Human Health and Ecological Risk Assessment
for the Use of Wildlife Damage Management Methods
by USDA-APHIS-Wildlife Services

Chapter I

Introduction to Risk Assessments for Methods Used in Wildlife Damage Management

MAY 2017

Introduction to Risk Assessments for Methods Used in Wildlife Damage Management

EXECUTIVE SUMMARY

The USDA-APHIS-Wildlife Services (WS) Program completed Risk Assessments for methods used in wildlife damage management in 1992 (USDA 1997). While those Risk Assessments are still valid, for the most part, the WS Program has expanded programs into different areas of wildlife management and wildlife damage management (WDM) such as work on airports, with feral swine and management of other invasive species, disease surveillance and control. Inherently, these programs have expanded the methods being used. Additionally, research has improved the effectiveness and selectiveness of methods being used and made new tools available. Thus, new methods and strategies will be analyzed in these risk assessments to cover the latest methods being used.

The risk assements are being completed in Chapters and will be made available on a website, which can be regularly updated. Similar methods are combined into single risk assessments for efficiency; for example Chapter IV contains all foothold traps being used including standard foothold traps, pole traps, and foot cuffs.

The Introduction to Risk Assessments is Chapter I and was completed to give an overall summary of the national WS Program. The methods being used and risks to target and nontarget species, people, pets, and the environment, and the issue of humanenss are discussed in this Chapter. From FY11 to FY15, WS had work tasks associated with 53 different methods being used. These are being grouped into 30 Chapters. With these methods, WS lethally took an annual average of 3,964,208 individuals, captured and freed 19,776, and hazed 22,907,420 individuals of 611 species, 10 identified subspecies, 2 captive species, and 4 unidentified groups (bats, turtles, snakes, and suckers). Take included 85% birds, 13% mammals, 1% reptiles, 1% fish, and few amphibians. Target take, as it relates to populations, would not be a limiting factor for any of the species targeted.

Nontarget take is also a risk of using WDM methods. Between FY11 and FY15, WS unintentionally took 258 different nontarget species lethally and nonlethally. WS lethally took 2,946 nontarget species with 21 different methods, freed 8,438 nontarget species taken with 11 methods, and accidentally dispersed 28 nontarget species with 2 methods in carrying out WDM activities. This represents only 0.1% of the lethal take, but 43% of the animals freed or relocated; the nontarget species hazed was less than 0.01% of the total or inconsequential.

In addition to risks to target and nontarget species, the risks to people, pets, and the environment are discussed. Risks to WS personnel from WS methods is detailed with most risks being low to inconsequential.

Finally, the issue of humaneness is discussed and the complexity of this issue as it relates to WS WDM methods. WS strives to implement methods that are considered humane.

Table of Contents

1 INTRODUCTION

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) recognizes the intrinsic value of wildlife resources and the high level of interest by the American people in them. Despite this, conflicts arise between the needs of wildlife and people, necessitating science-based wildlife damage management (WDM). WS provides federal leadership in the management of wildlife damage as referred to in its enabling legislation, the Wildlife Damage Control Act of 1931, as amended. WS personnel are highly trained professionals with expertise to respond to wildlife caused damage, using a wide variety of technical assistance and direct control measures (Table 1).

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 2015), 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 a 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. The WS program strives to develop and use wildlife damage management strategies that are biologically sound, environmentally safe, and socially acceptable. WS also strives to reduce damage caused by wildlife to the lowest possible levels while at the same time reducing wildlife mortality. This approach represents the future towards which WS is moving. In charting this course, WS must continuously improve and modify wildlife damage management strategies*." This is accomplished through:

- The development of procedures and technologies for mitigating WDM
- Cooperative WDM programs in collaboration with other government agencies, non-government organizations, and the public
- The provision of Technical Assistance, information and education on WDM
- The limited provision or loaning of WDM materials and equipment

WS conducts Risk Assessments (RAs) on its primary WDM methods to assess potential risks to the public, WS employees, pets, nontarget wildlife, and the environment. WS methods data is acquired from WS Management Information System (MIS[1]). WS methods, relative annual use patterns, rank by usage, and the mode of action (chemical or nonchemical) are provided (Table 1). Data are collected to help assess method take, effectiveness, and potential impacts. The methods employed by WS are reported along with pertinent information on mode, use characteristics and frequencies in the MIS (Table 1). Where a method was recorded, WS averaged a total of 838,855 work tasks[2] annually from the beginning of FY11 (Fiscal Year 2011 = Oct. 1, 2010 to Sept. 30, 2011, and so on) through FY15. Nonchemical methods had 766,414 work tasks associated with them whereas chemical methods accounted for 72,441 work tasks.

