063%
	YHBB	1.038	1.701%	20,499	21.159%	14.811%	11.430%	8.001%
	BRBB	0.903	1.480%	17,763	18.334%	12.834%	3.307%	6.335%
	GGRK	10.185	16.693%	8,945	9.223%	6.456%	12.958%	3.071%
	BHCB	5.748	9.421%	4,162	4.296%	3.007%	6.859%	4.801%
	BZCB	0.185	0.303%	39	0.040%	0.028%	0.172%	0.120%
Total		61.013	100%	96,883	100%	70%	100%	70%
Idaho	RWBB	21.863	44.715%	6,778	72.526%	7.253%	58.621%	5.862%
	YHBB	5.237	10.711%	15	0.161%	0.016%	5.436%	0.544%
	BRBB	14.763	30.194%	2,544	27.226%	2.723%	28.710%	2.871%
	RUBB	0	0%	0.2	0.002%	0.0002%	0.001%	0.0001%
	CGRK	0.023	0.047%	2	0.017%	0.002%	0.032%	0.003%
	BHCB	7.008	14.333%	6	0.069%	0.007%	0.007%	0.720%
Total		48.894	100%	9,345	100%	10%	100%	10%
New Mexico	RWBB	5.320	35.866%	19,963	36.495%	21.837%	36.181%	21.708%
	YHBB	0.229	1.544%	726	1.328%	0.737%	1.436%	0.862%
	BRBB	1.712	11.542%	19,119	34.952%	20.371%	23.247%	13.346%
	RUBB	0	0%	1	0.002%	0.001%	0.001%	0.001%
	CGRK	0.507	3.418%	285	0.521%	0.313%	1.370%	1.182%
	GGRK	3.627	3.418%	7,538	13.781%	8.269%	8.600%	5.160%
	BHCB	3.435	24.452%	7,059	12.905%	7.743%	18.673%	11.207%
	BZCB	0.003	23.158%	10	0.018%	0.011%	11.588%	6.353%
Total		14.833	100%	54,701	100%	60%	100%	60%

Under the "Mixed Blackbird" category, the species composition of blackbirds taken in control operations will be calculated using the species composition from USGS Breeding Bird Survey (BBS) data averaged with NAS Christmas Bird Count (CBC) data for projects occurring from April 1 to November 30, and from CBC data for projects occurring from December 1 to March 31. Table B2 provides the percentages used for blackbird species (excluding starlings) for estimating take with toxicants. With species composition determined (Table B2), WS take of birds with toxicants in Colorado can be estimated.

Rusty Blackbirds, a bird of conservation concern (USFWS 2008), winter in the southeastern United States, but could potentially be found in Colorado during migration and winter months (only 1 has been seen during CBC counts in the last 20 years (CBC 1990-2009). Their habitat preference is wet woodlands where they typically are found feeding, away from other blackbirds. Though, it is possible that they may be found at a confined animal feeding operation (feedlot), it is unlikely. However, to consider impacts, this species is included, but it should be noted that none are likely ever taken and none have been seen in the last 5 years giving them a percentage of zero take in Colorado.

Ravens and crows are also targeted for livestock protection with egg and meat baits. Fifty eggs or 267 meat baits are made with each gram of DRC-1339. Eggs and meat baits contain 20 mg and 3.75 mg per bait, respectively. The maximum weight of a raven and crow is 1625 g (Boarman and Heinrich 1999) and 575 g (Verbeek and Caffrey 2002). The oral LD_{50} is 5.62 mg/kg for ravens and 1.33-1.78 mg/kg crows. Thus, if all of the contents of an egg are eaten, it would likely kill either species. However, meat baits would deliver 2.31mg/kg for large ravens and 6.52 mg/kg for large crows. Therefore, a crow that consumes a meat bait would likely be killed, but it would take at least 3 meat baits to kill a large raven. Ravens and crows consume the meats and contents of eggs, but often cache them. They often continue taking baits while they are out. It is assumed that ravens will take 4 eggs (Coates 2006) or 10 meat baits (1/2" cubes). At this level of eating and caching, it is likely that all ravens and crows would be killed. This level of feeding would take 13 ravens or crows with eggs or 27 with meat baits per gram of DRC-1339 used. However, this may be an overestimate (Coates and Delehanty 2004) because caching and consumption of more than 4 eggs by targeted ravens and crows, and consumption by nontarget species, especially ground squirrels (not affected by the baits), reduces the number of eggs for targeted individual ravens and crows. Thus, our belief that a crow or a raven would be taken with 4 eggs is likely an overestimate, but to be conservative, this estimate will be used to determine take by WS.

Table B3. Estimate of birds taken in Colorado with chemicals and other methods for species being analyzed in the Colorado BDM EA. All mixed blackbird projects were conducted in Arizona, Idaho, and New Mexico during the winter months. The other RMS States (Colorado, Montana, Utah, and Wyoming) did not conduct DRC-1339 projects for mixed blackbirds. WS in the RMS area did not use Avitrol during this time.

State- Method	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**	**Spp. Comp. %**	**Take/g.**	**FY06**	**FY07**	**FY08**	**FY09**	**FY10**
(w-winter, m-migr.)	**Quantity of DRC-1339 (g), Avitrol (oz.)**							**Estimated Take**				
European Starling												
CO DRC-1339	0	39.7	1450.3	1844.6	1033.0	100%	76	0	3,017	110,223	140,190	78,508
CO Other Methods								7	28	108	681	743
TOTAL CO								**7**	**3,045**	**110,331**	**140,871**	**79,251**
Feral Pigeon												
CO DRC-1339	17.0	0	17.2	0	25.3	100%	60	1,020	0	1,032	0	1,518
CO Other Methods								7,267	7,023	4,425	3,510	3,742
TOTAL CO								**8,287**	**7,023**	**5,477**	**3,510**	**5,260**
Common Raven												
CO DRC-1339 meat	0	0	0.37	1.5	1.75	100%	27	0	0	11	41	47
CO DRC-1339 eggs	1.56	2.7	6.8	0	0	100%	13	20	35	88	0	0
CO Other Methods								102	2	6	4	7
TOTAL CO								**123**	**37**	**105**	**45**	**54**
Red-winged Blackbird												
AZ DRC Mix BB w	605.4	1568.8	1426.0	1288.0	184.0	32.86%	355	70,622	183,005	166,347	150,249	21,464
ID DRC Mix BB w	-	-	84.0	272.2	86.6	7.25%	355	0	0	2,163	7,009	2,230
NM DRC Mix BB w	-	-	-	188.0	0	21.84%	355	0	0	0	14,574	0
NM DRC All	-	-	90.2	-	2.0	100%	355	0	0	40,168	0	0
CO Other Lethal Take								18	22	250	272	4,720
Other RMS Take								11	78	126	2	55
TOTAL CO								**18**	**22**	**250**	**272**	**4,720**

TOTAL RMS								**70,622**	**183,105**	**209,054**	**172,106**	**29,179**
Brewer's Blackbird												
AZ DRC Mix BB w	605.4	1568.8	1426.0	1288.0	184.0	14.81%	325	25,252	65,435	59,479	53,723	7,675
ID DRC Mix BB w	-	-	84.0	272.2	86.6	2.72%	325	0	0	743	2,409	766
ID DRC All	-	-	-	-	10.5	100%	325	0	0	0	0	3,413
NM DRC Mix BB w	-	-	-	188.0	-	20.37%	325	0	0	0	12,447	0
NM DRC All	-	-	75.45	-	-	100%	325	0	0	24,521	0	0
UT DRC All	-	-	46.0	-	-	100%	325	0	0	14,950	0	0
CO Other Lethal Take								0	0	0	1	0
Other RMS Take								3	0	67	0	0
TOTAL CO								**0**	**0**	**0**	**1**	**0**
TOTAL RMS								**25,255**	**65,435**	**99,761**	**68,580**	**11,854**
Common Grackle(AZ/ID 0% w)												
ID DRC Mix BB w	-	-	84.0	272.2	86.6	0.002%	197	0	0	0	1	0
NM DRC Mix BB w	-	-	-	188.0	-	0.31%	197	0	0	0	115	0
WY DRC All	-	-	-	0.7	-	100%	197	0	0	0	138	0
CO Other Lethal Take								0	0	1	42	12
Other RMS Take								0	0	1	0	0
TOTAL CO								**0**	**0**	**1**	**42**	**12**
TOTAL RMS								**0**	**0**	**2**	**296**	**12**

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APPENDIX C: BIRD SPECIES OF COLORADO

The Colorado Field Ornithologists (CFO) lists 491 species of wild birds that have been documented in Colorado (CFO 2012) and these are listed in taxonomic order as given in the American Ornithologists Union (2012). Colorado has 309 species of birds that reside for some part of the year in Colorado. Additionally, almost 182 more species have been accidentally seen inside the state from outside their normal range. Most will not be the focus of a BDM project, but all are listed in the following tables to let readers know the diversity of birds in the State. Colorado WS expects to conduct BDM for relatively few of these species and anticipates that BDM will have minimal effect, if any, on species in Colorado and the Central and Pacific BBS Regions.

Table C1. Common and scientific names are given for the 197 wild bird species that typically reside for some part of the year in Colorado that have the potential of being a BDM project target. Even though all species with the potential to invoke a request are listed, the majority will not be involved in BDM in Colorado. About half of the species would only be involved in BDM at airports (99) where they are a strike risk. If the species has the potential to be involved in a request for assistance other than BDM at airports, it is noted (98). One species, the Sprague's Pipit, is rare in Colorado and a review species (CFO 2012) which should have been included in Table C3, but WS anticipates that it could be involved in BDM with this species at airports.

Species	*Scientific Name**	Status
Anseriformes - Waterfowl		
Greater White-fronted Goose[2]	*Anser albifrons*	M
Snow Goose[2]	*Chen caerulescens*	M
Ross's Goose[2]	*Chen rossii*	M
Canada Goose[2,4,5,6]	*Branta canadensis*	R
Cackling Goose[2]	*Branta hutchinsii*	W
Tundra Swan[2]	*Cygnus columbianus*	M
Wood Duck[2]	*Aix sponsa*	R
Gadwall	*Anas strepera*	R
American Wigeon[6]	*Anas americana*	R
Mallard[2,4,5,6]	*Anas platyrhynchos*	S
Blue-winged Teal	*Anas discors*	S
Cinnamon Teal	*Anas cyanoptera*	S
Northern Shoveler	*Anas clypeata*	R
Northern Pintail	*Anas acuta*	R
Green-winged Teal	*Anas crecca*	R
Canvasback	*Aythya valisineria*	W
Redhead	*Aythya americana*	R
Ring-necked Duck[1]	*Aythya collaris*	W
Lesser Scaup	*Aythya affinis*	W
Bufflehead[1]	*Bucephala albeola*	W
Common Goldeneye[1]	*Bucephala clangula*	W
Hooded Merganser[1]	*Lophodytes cucullatus*	M
Common Merganser[1]	*Mergus merganser*	R
Red-breasted Merganser[1]	*Mergus serrator*	M
Ruddy Duck	*Oxyura jamaicensis*	S
Order Galliformes – Pheasants, Grouse, Turkeys, and Quail		
Scaled Quail	*Callipepla squamata*	R AY
Gambel's Quail	Callipepla gambelii	R
Northern Bobwhite[2]	*Colinus virginianus*	R
Chukar	*Alectoris chukar*	R
Ring-necked Pheasant[2]	*Phasianus colchicus*	R
Greater Sage-Grouse	*Centrocercus urophasianus*	R FC SC
Gunnison Sage-Grouse	*Centrocercus minimus*	R FC SC
White-tailed Ptarmigan	*Lagopus leucura*	R
Dusky Grouse	*Dendragapus obscurus*	R
Sharp-tailed Grouse	*Tympanuchus phasianellus*	R SE*SC**
Greater Prairie-Chicken	*Tympanuchus cupido*	R
Lesser Prairie-Chicken	*Tympanuchus pallidicinctus*	R FC ST
Wild Turkey[2]	*Meleagris gallopavo*	R
Family Gavidae - Loons		
Common Loon[1]	*Gavia immer*	M
Family Podicipedidae - Grebes		
Pied-billed Grebe[1]	*Podilymbus podiceps*	R
Horned Grebe[1]	*Podiceps auritus*	M
Eared Grebe[1]	*Podiceps nigricollis*	S
Western Grebe[1]	*Aechmophorus occidentalis*	S
Clark's Grebe[1]	*Aechmophorus clarkii*	S AY
Order Suliformes– Frigatebirds, Boobies, and Cormorants		
Double-crested Cormorant[1]	*Phalacrocorax auritus*	S
Order Pelecaniformes – Pelicans, Egrets, Herons, and Ibises		
American White Pelican[1]	*Pelecanus erythrorhynchos*	S
American Bittern[1]	*Botaurus lentiginosus*	S BC
Great Blue Heron[1]	*Ardea herodias*	R
Great Egret[1,4,6]	*Ardea alba*	M
Snowy Egret[1,4,6]	*Egretta thula*	S
Cattle Egret[1,4,6]	*Bubulcus ibis*	S
Green Heron[1]	*Butorides virescens*	S
Black-crowned Night-Heron[1,4,6]	*Nycticorax nycticorax*	S
White-faced Ibis	*Plegadis chihi*	S
Order Acciptriformes – Vultures, Osprey, Kites, Hawks, and Eagles		
Turkey Vulture[3,4,6]	*Cathartes aura*	S
Osprey[1]	*Pandion haliaetus*	S
Mississippi Kite[4]	*Ictinia mississippiensis*	S
Bald Eagle[1, 2]	*Haliaeetus leucocephalus*	R SC BC
Northern Harrier	*Circus cyaneus*	R
Sharp-shinned Hawk[3]	*Accipiter striatus*	R
Cooper's Hawk[3]	*Accipiter cooperii*	R
Northern Goshawk	*Accipiter gentilis*	R
Swainson's Hawk	*Buteo swainsoni*	S AY
Red-tailed Hawk[3]	*Buteo jamaicensis*	R
Ferruginous Hawk	*Buteo regalis*	R SC BC
Rough-legged Hawk	*Buteo lagopus*	W
Golden Eagle[3]	*Aquila chrysaetos*	R BC
Order Falconiformes –Caracaras, Falcons		
American Kestrel	*Falco sparverius*	R
Merlin	*Falco columbarius*	W
Peregrine Falcon	*Falco peregrinus*	R SC# BC
Prairie Falcon	*Falco mexicanus*	R BC
Order Gruiformes – Rails and Cranes		
American Coot[6]	*Fulica americana*	R
Sandhill Crane[2]	*Grus canadensis*	S SC##
Order Charadriiformes – Shorebirds, Gulls, and Terns		
Black-bellied Plover	*Pluvialis squatarola*	M
American Golden-Plover	*Pluvialis dominica*	M AY
Snowy Plover	*Charadrius nivosus*	S SC BC
Semipalmated Plover	*Charadrius semipalmatus*	M
Piping Plover	*Charadrius melodus*	M FT ST
Killdeer	*Charadrius vociferus*	S
Mountain Plover	*Charadrius montanus*	S FPT SC
Black-necked Stilt	*Himantopus mexicanus*	S
American Avocet	*Recurvirostra americana*	S
Spotted Sandpiper	*Actitus macularius*	S
Solitary Sandpiper	*Tringa solitaria*	M
Greater Yellowlegs	*Tringa melanoleuca*	M
Willet	*Catoptrophorus semipalmatus*	M
Lesser Yellowlegs	*Tringa flavipes*	M
Upland Sandpiper	*Bartramia longicauda*	S BC
Whimbrel	*Numenius phaeopus*	M
Long-billed Curlew	*Numenius americanus*	S SC BC
Marbled Godwit	*Limosa fedoa*	M AY
Ruddy Turnstone	*Arenaria interpres*	M
Sanderling	*Calidris alba*	M AY
Semipalmated Sandpiper	*Calidris pusilla*	M AY
Western Sandpiper	*Calidris mauri*	M AY

Species	*Scientific Name**	Status
Least Sandpiper	*Calidris minutilla*	M
White-rumped Sandpiper	*Calidris fuscicollis*	M AY
Baird's Sandpiper	*Calidris bairdii*	M
Pectoral Sandpiper	*Calidris melanotos*	M
Dunlin	*Calidris alpina*	M
Stilt Sandpiper	*Calidris himantopus*	M AY
Short-billed Dowitcher	*Limnodromus griseus*	M
Long-billed Dowitcher	*Limnodromus scolopaceus*	M
Wilson's Snipe	*Gallinago delicata*	R
Wilson's Phalarope	*Phalaropus tricolor*	S
Red-necked Phalarope	*Phalaropus lobatus*	M
Bonaparte's Gull[1,4]	*Chroicocephalus philadelphia*	M
Franklin's Gull[1,4]	*Leucophaeus pipixcan*	M
Ring-billed Gull[1,4,6]	*Larus delawarensis*	M
California Gull[1,4,6]	*Larus californicus*	S
Herring Gull[1,4]	*Larus argentatus*	W
Caspian Tern[1]	*Hydroprogne caspia*	M
Black Tern[1]	*Childonias niger*	S
Common Tern[1]	*Sterna hirundo*	M
Forster's Tern[1]	*Sterna forsteri*	S
Order Columbiformes– Doves and Pigeons		
Rock Pigeon[2,3,4,5,6]	*Columba livia*	R
Band-tailed Pigeon[2]	*Columba fasciata*	S
Eurasian Collared Dove[6]	*Streptopelia decaocto*	R
White-winged Dove[2]	*Zenaida asiatica*	M
Mourning Dove[2]	*Zenaida macroura*	R
Order Cuculiformes – Cuckoos, Roadrunners, Anis		
Greater Roadrunner[5]	*Geococcyx californianus*	R
Order Strigiformes - Owls		
Barn Owl[4,6]	*Tyto alba*	R
Great Horned Owl[3]	*Bubo virginianus*	R
Burrowing Owl	*Athene cunicularia*	S ST BC
Long-eared Owl	*Asio otus*	R
Short-eared Owl	*Asio flammeus*	R AY
Order Caprimulgiformes - Goatsuckers		
Common Nighthawk	*Chordeiles minor*	S
Order Apodiformes – Swifts, Hummingbirds		
Black Swift	*Cypseloides niger*	S AY
Chimney Swift[4,6]	*Chaetura pelagica*	S
White-throated Swift	*Aeronautes saxatalis*	S
Order Coraciiformes - Kingfishers		
Belted Kingfisher[1]	*Megaceryle alcyon*	R
Order Piciformes - Woodpeckers		
Lewis's Woodpecker[6]	*Melanerpes lewis*	R BC AR
Red-headed Woodpecker[2,6]	*Melanerpes erythrocephalus*	S AY
Williamson's Sapsucker[6]	*Sphyrapicus thyroideus*	S AY
Yellow-bellied Sapsucker[2,6]	*Sphyrapicus varias*	M
Red-naped Sapsucker[2,6]	*Sphyrapicus nuchalis*	S
Downy Woodpecker[2]	*Picoides pubescens*	R
Hairy Woodpecker[2]	*Picoides villosus*	R
American 3-toed Woodpecker[2,6]	*Picoides dorsalis*	R
Northern Flicker[2,6]	*Colaptes auratus*	R
Order Passeriformes – Perching Birds		
Family Tyrannidae – Flycatchers		
Eastern Phoebe	*Sayornis phoebe*	S
Say's Phoebe	*Sayornis saya*	S
Cassin's Kingbird	*Tyrannus vociferans*	S
Western Kingbird	*Tyrannus verticalis*	S
Eastern Kingbird	*Tyrannus tyrannus*	S
Family Laniidae – Shrikes		
Loggerhead Shrike	*Lanius ludovicianus*	R
Northern Shrike	*Lanius excubitor*	W
Family Corvidae – Crows and Jays		
Gray Jay[2,4,6]	*Perisoreus canadensis*	R
Pinyon Jay[2,4,6]	*Gymnorhinus cyanocephalus*	R BC AY
Steller's Jay[2,4,6]	*Cyanocitta stelleri*	R
Blue Jay[2,4,6]	*Cyanocitta cristata*	R
Western Scrub Jay[2,4,6]	*Aphelocoma californica*	R
Clark's Nutcracker[2,4,6]	*Nucifraga columbiana*	R
Black-billed Magpie[2,3,4,5,6]	*Pica hudsonia*	R
American Crow[2,3,4,6]	*Corvus brachyrhynchos*	R
Chihuahuan Raven[2,3,4,5,6]	*Corvus cryptoleucus*	S
Common Raven[2,3,4,5,6]	*Corvus corax*	R