Primary concerns expressed over WS activities include risks to nontarget species, people, pets, the environment, and humaneness. However, National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) compliance practices are in place to address these issues and related concerns.

[1] MIS - Computer-based Management Information System used for tracking APHIS-WS-WDM activities nationwide. Throughout the text, data for a year (i.e. FY11 (*next footnote*)) will be given and is from the MIS. MIS reports will not be referenced in the text or Literature Cited Section because MIS reports are not kept on file. A database is kept that allows queries to be made to retrieve the information needed.

[2] A Work Task is defined as a visit to a property, or a portion of it, where a WS employee conducts field work. However, duration is not taken into account and, thus, a Work Task could be 10 minutes to 10 hours in duration.

Table 1. Methods used by WS between FY11 and FY15 throughout the United States (USA) and its territories.

ANNUAL AVERAGE WORK TASKS FOR MECHANICAL/PHYSICAL AND CHEMICAL METHODS IN WDM PROGRAMS			
Nonchemical WDM Methods	**WT/yr**	**Chemical WDM Methods**	**WT/yr**
Cage Trap (e.g., decoy, corral, walk-in)	333,469	Sodium Cyanide (M-44)	52,612
Cable Restraint (e.g., snares, noose mats)	108,910	Immobilization (e.g., ketamine, tiletamine, xylazine)	6,537
Foothold Trap (e.g., standard, pole traps, dog-proof)	65,172	Euthanasia (sodium phenol derivatives)	3,289
Firearms (shotgun, rifle,	64,199	Prebaiting (e.g. for DRC-1339, zinc phosphide)	3,015
Body Grip Traps (conibear, snap trap, gopher trap)	59,600	Rabies Abatement (putting out vaccine baits)	2,103
Bait Station (set up/attract e.g. rodents, snakes, coyotes)	28,725	DRC-1339 (e.g., starlicide)	1,289
Pyrotechnics (e.g., whistlers, crackershells, rockets)	24,149	Carbon Monoxide (e.g., gas cartridges, PERC)	927
Vehicle (visual repellent - hazing)	22,465	Acetaminophen	657
Dog (tracking/trailing, decoy dogs, hazing)	17,124	Egg Oiling	515
Aircraft (firearms, immobilization, hazing, survey)	17,120	Aluminum Phosphide (fumigant)	448
Hand Capture (e.g., sick, stuck, roosting)	9,523	Zinc Phosphide	314
Physical Repellent (e.g. rubber bullets, paint balls)	3,803	LPC (Compound 1080)	274
Monitoring (surveying, radio telemetry, camera)	3,619	Chemical Repellent (e.g. MA, Hinder)	109
Sound Repellent (e.g. propane exploders)	3,519	Strychnine	102
Visual Repellent (e.g. effigies, balloons, lasers)	1,733	Alpha Chloralose (A/C) (immobilization)	97
Herd Trap	989	Chlorophacinone	63
Exclusion (e.g. electric and standard fence, sheaths)	708	Insecticide (e.g., Delta Dust)	36
Explosive (beaver dam removal)	693	Diphacinone	21
Fishing (e.g. poles)	363	Avitrol	17
Net (e.g., mist net, fishing net)	222	Odor Abatement	6
Projectile Net (cannon net/rocket net, net gun)	177	Bromethalin	4
Light Trap	78	Immobilization Antidote	2
Water Spray	25	Brodifacoum	1
Heavy Equipment	11	Nicarbizin	1
Sticky Trap (e.g. glue board)	10	Glyphosate	1
Pond Leveler	6	Sodium Laurel Sulfate	1
Supplemental Feeding	2	Sodium Nitrite (*currently experimental*)	*
Bat Trap (e.g., harp trap)	*	Bromadiolone	*
Egg Addling	*	Warfarin	*
Electrical Barrier	*	Cholecalciferol	*
Guard Animal (*recommended extensively*)	*	Citric Acid	*
Human Behavior Change (e.g., don't feed)	*	Methiocarb (Mesurol)	*
Lure Crops	*	Chemical Sterilization (GonaCon/PZP)	*
Habitat Management (nonchemical) (e.g. removal, trim)	*	Surgical Sterilization	*