Species	*Scientific Name**	Status
Family Alaudidae - Larks		
Horned Lark	*Eremophila alpestris*	R
Family Hirundinidae - Swallows		
Purple Martin[6]	*Progne subis*	S
Tree Swallow[6]	*Tachycineta bicolor*	S
Violet-green Swallow	*Tachycineta thalassina*	S
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	S
Bank Swallow	*Riparia riparia*	S
Cliff Swallow[6]	*Petrochelidon pyrrhonota*	S
Barn Swallow[3,6]	*Hirundo rustica*	S
Family Turdidae – Robins and Thrushes		
American Robin[2]	*Turdus migratorius*	R
Family Mimidae – Mockingbirds and Thrashers		
Northern Mockingbird[4]	*Mimus polyglottos*	S
Family Sturnidae - Starlings		
European Starling[2,3,4,5,6]	*Sturnus vulgaris*	R
Family Motacillidae - Pipits		
American Pipit	*Anthus rubescens*	M
Sprague's Pipit	*Anthus spragueii*	M FC
Family Bombycillidae - Waxwings		
Bohemian Waxwing	*Bombycilla garralus*	W
Cedar Waxwing[2]	*Bombycilla cedrorum*	W
Family Calcariidae - Longspurs		
Lapland Longspur	*Calcarius lapponicus*	W
McCown's Longspur	*Rhynchophanes mccownii*	S BC
Snow Bunting	*Plectrophenax nivalis*	W
Family Emberizidae –Sparrows		
American Tree Sparrow	*Spizella arborea*	W
Lark Bunting	*Calamospiza melanocorys*	S BC AY
Savannah Sparrow	*Passerculus sandwichensis*	S
White-crowned Sparrow	*Zonotrichia leucophrys*	S
Family Cardinalidae - Cardinals		
Northern Cardinal[4]	*Cardinalis cardinalis*	S
Dickcissel	*Spiza americana*	S
Family Icteridae – Blackbirds and Meadowlarks		
Bobolink	*Dolichonyx oryzivorus*	S
Red-winged Blackbird[2,3,6]	*Agelaius phoeniceus*	R
Western Meadowlark	*Sturnella neglecta*	R
Yellow-headed Blackbird[2,3]	*Xanthocephalus xanthocephalus*	S
Brewer's Blackbird[2,3,6]	*Euphagus cyanocephalus*	R
Common Grackle[2,3,6]	*Quiscalus quiscula*	S
Great-tailed Grackle[2,3,4,6]	*Quiscalus mexicanus*	R
Brown-headed Cowbird[2,3,5,6]	*Molothrus ater*	S
Family Fringillidae - Finches		
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*	W
Black Rosy Finch	*Leucosticte atrata*	W BC AY
Brown-capped Rosy Finch	*Leucosticte australis*	R BC AY
Cassin's Finch	*Carpodacus cassinii*	R BC
House Finch[2,4,,6]	*Carpodacus mexicanus*	R
Lesser Goldfinch	*Spinus psaltria*	S
American Goldfinch	*Spinus tristis*	R
Family Passeridae – Weaver Finches		
House Sparrow[2,3,4,6]	*Passer domesticus*	R

F = Federal S = State
E = Endangered T = Threatened C = Candidate
BCC = Birds of Conservation Concern (USFWS 2008)
AY/AR - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern
1 = Aquaculture; 2 = Crops; 3 = Livestock and feed; 4= Human Health and Safety; 5 = Natural resources; 6 = Property
*-*T. p. jamesii* **-*T. p. columbianus* #*F. p. anatum*
##-*G. c. tabida*

Table C2. Common and scientific names are given for the 108 bird species commonly occurring in Colorado that have little or no potential to be the target of a WS BDM project including BDM projects at airports because these species are mostly limited in their distribution in Colorado, not associated with any type of damage, and are typically not found in habitat associated with areas of potential damage (*e.g.*, urban areas, croplands, airport operating areas). Thus, WS does not anticipate that it will conduct BDM for these species, but the possibility could always arise.

Species	Scientific Name*	Status
Black Rail	*Laterallus jamaicensis*	M AR
Virginia Rail	*Rallus limicola*	R
Sora	*Porzana carolina*	S
Yellow-billed Cuckoo	*Coccyzus americanus*	S FC^ SC
Flammulated Owl	*Otus flammeolus*	S BC AY
Western Screech-Owl	*Megascops kennicottii*	R
Eastern Screech-Owl	*Megascops asio*	R
Northern Pygmy-Owl	*Glaucidium gnoma*	R
Spotted Owl	*Strix occidentalis*	R FT^^ ST
Boreal Owl	*Aegolius funereus*	R
Northern Saw-whet Owl	*Aegolius acadicus*	R
Common Poorwill	*Phalaenoptilus nuttallii*	S
Black-chinned Hummingbird	*Archilochus alexandri*	S
Calliope Hummingbird	*Stellula calliope*	S AY
Broad-tailed Hummingbird	*Selasphorus platycercus*	S
Rufous Hummingbird	*Selasphorus rufus*	M
Olive-sided Flycatcher	*Contopus cooperi*	S AY
Western Wood-Pewee	*Contopus sordidulus*	S
Willow Flycatcher	*Empidonax traillii*	S FE SE
Least Flycatcher	*Empidonax minimus*	M
Hammond's Flycatcher	*Empidonax hammondii*	S
Gray Flycatcher	*Empidonax wrightii*	S
Dusky Flycatcher	*Empidonax oberholseri*	S
Cordilleran Flycatcher	*Empidonax occidentalis*	S
Ash-throated Flycatcher	*Myiarchus cinerascens*	S
Bell's Vireo	*Vireo bellii*	S BC AY
Gray Vireo	*Vireo vicinior*	S BC AY
Plumbeous Vireo	*Vireo plumbeus*	S
Cassin's Vireo	*Vireo cassinii*	M
Warbling Vireo	*Vireo gilvus*	S
Red-eyed Vireo	*Vireo olivaceus*	M
Black-capped Chickadee	*Poecile atricapillus*	R
Mountain Chickadee	*Poecile gambeli*	R
Juniper Titmouse	*Baeolophus ridgwayi*	S BC
Bushtit	*Psaltriparus minimus*	R
Red-breasted Nuthatch	*Sitta canadensis*	R
White-breasted Nuthatch	*Sitta carolinensis*	R
Pygmy Nuthatch	*Sitta pygmaea*	R
Brown Creeper	*Certhia americana*	R
Rock Wren	*Salpinctes obsoletus*	S
Canyon Wren	*Catherpes mexicanus*	R
Bewick's Wren	*Thryomanes bewickii*	R
House Wren	*Troglodytes aedon*	S
Winter Wren	*Troglodytes hiemalis*	M
Marsh Wren	*Cistothorus palustris*	S
American Dipper	*Cinclus mexicanus*	R
Golden-crowned Kinglet	*Regulus satrapa*	R
Ruby-crowned Kinglet	*Regulus calendula*	S
Blue-gray Gnatcatcher	*Polioptila caerulea*	S
Eastern Bluebird	*Sialia sialis*	M
Western Bluebird	*Sialia mexicana*	R
Mountain Bluebird	*Sialia currucoides*	R
Townsend's Solitaire	*Myadestes townsendi*	R
Veery	*Catharus fuscescens*	S BC
Swainson's Thrush	*Catharus ustulatus*	S
Hermit Thrush	*Catharus guttatus*	S
Gray Catbird	*Dumetella carolinensus*	S
Sage Thrasher	*Oreoscoptes montanus*	S
Brown Thrasher	*Toxostoma rufum*	S
Curve-billed Thrasher	*Toxostoma curvirostre*	M
Chestnut-collared Longspur	*Calcarius ornatus*	S BC AY
Ovenbird	*Seiurus aurocapillus*	S
Northern Waterthrush	*Parkesia noveboracensis*	M
Orange-crowned Warbler	*Oreothlypis celata*	S
Virginia's Warbler	*Oreothlypis virginiae*	S AY
MacGillivray's Warbler	*Geothlypis tolmiei*	S
Common Yellowthroat	*Geothlypis trichas*	S
American Redstart	*Setophaga ruticilla*	S
Yellow Warbler	*Setophaga petechia*	S
Yellow-rumped Warbler	*Setophaga coronata*	S
Grace's Warbler	*Setophaga graciae*	S BC AY
Black-throated Gray Warbler	*Setophaga nigrescens*	S
Wilson's Warbler	*Cardellina pusilla*	S
Yellow-breasted Chat	*Icteria virens*	S
Green-tailed Towhee	*Pipilo chlorurus*	S
Spotted Towhee	*Pipilo maculatus*	S
Canyon Towhee	*Melozone fuscus*	S
Cassin's Sparrow	*Peucaea cassinii*	S
Chipping Sparrow	*Spizella passerina*	S
Clay-colored Sparrow	*Spizella pallida*	S
Brewer's Sparrow	*Spizella breweri*	S BC AY
Field Sparrow	*Spizella pusilla*	M
Vesper Sparrow	*Pooecetes gramineus*	S
Lark Sparrow	*Chondestes grammacus*	S
Black-throated Sparrow	*Amphispiza bilineata*	S
Sage Sparrow	*Amphispiza belli*	S AY
Grasshopper Sparrow	*Ammodramus savannarum*	S BC
Fox Sparrow	*Passerella iliaca*	S
Song Sparrow	*Melospiza melodia*	S
Lincoln's Sparrow	*Melospiza lincolnii*	S
Swamp Sparrow	*Melospiza georgiana*	M
White-throated Sparrow	*Zonotrichia albicollis*	S
Harris's Sparrow	*Zonotrichia querula*	M
Dark-eyed Junco	*Junco hyemalis*	R
Western Tanager	*Piranga ludoviciana*	S
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	M
Black-headed Grosbeak	*Pheucticus melanocephalus*	S
Blue Grosbeak	*Guiraca caerulea*	S
Lazuli Bunting	*Passerina amoena*	S
Indigo Bunting	*Passerina cyanea*	S
Orchard Oriole	*Icterus spurius*	S
Bullock's Oriole	*Icterus bullockii*	S
Scott's Oriole	*Icterus parisorum*	S
Pine Grosbeak	*Pinicola enucleator*	R
Red Crossbill	*Loxia curvirostra*	R
White-winged Crossbill	*Loxia leucoptera*	R
Pine Siskin	*Spinus pinus*	R
Evening Grosbeak	*Coccothraustes vespertinus*	R

F = Federal S = State
E = Endangered T = Threatened C = Candidate
BCC = Birds of Conservation Concern (USFWS 2008)
AY/AR - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern
*Southwestern Willow Flycatcher (*E. t. extimus*)
^- western pop. (DPS) ^^- *S. o. lucida*

Table C3. Common and scientific names are given for the 186 bird species that are infrequently or accidentally seen in Colorado (does not include extinct or extirpated species). Most of the following species have been designated by CFO (2012) as review species (only 1 was not included here, the Sparague's Pipit) because they have been documented to occur rarely in Colorado with many only a few times (designated by bold species names). Some of these species have the potential of being the focus of a BDM project. Species in shaded cells (90) will not be or are not likely to ever be involved in a BDM project. Little information on these species is discussed in the EA because they occur so infrequently or in such remote areas on the border, especially southwest and southeast Colorado, that it is highly unlikely in any given span of years that these would be the focus of a single BDM project. These are given to let the reader know that WS is aware of the other species potentially present in Colorado.

Species	Scientific Name*	Status
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	S
Fulvous Whistling-Duck	*Dendrocygna bicolor*	S
Brant	*Branta bernicla*	M
Trumpeter Swan	*Cygnus buccinator*	W AY
Eurasian Wigeon	*Anas penelope*	W
American Black Duck	*Anas rubripes*	M

Species	Scientific Name*	Status
Garganey	*Anas querquedula*	W
Tufted Duck	*Aythya fuligula*	W
Greater Scaup	*Aythya marila*	M
Harlequin Duck	*Histrionicus histrionicus*	M
Surf Scoter	*Melanitta perspicillata*	M
White-winged Scoter	*Melanitta fusca*	M
Black Scoter	*Melanitta americana*	M
Long-tailed Duck	*Clangula hyemalis*	M
Barrow's Goldeneye	*Bucephala islandica*	W
Ruffed Grouse	*Bonasa umbellus*	R
Red-throated Loon	*Gavia stellata*	M
Arctic Loon	*Gavia arctica*	M
Pacific Loon	*Gavia pacifica*	M
Yellow-billed Loon	*Gavia adamsii*	M AY
Red-necked Grebe	*Podiceps grisegena*	M
Wood Stork	*Mycteria americana*	S
Magnificent Frigatebird	*Fregata magnificens*	M AR
Neotropic Cormorant	*Phalacrocorax brasilianus*	S
Anhinga	*Anhinga anhinga*	S
Brown Pelican	*Pelecanus occidentalis*	M
Least Bittern	Ixobrychus exilis	M
Little Blue Heron	*Egretta caerulea*	S
Tricolored Heron	*Egretta tricolor*	S
Reddish Egret	*Egretta rufescens*	S AR
Yellow-crowned Night-Heron	*Nyctanassa violacea*	S
White Ibis	*Eudocimus albus*	S
Glossy Ibis	*Plegadis falcinellus*	S
Roseate Spoonbill	*Ajaia ajaja*	S
Black Vulture	*Coragyps atratus*	S
Swallow-tailed Kite	*Elanoides forficatus*	M AY
Common Black-Hawk	*Buteogallus anthracinus*	S
Harris's Hawk	*Parabuteo unicinctus*	S
Red-shouldered Hawk	*Buteo lineatus*	M
Broad-winged Hawk	*Buteo platypterus*	S
Zone-tailed Hawk	*Buteo albonotatus*	S
Crested Caracara	*Caracara cheriway*	S
Gyrfalcon	*Falco rusticolus*	W
Yellow Rail	*Coturnicops noveboracensis*	M AR
King Rail	*Rallus elegans*	M AY
Purple Gallinule	*Porphyrio martinica*	S
Common Gallinule	*Gallinula galeata*	S
Whooping Crane	*Grus americana*	M FE SE
Eskimo Curlew	*Numenius borealis*	M AR*
Hudsonian Godwit	*Limosa haemastica*	M AY
Red Knot	*Calidris canutus*	M AY
Sharp-tailed Sandpiper	*Calidris acuminata*	M
Curlew Sandpiper	*Calidris ferruginea*	M
Buff-breasted Sandpiper	*Tryngites subruficollis*	M AR
Ruff	*Philomachus pugnax*	M
American Woodcock	*Scolopax minor*	M
Red Phalarope	*Phalaropus fulicarius*	M
Black-legged Kittiwake	*Rissa tridactyla*	W
Ivory Gull	*Pagophila eburnea*	W AR
Sabine's Gull	*Xema sabini*	M
Black-headed Gull	*Chroicocephalus ridibundus*	M
Little Gull	*Hydrocoloeus minutus*	W
Ross's Gull	*Rhodostethia rosea*	M AY
Laughing Gull	*Leucophaeus atricilla*	M
Mew Gull	*Larus canus*	M
Thayer's Gull	*Larus thayeri*	W AY
Iceland Gull	*Larus glaucoides*	W AY
Lesser Black-backed Gull	*Larus fuscus*	R
Slaty-backed Gull	*Larus schistisagus*	M
Glaucous-winged Gull	*Larus glaucescens*	W
Glaucous Gull	*Larus hyperboreus*	W
Great Black-backed Gull	*Larus marinus*	W
Kelp Gull	*Larus dominicanus*	M
Sooty Tern	*Onychoprion fuscatus*	M
Least Tern	*Sternula antillarum*	M FE**SE
Arctic Tern	*Sterna paradisaea*	M
Royal Tern	*Thalasseus maxima*	M
Black Skimmer	*Rhynchops niger*	M AY
Pomarine Jaeger	*Stercorarius pomarinus*	M

Species	Scientific Name*	Status
Parasitic Jaeger	*Stercorarius parasiticus*	M
Long-tailed Jaeger	*Stercorarius longicaudus*	M
Long-billed Murrelet	*Brachyramphus perdix*	M
Ancient Murrelet	*Synthliboarmphus antiquus*	M AY
Inca Dove	*Columbina inca*	S
Common Ground-Dove	*Columbina passerina*	M
Black-billed Cuckoo	*Coccyzus erythropthalmus*	S
Groove-billed Ani	*Crotophaga sulcirostris*	M
Snowy Owl	*Bubo scandiacus*	W
Barred Owl	*Strix varia*	M
Lesser Nighthawk	*Chordeiles acutipennis*	S
Eastern Whip-poor-will	*Caprimulgus vociferus*	M
Mexican Whip-poor-will	*Caprimulgus arizonae*	M
Green Violetear	*Colibri thalassinus*	S
Broad-billed Hummingbird	*Cynanthus latirostris*	S
White-eared Hummingbird	*Hylocharis leucotis*	S
Blue-throated Hummingbird	*Lampornis clemenciae*	S AY
Magnificent Hummingbird	*Eugenes fulgens*	S
Ruby-throated Hummingbird	*Archilochus colubris*	M
Anna's Hummingbird	*Calypte anna*	M
Costa's Hummingbird	*Calypte costae*	M AY
Acorn Woodpecker	*Melanerpes formicivorus*	R
Red-bellied Woodpecker	*Melanerpes carolinus*	S
Ladder-backed Woodpecker	*Picoides scalaris*	R
Eastern Wood-Pewee	*Contopus virens*	M
Acadian Flycatcher	*Empidonax virescens*	M
Alder Flycatcher	*Empidonax alnorum*	M
Buff-breasted Flycatcher	*Empidonax fulvifrons*	M
Black Phoebe	*Sayornis nigricans*	S
Vermillion Flycatcher	*Pyrocephalus rubinus*	S
Dusky-capped Flycatcher	*Myriarchus tuberculifer*	M
Great Crested Flycatcher	*Myiarchus crinitus*	M
Brown-crested Flycatcher	*Myiarchus tryannulus*	M
Sulphur-bellied Flycatcher	*Myiodynnastes luteiventris*	M
Thick-billed Kingbird	*Tyrannus crassirostris*	M
Scissor-tailed Flycatcher	*Tyrannus forficatus*	S
White-eyed Vireo	*Vireo griseus*	M
Yellow-throated Vireo	*Vireo flavifrons*	M
Blue-headed Vireo	*Vireo solitarius*	M
Philadelphia Vireo	*Vireo philadelphicus*	M
Carolina Wren	*Thryothorus ludovicianus*	M
Pacific Wren	*Troglodytes pacificus*	W
Sedge Wren	*Cistothorus platensis*	M
Gray-cheeked Thrush	*Catharus mimimus*	M
Wood Thrush	*Hylocichla mustelina*	M AY
Varied Thrush	*Ixoreus naevius*	S AY
Long-billed Thrasher	*Toxostoma longirostre*	S
Bendire's Thrasher	*Toxostoma bendirei*	M BC AR
Phainopepla	*Phainopepla nitens*	S
Smith's Longspur	*Calcarius pictus*	M AY
Worm-eating Warbler	*Helmitheros vermivorum*	M
Louisiana Waterthrush	*Parkesia motacilla*	M
Golden-winged Warbler	*Vermivora chrysoptera*	M AR
Blue-winged Warbler	*Vermivora pinus*	M AY
Black-and-white Warbler	*Mniotilta varia*	M
Prothonotary Warbler	*Protonotaria citrea*	M AY
Swainson's Warbler	*Limnothylpis swainsonii*	M AY
Tennessee Warbler	*Oreothlypis peregrina*	M
Lucy's Warbler	*Oreothlypis luciae*	S AY
Nashville Warbler	*Oreothlypis ruficapilla*	M
Connecticut Warbler	*Oporornis agilis*	M
Mourning Warbler	*Geothlypis philadelphia*	M
Kentucky Warbler	*Geothlypis formosus*	M AY
Hooded Warbler	*Setophaga citrina*	M
Cape May Warbler	*Setophaga tigrini*	M
Cerulean Warbler	*Setophaga cerulea*	M AY
Northern Parula	*Setophaga americana*	M
Tropical Parula	*Setophaga pitiayumi*	M
Magnolia Warbler	*Setophaga magnolia*	M
Bay-breasted Warbler	*Setophaga castanea*	M AY
Blackburnian Warbler	*Setophaga fusca*	M
Chestnut-sided Warbler	*Setophaga pensylvanica*	M
Blackpoll Warbler	*Setophaga striata*	M