WT = Work Task (annual average work tasks/year: FY11 to FY15) * No activity

2 RISKS TO TARGET SPECIES

WS manages damage from mammals, birds, reptiles, amphibians, and fish; and works to reduce zoonotic disease threats. WDM programs are to manage varying fish and wildlife and their impacts are discussed in the following section. A variety of methods are available to WS (Table 1), and the most selective, effective, humane and economical are chosen by WS employees according to WS Directive 2.201 and the WS Decision Model (Slate et al. 1992). The WS Decision Model gives preference to nonlethal methods where they are effective. However, lethal removal remains necessary at times. WS WDM activities are subject to review of potential effects on the human and natural environments through the National Environmental Policy Act (NEPA) process, which provides for stakeholder input. Significantly, WS biologists and technicians are highly-trained and dedicated professionals.

Assessing population and nontarget impacts is critical to science-based WDM as practiced by WS. Most mammal species are managed by state agencies that employ a variety of population assessment efforts, and estimates are incorporated into WS planning and post-action assessments whenever possible. Bird population assessments are often easier to obtain as many are federally-managed at the Flyway level. The Tables below for WS take for birds have estimated populations for them and USA harvest information where available. The two give context for the low level of take by WS. Every effort is made to collaborate with federal, state, and tribal natural resource agencies to plan and assess WDM activities. Furthermore, ecological modeling continues to be refined and employed for assessing potential population, economic,

and human health and safety impacts from WDM, and the USDA, APHIS, WS National Wildlife Research Center is a recognized world leader in this field.

2.1 Mammal Damage Management Programs

WS provides federal leadership in wild mammal damage management. A total of 153 species, 5 subspecies, and 1 species group (unidentified bats[3]) were managed during FY11 to FY15 (Tables 2a-f). WS had an average annual lethal take of 532,910 mammals, freed or relocated 10,977 mammals, and dispersed 11,434 mammals. Mammals are rarely dispersed, especially from airports because their response is often unpredictable and most are within their territory and not going to leave (e.g. burrowing rodents go below ground). Burrowing rodents accounted for the majority of lethal take at 56%; predators (20%), terrestrial rodents and lagomorphs (12%), hoofed mammals (7%), aquatic rodents (5%), and other mammals (0.1%) accounted for the remaining 44%. It should be noted that most mammals, with the exception of bats, are managed by states.

WS Predator Damage Management (PDM) focuses on reducing threats to human health and safety, companion animals, livestock, property, and natural resources from primarily coyotes, wolves, bears, mountain lions, foxes, bobcats, raccoons, skunks, weasels, opossums, mongoose, and seals or sea lions (Table 2a). The most commonly involved predators included coyotes, raccoons, and striped skunks (Table 2a). A total of 105,197[4] predators were lethally taken including estimates for the number of animals in dens (678 dens were taken), 10,325 were relocated or freed (freed target species were typically sampled for disease or radio-collared and released), and 4,306 were dispersed to alleviate damage situations. Of the lethal take, coyotes alone accounted for 75,036 of the national WS take. No population or harvest data are available for coyotes at the national level and often is difficult to obtain at statewide levels as many agencies do not estimate population numbers or no longer collecting harvest data. However, in just the states of Colorado (Colorado Parks and Wildlife 2015) and Montana (Montana Fish, Wildlife and Parks 2017), hunter harvest averaged 87,600 annually combined between FY11 and FY15. WS take in the two States was 8,500. WS take is similar in all states nationally and low compared to hunter harvest. NEPA documents, as discussed, analyze impacts at the statewide level and none have found that WS take was a significant impact on the population.

The methods which will be discussed in individual methods risk assessments used to take predators lethally included shooting from aircraft (27,354), traps including cage, foothold, and body grip (27,291), cable restraints including neck and foot snares (17,728), toxicants (sodium cyanide and sodium fluoroacetate) (13,970), firearms with or without aids such as calling (13,806), gas cartridges (2,607), tracking/trailing, decoy, and chase dogs (2,085), hand gathering including with hand tools like catch poles (198), denning (129), and immobilization (30). The methods used for relocating, transferring custody, or sampling and freeing (used most extensively in the National Rabies Management Program) animals were traps (10,042), hand capture (223), cable restraints (36), immobilization including from aircraft (17), dogs (5), and nets (2). Predators were hazed a variety of sound repellents including pyrotechnics (2,455), sight repellents such as people on the ground or in vehicles (1,293), physical repellents such as paint ball guns and rubber ammunition (535), dogs (20), and exclusion (3).