Species	Scientific Name*	Status
Black-throated Blue Warbler	*Setophaga caerulescens*	M
Palm Warbler	*Setophaga palmarum*	M
Pine Warbler	*Setophaga pinus*	M
Yellow-throated Warbler	*Setophaga dominica*	M
Prairie Warbler	*Setophaga discolor*	M AY
Townsend's Warbler	*Setophaga townsendi*	M
Hermit Warbler	*Setophaga occidentalis*	M AY
Black-throated Green Warbler	*Setophaga virens*	M
Canada Warbler	*Cardellina canadensis*	M AY
Red-faced Warbler	*Cardellina rubrifrons*	S AY
Painted Redstart	*Myioborus pictus*	S
Eastern Towhee	*Pipilo erythrophthalmus*	S
Rufous-crowned Sparrow	*Aimophila ruficeps*	S
Black-chinned Sparrow	*Spizella atrogularis*	S
Baird's Sparrow	*Ammodramus bairdii*	S AR
Henslow's Sparrow	*Ammodramus henslowii*	M AR
Le Conte's Sparrow	*Ammodramus leconteii*	M AY
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	M AY
Golden-crowned Sparrow	*Zonotrichia atricapilla*	M
Hepatic Tanager	*Piranga flava*	S
Summer Tanager	*Piranga rubra*	M
Scarlet Tanager	*Piranga olivacea*	M
Pyrrhuloxia	*Cardinalis sinuatus*	S
Painted Bunting	*Passerina ciris*	M AY
Eastern Meadowlark	*Sturnella magna*	S
Rusty Blackbird	*Euphagus carolinus*	M AY
Bronzed Cowbird	*Molothrus aeneus*	M
Hooded Oriole	*Icterus cucullatus*	M
Streak-backed Oriole	*Icterus pustulatus*	W
Baltimore Oriole	*Icterus galbula*	M
Brambling	*Fringilla montifringilla*	W
Purple Finch	*Carpodacus purpureus*	W
Common Redpoll	*Acanthis flammea*	W
Lawrence's Goldfinch	*Spinus lawrencei*	S

F = Federal S = State
E = Endangered T = Threatened C = Candidate
BCC = Birds of Conservation Concern (USFWS 2008)
AY/AR - Audubon's Watch List (NAS 2007) Yellow/Red Species where Yellow = Concern, Red = High Concern
Species not likely to cause damage are shaded
*- Likely extinct **-Interior pop.

Table C4. Several species of waterfowl and gallinaceous birds have been released into the wild from captivity and periodically are the focus of a BDM project or affect it with the most prevalent species seen given. The most common species involved in feral poultry damage management projects are the domestic Mallard, Muscovy Duck, Graylag and Chinese Goose, peafowl, and feral chickens. Several other species of birds escape from private collections and have the possibility of being seen and the focus of a BDM project. None of these species are listed by CFO (2012) as being established in Colorado.

Species	Scientific Name
Domestic Graylag Goose	*Anser anser*
Domestic Swan Goose (*Chinese Goose*)	*Anser cygnoides*
Mute Swan	*Cygnus olor*
Domestic Muscovy Duck	*Cairina moschata*
Domestic Mallard	*Anas platyrhynchos*
Helmeted Guineafowl	*Numida meleagris*
Feral chicken (*Red Junglefowl*)	*Gallus gallus*
Common Peafowl	*Pavo cristatus*
California Condor	*Gymnogyps californianus*
African Collared-Dove	*Streptopelia risoria*

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APPENDIX D: BIRD STRIKES IN THE UNITED STATES AND COLORADO

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 numbers being reported today far exceed the number reported in the 1990s. Table D-1 has all of the strikes reported in the United States and Colorado from FY01 to FY10.

Table D-1. Bird strikes at airfields in Colorado and the United States as reported to the Federal Aviation Administration from FY01 to FY10. The species included are only those that are commonly found in Colorado. The other known categories include those species not found in Colorado where the species was known such as "Other Duck" which includes American Black Duck, Long-tailed Duck, and others not commonly found in Colorado. A total of 77,416 were recorded and 3,200 occurred in Colorado.

	UNITED STATES					COLORADO				
SPECIES	**Number of Strikes**	**% of Strikes w/ Known Sp.**	**Damaging Strikes**	**% Strikes That Cause Damage**	**# Strikes w/ No Damage Data**	**Number of Strikes**	**% of Strikes w/ Known Sp.**	**Damaging Strikes**	**% Strikes That Cause Damage**	**# Strikes w/ No Damage Data**
Waterfowl (Geese, Swans, Ducks, Cranes, Gallinules, Rails)										
Greater White-fronted Goose	17	0.05%	10	71%	3	-	-	-	-	-
Snow Goose	59	0.16%	49	88%	3	-	-	-	-	-
Canada/Cackling Goose	648	1.77%	334	59%	83	13	0.85%	8	67%	1
Other Goose (Brant)	13	0.04%	5	63%	5	-	-	-	-	-
Unknown Goose	125	0.34%	70	58%	5	4	0.26%	4	100%	0
Tundra Swan	4	0.01%	3	100%	1	-	-	-	-	-
Other Swans*	4	0.01%	2	100%	2	-	-	-	-	-
Unknown Swan	1	0.00%	0	0%	0	-	-	-	-	-
Gadwall	34	0.09%	10	38%	8	-	-	-	-	-
American Wigeon	32	0.09%	12	43%	4	1	0.07%	1	100%	0
Mallard	382	1.05%	85	40%	168	6	0.39%	0	0%	2
Blue-winged Teal	21	0.06%	11	61%	3	-	-	-	-	-
Cinnamon Teal	4	0.01%	1	50%	2	-	-	-	-	-
Northern Shoveler	33	0.09%	14	50%	5	-	-	-	-	-
Northern Pintail	77	0.21%	47	64%	4	-	-	-	-	-
Green-winged Teal	36	0.10%	10	36%	8	1	0.07%	0	0%	0
Canvasback	12	0.03%	5	71%	5	-	-	-	-	-
Redhead	6	0.02%	4	100%	2	-	-	-	-	-
Ring-necked Duck	9	0.02%	4	50%	1	-	-	-	-	-
Lesser Scaup	23	0.06%	13	72%	5	-	-	-	-	-
Bufflehead	7	0.02%	1	25%	3	-	-	-	-	-
Common Goldeneye	4	0.01%	2	67%	1	-	-	-	-	-
Hooded Merganser	4	0.01%	2	67%	1	-	-	-	-	-
Common Merganser	1	0.00%	1	100%	0	-	-	-	-	-
Ruddy Duck	23	0.06%	4	40%	13	-	-	-	-	-
Wood Duck	25	0.07%	9	56%	9	-	-	-	-	-
Other Duck*	61	0.17%	11	38%	32	-	-	-	-	-
Unknown Duck	276	0.76%	89	35%	25	7	0.46%	2	40%	2
Unknown Goose/Swan/Duck	49	0.13%	15	31%	0	1	0.07%	1	100%	0
Waterfowl Total	**1,990**	**5.45%**	**823**	**52%**	**401**	**33**	**2.15%**	**16**	**57%**	**5**
Gallinaceous Bird (Quail, Grouse, Turkey and Introduced Pheasant, Francolin, and Partridge)										
Scaled Quail	3	0.01%	0	0%	3	-		-		-
Northern Bobwhite	4	0.01%	0	0%	2	-		-		-
Unknown Quail	6	0.02%	0	0%	2	-		-		-
Chukar	2	0.01%	0	0%	0	-		-		-
Ring-necked Pheasant	24	0.07%	6	40%	9	1	0.07%	0	0%	0
Greater Sage-Grouse	26	0.07%	9	39%	3	-		-		-
Unknown Ptarmigan	3	0.01%	0	0%	0			-		-
Sharp-tailed Grouse	1	0.00%	0	0%	0	-		-		-
Other Grouse*	7	0.02%	2	50%	3	-		-		-
Unknown Grouse	2	0.01%	0	0%	0	-		-		-
Wild Turkey	34	0.09%	15	56%	7	-		-		-
Gallinaceous Bird Total	**112**	**0.31%**	**32**	**39%**	**29**	**1**	**0.07%**	**0**	**0%**	**0**
Waterbirds (Loons, Grebes, Pelicans, Cormorants, Pelagics, Kingfishers)										
Common Loon	20	0.05%	12	86%	6	-		-		-
Other Loons (Red-throated)	2	0.01%	1	100%	1	-		-		-
Unknown Loon	1	0.00%	1	100%	0	-		-		-
Pied-billed Grebe	14	0.04%	2	25%	6	-		-		-
Horned Grebe	6	0.02%	2	100%	4	-		-		-
Eared Grebe	2	0.01%	0	N/A	2	-		-		-
Western Grebe	15	0.04%	5	63%	7	-		-		-

Clark's Grebe	1	0.00%	0	0%	1	-		-		-
Other Grebe (Red-necked)	2	0.01%	0	0%	2	-		-		-
Unknown Grebe	4	0.01%	1	50%	2	-		-		-
Pelagic Birds*	15	0.04%	0	0%	14					
American White Pelican	9	0.02%	6	75%	1	1	0.07%	1	100%	0
Double-crested Cormorant	69	0.19%	26	65%	29	-		-		-
Other Pelecaniformes*	61	0.17%	26	49%	8	-		-		-
Unknown Pelecaniformes	5	0.01%	2	67%	2	-		-		-
Belted Kingfisher	2	0.01%	0	0%	1	-		-		-
Waterbird Total	**228**	**0.62%**	**84**	**59%**	**86**	**1**	**0.07%**	**1**	**100%**	**0**
Wading Birds (Herons, Egrets, Ibises, Storks, Bitterns, Rails, Cranes)										
American Bittern	7	0.02%	2	33%	1	-		-		-
Other Bittern (Least)	1	0.00%	0	0%	0	-		-		-
Great Blue Heron	179	0.49%	43	41%	74	2	0.13%	1	100%	1
Great Egret	40	0.11%	10	40%	15	-		-		-
Snowy Egret	17	0.05%	1	25%	13	-		-		-
Cattle Egret	161	0.44%	15	15%	62	-		-		-
Green Heron	9	0.02%	1	17%	3	-		-		-
Black-Crowned Night Heron	38	0.10%	3	38%	30	-		-		-
Other Heron/Spoonbill/Stork*	31	0.08%	6	40%	16	-		-		-
Unknown Egret/Heron	104	0.28%	13	15%	18	-		-		-
White-faced Ibis	10	0.03%	6	100%	4	-		-		-
Other Ibis (White)	4	0.01%	0	0%	3	-		-		-
Unknown Ibis	3	0.01%	0	0%	0	-		-		-
American Coot	86	0.24%	24	48%	36	1	0.07%	1	100%	0
Other Gallinule*	3	0.01%	2	67%	0	-		-		-
Sandhill Crane	57	0.16%	22	47%	10	2	0.13%	2	100%	0
Whooping Crane	1	0.00%	1	100%	0	-		-		-
Unknown Crane	4	0.01%	0	0%	0	-		-		-
Virginia Rail	5	0.01%	0	0%	2	-		-		-
Sora	20	0.05%	2	17%	8	-		-		-
Other Rail (Clapper)	5	0.01%	0	0%	4	-		-		-
Unknown Rail	2	0.01%	0	0%	0	-		-		-
Total Wading Birds	**787**	**2.15%**	**151**	**31%**	**299**	**5**	**0.33%**	**4**	**100%**	**1**
Raptors (Vultures, Kites, Eagles, Harriers, Accipiters, Hawks, Falcons, Owls, Shrikes)										
Turkey Vulture	316	0.86%	153	57%	46	1	0.07%	0	0%	0
Other Vulture (Black)	82	0.22%	54	70%	5	-		-		-
Unknown Vulture	117	0.32%	68	61%	5	-		-		-
Osprey	143	0.39%	29	35%	60	-		-		-
Mississippi Kite	5	0.01%	0	0%	1	-		-		-
Other Kite*	17	0.05%	5	42%	5	-		-		-
Bald Eagle	95	0.26%	41	54%	19	2	0.13%	1	50%	0
Golden Eagle	9	0.02%	1	20%	4	1	0.07%	0	0%	0
Unknown Eagle	4	0.01%	2	67%	1	1	0.07%	1	100%	0
Northern Harrier	57	0.16%	1	7%	43	9	0.59%	0	0%	8
Sharp-shinned Hawk	13	0.04%	0		8	1	0.07%	0	0%	0
Cooper's Hawk	49	0.13%	3	14%	28	-		-		-
Northern Goshawk	1	0.00%	0	-50%	1	-		-		-
Swainson's Hawk	66	0.18%	14	39%	30	11	0.72%	1	20%	6
Red-tailed Hawk	1,022	2.80%	164	32%	515	43	2.80%	4	33%	31
Ferruginous Hawk	15	0.04%	1	20%	10	8	0.52%	0	0%	7
Rough-legged Hawk	39	0.11%	3	25%	27	3	0.20%	0	0%	2
Other Hawk*	33	0.09%	4	25%	17	-		-		-
Unknown Hawk	560	1.53%	105	24%	117	21	1.37%	5	26%	2
American Kestrel	2,093	5.73%	22	4%	1,473	37	2.41%	0	0%	29
Merlin	39	0.11%	0		25	-		-		-
Peregrine Falcon	132	0.36%	11	24%	87	2	0.13%	0		2
Prairie Falcon	13	0.04%	1	14%	6	2	0.13%	0		2
Other Falcon/Caracara*	8	0.02%	1	50%	6	-		-		-
Unknown Falcon	27	0.07%	0	0%	7	3	0.20%	0	0%	2
Unknown Falcon/Hawk/Vulture	15	0.04%	7	47%	0	2	0.13%	0	0%	0
Barn Owl	536	1.47%	23	15%	381	5	0.33%	0		5
Western Screech-Owl	2	0.01%	0		1	-		-		-
Eastern Screech-Owl	2	0.01%	1	100%	1	-		-		-
Great Horned Owl	106	0.29%	15	36%	64	28	1.82%	4	50%	20
Northern Pygmy-Owl	1	0.00%	0		1	-		-		-
Burrowing Owl	86	0.24%	1	4%	62	14	0.91%	1	50%	12
Long-eared Owl	6	0.02%	2	100%	4	-		-		-
Short-eared Owl	207	0.57%	5	9%	149	9	0.59%	0		9
Northern Saw-whet Owl	2	0.01%	0		0	-		-		-
Other Owl*	60	0.16%	4	21%	41	-		-		-
Unknown Owl	117	0.32%	12	14%	31	4	0.26%	1	50%	2
Loggerhead Shrike	10	0.03%	0	0%	5	-		-		-
Raptor Total	**6,105**	**16.71%**	**753**	**27%**	**3,286**	**207**	**13.47%**	**18**	**26%**	**139**
Shorebirds (Plovers, Sandpipers, Curlews, Godwits, Turnstones, Snipe, Phalaropes)										
Black-bellied Plover	56	0.15%	3	11%	29	-				-

American Golden-Plover	64	0.18%	5	23%	42	-				-
Snowy Plover	1	0.00%	0	0%	0	-				-
Semipalmated Plover	47	0.13%	0	0%	35	-				-
Piping Plover	2	0.01%	1	50%	0	-				-
Killdeer	2,143	5.86%	47	6%	1,406	19	1.24%	0%	0.0%	18
Unknown Plover	39	0.11%	3	12%	14	1	0.07%	0%	0.0%	0
Black-necked Stilt	3	0.01%	0		3	-				-
American Avocet	4	0.01%	1	100%	3	-				-
Spotted Sandpiper	14	0.04%	4	57%	7	-				-
Solitary Sandpiper	3	0.01%	0		3	-				-
Greater Yellowlegs	5	0.01%	1	20%	0	-				-
Lesser Yellowlegs	2	0.01%	1	100%	1	-				-
Willet	5	0.01%	0	0%	4	-				-
Upland Sandpiper	96	0.26%	0	0%	69	2	0.13%	0%	0.0%	1
Whimbrel	7	0.02%	1	25%	3	-				-
Long-billed Curlew	6	0.02%	1	33%	3	2	0.13%			2
Marbled Godwit	1	0.00%	1	100%	0	-				-
Ruddy Turnstone	5	0.01%	0	0%	4	-				-
Sanderling	18	0.05%	1	11%	9	1	0.07%			1
Semipalmated Sandpiper	27	0.07%	0	0%	9	-				-
Western Sandpiper	43	0.12%	3	9%	8	-				-
Least Sandpiper	44	0.12%	2	10%	23	-				-
White-rumped Sandpiper	4	0.01%	0		4	-				-
Baird's Sandpiper	14	0.04%	0	0%	9	-				-
Pectoral Sandpiper	11	0.03%	1	14%	4	-				-
Dunlin	23	0.06%	3	27%	12	1	0.07%			1
Buff-breasted Sandpiper	24	0.07%	1	10%	14	-				-
Unknown Sandpiper/Curlew	138	0.38%	5	7%	67	-				-
Short-billed Dowitcher	7	0.02%	1	17%	1	-				-
Long-billed Dowitcher	6	0.02%	0	0%	2	-				-
Wilson’s Snipe	42	0.11%	2	7%	14	-				-
Wilson’s Phalarope	2	0.01%	0	0%	0	-				-
Red-necked Phalarope	3	0.01%	0	0%	2	-				-
Other Shorebird*	532	1.46%	6	3%	360	1^	0.07%	0%	0.0%	0
Unknown Shorebird	21	0.06%	1	8%	8	-				-
Shorebird Total	**3,462**	**9.47%**	**95**	**7%**	**2,172**	**27**	**1.76%**	**0%**	**0.0%**	**23**
Larids (Gulls, Terns, Skimmers, Jaegers)										
Franklin's Gull	67	0.18%	2	7%	37	1	0.07%	1	100%	0
Bonaparte's Gull	26	0.07%	1	9%	15	-		-		-
Ringed-billed Gull	789	2.16%	70	21%	454	1	0.07%	0	0%	0
California Gull	66	0.18%	6	17%	31	-		-		-
Herring Gull	673	1.84%	56	22%	417	-		-		-
Other Gull*	419	1.15%	37	21%	242	-		-		-
Unknown Gull	2,242	6.14%	359	20%	439	3	0.20%	1	33%	0
Caspian Tern	17	0.05%	1	33%	14	-		-		-
Black Tern	3	0.01%	0	0%	0	-		-		-
Common Tern	10	0.03%	1	33%	7	-		-		-
Forster’s Tern	6	0.02%	0		6	-		-		-
Other Tern*	28	0.08%	0	0%	16	-		-		-
Unknown Tern	16	0.04%	0	0%	3	-		-		-
Unknown Gull/Tern	2	0.01%	0	0%	0	-		-		-
Other Larid*	8	0.02%	0		8	-		-		-
Larid Total	**4,372**	**11.96%**	**533**	**20%**	**1,689**	**5**	**0.33%**	**2**	**40%**	**0**
Invasive Species (Introduced Parrots, Doves, Starlings, Sparrows)										
Parrots	13	0.04%	0	0%	8	-		-		-
Feral Rock Pigeon	1,270	3.48%	113	17%	607	71	4.62%	5	20%	46
Hawaii Exotic Doves*	246	0.67%	1	1%	122	-		-		-
Unknown Pigeon/Dove	24	0.07%	2	10%	3	1	0.07%	0	0%	0
European Starling	1,768	4.84%	70	7%	799	18	1.17%	1	14%	11
House Sparrow	87	0.24%	2	5%	49	4	0.26%	0	0%	3
Hawaii Exotic Passerines*	170	0.47%	0	0%	86	-		-		-
Invasive Spp. Total	**3,578**	**9.79%**	**188**	**10%**	**1,674**	**94**	**6.12%**	**6**	**18%**	**60**
Natives Doves and Pigeons										
Band-tailed Pigeon	6	0.02%	3	60%	1	-	-	-	-	
White-winged Dove	29	0.08%	1	7%	15	-	-	-	-	
Mourning Dove	3,440	9.41%	100	8%	2,142	189	12.30%	4	10%	150
Other Dove*	12	0.03%	0	0%	10	-	-	-	-	
Unknown Dove	513	1.40%	21	8%	250	-	-	-	-	
Native Dove Total	**4,000**	**10.95%**	**125**	**8%**	**2,418**	**189**	**12.30%**	**4**	**10%**	**150**
Aerialists (Nightjars, Swifts, Swallows)										
Common Nighthawk	247	0.68%	2	2%	146	11	0.72%	0	0%	10
Common Poorwill	6	0.02%	0		6	2	0.13%	0		2
Other Nightjar*	12	0.03%	0	0%	9	-		-		-
Unknown Nightjar	5	0.01%	0	0%	4	-		-		-
Black Swift	2	0.01%	0	0%	1	-		-	-	-
Chimney Swift	279	0.76%	16	8%	73	-		-	-	-

White-throated Swift	19	0.05%	1	6%	2	5	0.33%	0	0%	0
Other swift (Vaux's)	16	0.04%	0	0%	7	-		-		-
Unknown Swift	6	0.02%	0	0%	1	-		-		-
Purple Martin	105	0.29%	4	6%	33	-		-		-
Tree Swallow	236	0.65%	8	5%	77	-		-		-
Violet-green Swallow	12	0.03%	0	0%	6	-		-		-
N. Rough-winged Swallow	20	0.05%	1	13%	12	-		-		-
Bank Swallow	143	0.39%	2	3%	74	-		-		-
Cliff Swallows	558	1.53%	14	4%	241	120	7.81%	1	5%	98
Cave Swallow	6	0.02%	0	0%	3	-		-		-
Barn Swallow	1,508	4.13%	12	2%	813	6	0.39%	0	0%	4
Unknown Swallow	475	1.30%	6	2%	126	11	0.72%	1	14%	4
Aerialist Total	**3,655**	**10.00%**	**66**	**3%**	**1,634**	**155**	**10.08%**	**2**	**5%**	**118**
Other Non-passerines (Woodpeckers, Cuckoos, Hummingbirds)										
Yellow-bellied Sapsucker	16	0.04%	2	15%	3	-		-		-
Red-naped Sapsucker	2	0.01%	1	50%	0	1	0.07%	0	0%	0
Downy Woodpecker	1	0.00%	0	0%	0	-		-		-
Hairy Woodpecker	3	0.01%	0	0%	2	-		-		-
Northern Flicker	34	0.09%	3	33%	25	-		-		-
Unknown Woodpecker	4	0.01%	0	0%	1	-		-		-
Yellow-billed Cuckoo	24	0.07%	4	24%	7	-		-		-
Black-billed Cuckoo	1	0.00%	0	0%	0	-		-		-
Unknown Cuckoo	4	0.01%	1	25%	0	-		-		-
Greater Roadrunner	1	0.00%	0		1	-		-		-
Hummingbirds*	22	0.06%	1	6%	5	-		-		-
Other Bird Total	**112**	**0.31%**	**12**	**18%**	**44**	**1**	**0.07%**	**0**	**0%**	**0**
Grassland Species (Larks, Pipits, Longspurs, Sparrows, Meadowlarks)										
Horned Lark	1,624	4.44%	30	4%	859	520	33.83%	2	1%	352
American Pipit	41	0.11%	3	10%	11	-		-		-
Sprague's Pipit	4	0.01%	0	0%	1	1	0.07%	0	0%	0
Unknown Pipit	2	0.01%	0	0%	0	-		-		-
Lapland Longspur	14	0.04%	0	0%	5	-		-		-
Chestnut-collared Longspur	4	0.01%	0	0%	1	-		-		-
Smith's Longspur	4	0.01%	0	0%	0	-		-		-
McCown's Longspur	1	0.00%	0		1	-		-		-
Snow Bunting	104	0.28%	2	3%	45	-		-		-
American Tree Sparrow	12	0.03%	0	0%	5	1	0.07%	0	0%	0
Chipping Sparrow	27	0.07%	3	17%	9	3	0.20%	0	0%	1
Field Sparrow	16	0.04%	0	0%	8	-		-		-
Lark Sparrow	11	0.03%	0	0%	9	1	0.07%	0		1
Vesper Sparrow	24	0.07%	1	6%	8	-		-		-
Black-throated Sparrow	1	0.00%	0		1	-		-		-
Sage Sparrow	8	0.02%	0	0%	3	2	0.13%	0		2
Lark's Bunting	45	0.12%	1	10%	35	40	2.60%	0	0%	32
Savannah Sparrow	206	0.56%	8	7%	85	3	0.20%	0	0%	1
Grasshopper Sparrow	38	0.10%	1	5%	16	-		-		-
Fox Sparrow	17	0.05%	2	15%	4	-		-		-
Song Sparrow	60	0.16%	2	6%	27	-		-		-
Lincoln's Sparrow	22	0.06%	4	19%	1	-		-		-
Swamp Sparrow	14	0.04%	0	0%	5	-		-		-
White-throated Sparrow	45	0.12%	4	12%	12	1	0.07%	0	0%	0
Harris's Sparrow	1	0.00%	0		1	-		-		-
White-crowned Sparrow	27	0.07%	5	21%	3	1	0.07%	0	0%	0
Golden-crowned Sparrow	2	0.01%	0	0%	1	-		-		-
Dark-eyed Junco	44	0.12%	6	16%	7	1	0.07%	0		1
Other Sparrow (Towhees)*	2	0.01%	1	50%	0	-		-		-
Unknown Sparrow	1,414	3.87%	17	2%	445	60	3.90%	3	6%	10
Bobolink	18	0.05%	1	6%	2	-		-		-
Eastern Meadowlark	693	1.90%	18	6%	380	2	0.13%	0	0%	1
Western Meadowlark	425	1.16%	11	7%	259	128	8.33%	0	0%	109
Unknown Meadowlark	248	0.68%	2	3%	180	-		-		-
Grassland Species Total	**5,218**	**14.28%**	**122**	**4%**	**2,429**	**764**	**49.71%**	**5**	**2%**	**510**
Corvids (Ravens, Crows, Magpies, Jays)										
Blue Jay	10	0.03%	0	0%	4	-		-		-
Black-billed Magpie	6	0.02%	0	0%	2	-		-		-
Other Magpie (Yellow-billed)	1	0.00%	0	0%	0	-		-		-
American Crow	185	0.51%	14	13%	77	4	0.26%	0	0%	1
Other Crow (Northwestern)	3	0.01%	0	0%	2	-		-		-
Unknown Crow	70	0.19%	10	25%	30	-		-		-
Common Raven	21	0.06%	5	45%	10	-		-		-
Corvid Total	**296**	**0.81%**	**29**	**17%**	**125**	**4**	**0.26%**	**0**	**0%**	**1**
Woodland Birds (Vireos, Chickadees, Nuthatches, Thrushes, Waxwings, Warblers)										
Cassin's Vireo	2	0.01%	0	0%	0	-		-		-
Blue-headed Vireo	3	0.01%	0	0%	0	-		-		-
Warbling Vireo	14	0.04%	3	27%	3	-		-		-
Red-eyed Vireo	38	0.10%	2	6%	2	-		-		-

Other Vireo	11	0.03%	1	9%	0	-		-		-
Unknown Vireo	6	0.02%	0	0%	1	-		-		-
Black-capped Chickadee	14	0.04%	0	0%	7	-		-		-
Mountain Chickadee	1	0.00%	0	0%	0	-		-		-
Other Chickadee	4	0.01%	0	0%	1	-		-		-
Unknown Chickadee	3	0.01%	1	50%	1	-		-		-
White-breasted Nuthatch	1	0.00%	0		1	-		-		-
Golden-crowned Kinglet	6	0.02%	1	17%	0	-		-		-
Ruby-crowned Kinglet	16	0.04%	4	29%	2	-		-		-
Eastern Bluebird	6	0.02%	0	0%	3	-		-		-
Western Bluebird	4	0.01%	0	0%	2	2	0.13%	0	0%	1
Mountain Bluebird	6	0.02%	0	0%	2	-		-		-
Veery	9	0.02%	0	0%	0	-		-		-
Gray-cheeked Thrush	10	0.03%	0	0%	1	-		-		-
Swainson's Thrush	58	0.16%	9	16%	3	-		-		-
Hermit Thrush	48	0.13%	5	12%	6	1	0.07%	0		1
American Robin	386	1.06%	35	13%	112	3	0.20%	0	0%	1
Other Thrush (Varied, Wood)	36	0.10%	4	11%	0	-		-		-
Unknown Thrush	56	0.15%	2	4%	0	1	0.07%	0	0%	0
Bohemian Waxwing	1	0.00%	0	0%	0	-		-		-
Cedar Waxwing	68	0.19%	5	9%	15	-		-		-
Orange-crowned Warbler	12	0.03%	1	9%	1	-		-		-
Yellow Warbler	11	0.03%	2	20%	1	-		-		-
Yellow-rumped Warbler	64	0.18%	11	18%	4	1	0.07%	0		1
Black-throated Gray Warbler	1	0.00%	0	0%	0	-		-		-
American Redstart	10	0.03%	1	10%	0	-		-		-
Ovenbird	27	0.07%	2	8%	1	-		-		-
Northern Waterthrush	8	0.02%	0	0%	3	-		-		-
MacGillivray's Warbler	2	0.01%	0		2	-		-		-
Common Yellowthroat	34	0.09%	2	6%	2	-		-		-
Wilson's Warbler	18	0.05%	0	0%	1	-		-		-
Yellow-breasted Chat	5	0.01%	0	0%	1	-		-		-
Other Wood Warblers	100	0.27%	6	7%	19	-		-		-
Unknown Wood Warblers	51	0.14%	1	3%	11	-		-		-
Woodland Bird Total	**1,150**	**3.15%**	**98**	**10%**	**208**	**8**	**0.52%**	**0**	**0%**	**4**
Open Woodland Birds (Flycatchers, Wrens, Thrashers, Grosbeaks, Cardinal, Finches)										
Western Wood-Pewee	2	0.01%	1	100%	1	-	-	-	-	-
Least Flycatcher	2	0.01%	0		2	-	-	-	-	-
Hammond's Flycatcher	1	0.00%	0	0%	0	-	-	-	-	-
Eastern Phoebe	1	0.00%	0	0%	0	-	-	-	-	-
Say's Phoebe	5	0.01%	0	0%	3	-	-	-	-	-
Ash-throated Flycatcher	1	0.00%	0	0%	0	-	-	-	-	-
Western Kingbird	106	0.29%	0	0%	76	11	0.72%	0	0%	6
Eastern Kingbird	14	0.04%	2	22%	5	1	0.07%	0	0%	0
Scissor-tailed Flycatcher	88	0.24%	2	6%	52	-	-	-	-	-
Other Tyrant Flycatchers	10	0.03%	1	20%	5	-	-	-	-	-
Unknown Tyrant Flycatcher	15	0.04%	0	0%	9	1	0.07%	0	0%	0
Rock Wren	1	0.00%	0		1	-	-	-	-	-
House Wren	8	0.02%	0	0%	4	-	-	-	-	-
Winter Wren	1	0.00%	0		1	-	-	-	-	-
Marsh Wren	6	0.02%	0	0%	1	-	-	-	-	-
Other Wren	6	0.02%	0	0%	5	-	-	-	-	-
Unknown Wren	20	0.05%	0	0%	3	1	0.07%	0	0%	0
Blue-gray Gnatcatcher	5	0.01%	0	0%	0	-	-	-	-	-
Gray Catbird	51	0.14%	5	12%	9	-	-	-	-	-
Northern Mockingbird	32	0.09%	0	0%	17	-	-	-	-	-
Sage Thrasher	1	0.00%	0	0%	0	-	-	-	-	-
Brown Thrasher	7	0.02%	0	0%	5	-	-	-	-	-
Curve-billed Thrasher	1	0.00%	0		1	-	-	-	-	-
Unknown Mimidae (Thrashers et	8	0.02%	0	0%	0	1	0.07%	0	0%	0
Western Tanager	12	0.03%	1	9%	1	-	-	-	-	-
Other Tanager (Scarlet)	5	0.01%	1	25%	1	-	-	-	-	-
Unknown Tanager	2	0.01%	0	0%	0					
Northern Cardinal	5	0.01%	0	0%	4	-		-		-
Rose-breasted Grosbeak	2	0.01%	0	0%	0	-		-		-
Black-headed Grosbeak	1	0.00%	0	0%	0	-		-		-
Indigo Bunting	13	0.04%	2	17%	1	-		-		-
Dickcissel	5	0.01%	0	0%	2	-		-		-
Cardinals, buntings, sparrows	6	0.02%	0	0%	0	-		-		-
Purple Finch	1	0.00%	0		1	-		-		-
House Finch	52	0.14%	0	0%	31	2	0.13%	0	0%	1
White-winged Crossbill	1	0.00%	0		1	-		-		-
Pine Siskin	5	0.01%	0	0%	1	2	0.13%	0	0%	1
Lesser Goldfinch	2	0.01%	0		2	-		-		-
American Goldfinch	28	0.08%	0	0%	15	-		-		-
Unknown Finches	46	0.13%	1	4%	18	2	0.13%	0	0%	1
Evening Grosbeak	1	0.00%	0	0%	0	-		-		-
Open Woodland Species Total	**579**	**1.58%**	**16**	**5%**	**278**	**21**	**1.37%**	**0**	**0%**	**9**

Blackbirds (Blackbirds, Cowbirds, Grackles, Orioles)										
Red-winged Blackbird	124	0.34%	6	9%	56	8	0.52%	0	0%	7
Yellow-headed Blackbird	4	0.01%	0	0%	1	1	0.07%	0		1
Rusty Blackbird	1	0.00%	0		1					
Brewer's Blackbird	32	0.09%	0	0%	29	1	0.07%	0		1
Common Grackle	85	0.23%	6	18%	52	2	0.13%	0		2
Great-tailed Grackle	21	0.06%	0	0%	11					
Other Grackle (Boat-tailed)	5	0.01%	1	33%	2					
Unknown Grackle	64	0.18%	5	20%	39					
Brown-headed Cowbird	100	0.27%	3	6%	50	3	0.20%	0	0%	1
Unknown Blackbird	445	1.22%	24	6%	49	5	0.33%	0	0%	1
Orchard Oriole	1	0.00%	0	0%	0					
Bullock's Oriole	1	0.00%	0		1	1	0.07%	0		1
Baltimore Oriole	15	0.04%	1	9%	4	1	0.07%	0	0%	0
Unknown Oriole	1	0.00%	0		1					
Blackbird Total	**899**	**2.46%**	**46**	**8%**	**296**	**22**	**1.43%**	**0**	**0%**	**14**
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	**36,543**	**47.2%**	**3,173**	**16.3%**	**17,068**	**1,537**	**48.0%**	**58**	**11.5%**	**1,034**
Unidentified Birds Strikes										
Unknown Bird	38,420	49.6%	3,058	8.5%	2,552	1,627	50.8%	75	5.0%	136
Unknown Passerine	449	0.6%	21	4.9%	19	10	0.3%	1	12.5%	2
Unknown Bird/Bat (Less Bats**)	2,004	2.6%	124	6.2%	7	26	0.8%	1	3.8%	0
Unknown Total	**40,873**	**52.8%**	**3,203**	**8.4%**	**2,578**	**1,663**	**52.0%**	**77**	**5.0%**	**138**
BIRD STRIKE TOTAL FY01 TO FY10										
ALL BIRD STRIKE TOTAL	**77,416**	**100%**	**6,376**	**11.0%**	**19,646**	**3,200**	**100%**	**135**	**6.7%**	**1,172**

*__Other Swan__= Mute (2), Trumpeter (2)

Other Duck = American Black Duck (28), Common Eider (1), Greater Scaup (4), Harlequin Duck (1), Hawaiian Duck (2), Long-tailed Duck (4), Mottled Duck (13), Muscovy (1), Red-breasted Merganser (5), White-winged Scoter (1)

Other Grouse = Ruffed Grouse (1), Black Francolin (2), Gray Francolin (2), Gray Partridge (2)

Pelagic Birds = Fork-tailed Storm-Petrel (1), Townsend's Shearwater (5), Wedge-tailed Shearwater (9)

Other Pelecaniformes = Brown Pelican (26), Great Cormorant (2), Pelagic Cormorant (1), Anhinga (15), Frigatebirds (7), Tropicbirds (12)

Other Heron, Spoonbill Stork = Little Blue Heron (4), Tricolored Heron (2), Yellow-crowned Night-Heron (13), Roseate Spoonbill (2), Wood Stork (10)

Other Gallinule = Common Moorhen (4), Purple Gallinule (3)

Other Kite = White-tailed Kite (13), Swallow-tailed Kite (4)

Other Hawk = Broad-winged Hawk (14), Harris's Hawk (2), Red-shouldered Hawk (15), White-tailed Hawk (2)

Other Falcon = Eurasian Kestrel (1), Gyrfalcon (1), Crested Caracara (6)

Other Owl = Barred Owl (10), Snowy Owl (50)

Other Shorebird = American Oystercatcher (15), European Golden-Plover (5), Pacific Golden-Plover (469), Wilson's Plover (2), Black Turnstone (1), Red Knot (2), Rock Sandpiper (1)

Other Gull = Black-legged Kittiwake (2), Red-legged Kittiwake (1), Laughing Gull (187), Mew Gull (36), Western Gull (66), Thayer's Gull (3), Lesser Black-backed Gull (1), Glaucous-winged Gull (49), Glaucous Gull (9), Great Black-backed Gull (65)

Other Tern = Sooty Tern (1), Ferry Tern (1), White Tern (2), Least Tern (20), Gull-billed Tern (2), Roseate Tern (1), Royal Tern (1)

Other Larid = Black Noddy (1), Parasitic Jaeger (1), Black Skimmer (6)

Invasive Parrots = Budgerigar (9), Black-hooded Parakeet (1), Unknown Parrot (3)

HI Invasive Doves = Spotted Dove (101), Mourning Dove (3), Zebra Dove (105), Unknown Dove (37)

HI Invasive Passerines = Sky Lark (33), Common Myna (36), Unknown Myna (4), Japanese White-eye (1), Red-crested Cardinal (2), Red Avadavat (2), Black-headed Munia (33), White-throated Munia (3), Nutmeg Mannikin (38), Unknown Mannikin-Munia (7), Java Sparrow (2), Common Waxbill (3), Unknown (3), and included Red-vented Bulbul (3)

Other Native Dove = Inca Dove (5), Common ground-Dove (7)

Other Nightjar = Chuck-will's-widow (3), Whip-poor-will (3), Lesser Nighthawk (6)

Hummingbirds = Anna's (4), Black-chinned (1), Ruby-throated (11), Rufous (1), and Unknown (5)

Other Sparrow = California Towhee (1), Eastern Towhee (1)

Other Vireo = White-eyed Vireo (7), Yellow-throated Vireo (4)

Other Chickadee = Carolina Chickadee (2), Gray-headed Chickadee (1), Tufted Titmouse (1)

Other Thrush = Varied Thrush (23), Wood Thrush (13)

Other Wood Warbler = Black-and-white Warbler (6), Blackpoll Warbler (22), Black-throated Blue Warbler (8), Black-throated Green Warbler (1), Canada Warbler (3), Cape May Warbler (5), Hermit Warbler (1), Hooded Warbler (4), Louisiana Waterthrush (2), Magnolia Warbler (8), Mourning Warbler (3), Nashville Warbler (11), Northern Parula (2), Palm Warbler (7), Pine Warbler (7), Prairie Warbler (1), Prothonotary Warbler (1), Tennessee Warbler (1), Townsend's Warbler (1), Yellow-throated Warbler (3)

Other Tyrant Flycatchers = Eastern Wood-Pewee (3), Acadian Flycatcher (2), Pacific-slope Flycatcher (1), Yellow-bellied Flycatcher (1), Great-crested Flycatcher (2), Sulphur-bellied Flycatcher (1)

Other Wren = Cactus Wren (3), Carolina Wren (2), and included Wrentit (1)

**A total of 556 bat strikes were reported from FY01 to FY10 while 75,412 bird strikes. Thus, 0.73% of the reported unknown bird/bat strikes were estimated to be bat strikes. Using that percentage for Unknown Bird or Bat Strikes would result in 15 strikes caused by bats with 1 damaging strike. Reducing this category to birds only would result in 2,004 bird strikes instead of 2,019 bird/bat strikes with 124 damaging strikes instead of 125.