[3] The MIS only recorded a bats (all) category and individual species did not need to be identified. Most species were kept in comments.

[4] Rounding error can occur for data by species versus by method and can add up differently, differing by at most one or two.

Table 2a. The annual average number of target predators controlled by WS in WDM between FY11 and FY15 throughout the USA.

PREDATORS				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Virginia Opossum^	*Didelphis virginiana*	2,208	346	10
Feral/Free-roaming Cat*	*Felis catus*	895	551	282
Lynx	*Lynx canadensis*	0	0	0.4
Bobcat	*Lynx rufus*	920	11	6
Mountain Lion	*Puma concolor*	347	5	8
Small Asian Mongoose*	*Herpestes javanicus*	2,175	1	372
Coyote^#	*Canis latrans*	75,042	16	535
Northwestern Gray Wolf	*Canis lupus occidentalis*	165	23	1
- Mexican Gray Wolf T&E	*Canis lupus baileyi*	0.4	1	0
- Great Plains Gray Wolf T&E	*Canis lupus nubilus*	213	34	0
- Feral/Free-Roaming Dog*	*Canis lupus familiaris*	287	201	126
Red Fox^#	*Vulpes vulpes*	2,145	14	229
Swift Fox	*Vulpes velox*	0.8	0	0
Kit Fox	*Vulpes macrotis*	0.4	0.4	0
Arctic Fox^	*Vulpes lagopus*	176	0	15
Common Gray Fox	*Urocyon cinereoargenteus*	1,818	24	10
Black Bear	*Ursus americanus*	516	568	93
- Louisiana Black Bear T&E	*Ursus americanus luteolus*	0	4	0
Grizzly Bear T&E	*Ursus arctos horribilis*	0.4	9	6
Steller Sea Lion T&E	*Eumetopias jubatus*	0	0	1,288
California Sea Lion	*Zalophus californianus*	0	0	1,193
River Otter	*Lontra canadensis*	105	2	36
Fisher	*Martes pennanti*	0.8	11	0
American Marten	*Martes americana*	0.4	0	0
European Ferret*	*Mustela putorius*	0	0.8	0
Least Weasel	*Mustela nivalis*	0.2	0.2	0
Long-tailed Weasel	*Mustela frenata*	8	0	0
Short-tailed Weasel (*Ermine*)	*Mustela erminea*	2	0	0.4
Mink	*Mustela vison*	36	1	7
Badger#	*Taxidea taxus*	316	4	2
Ringtail	*Bassariscus astutus*	0	1	0
Coati	*Nasua narica*	0.2	0.4	0.2
Raccoon	*Procyon lotor*	11,381	8,202	41
Hog-nosed Skunk	*Conepatus leuconotus*	0.8	0	0
Hooded Skunk	*Mephitis macroura*	9	0.6	0
Striped Skunk#	*Mephitis mephitis*	6,416	293	45
Eastern Spotted Skunk	*Spilogale putorius*	4	0.2	0
Western Spotted Skunk	*Spilogale gracilis*	9	0.6	0
TOTAL	**34 Sp. + 4 Ssp.**	**105,197**	**10,325**	**4,306**

* Introduced Species ^ Translocated from former range within North America to areas where invasive

Numbers killed were estimated for dens taken (2 for each badger den, 3 for striped skunk, and 4 for coyote, red fox, and opossum)

T&E –Threatened and endangered species (Federal only)

Feral Swine Damage Management (FSDM) is a relatively new program for WS, based on growing resource owner concern and Congressional funding over damage to agriculture, property, and natural resources, and threats to human health and safety from a burgeoning national population of this invasive species. FSDM is conducted with cage and corral traps, firearms, aerial hunting, dogs, and drop nets. Similar to FSDM is the control of other hoofed animals, including several that are invasive (for example, white-tailed deer in Hawaii), that also cause damage to crops and property. Many of these species are managed to protect human health and safety at airports where they are a serious flight risk (deer have caused catastrophic collisions where people have been killed and aircraft lost), and to reduce property damage, or to protect natural resources. Table 2b lists 17 species of hoofed mammals, 1 distinct subspecies, and 1 captive herd that were controlled within FY11-FY15. The most common hoofed animals involved in WDM include feral swine and white-tailed deer (Table 2b) with 38,865 lethally taken, 106 captured and freed (e.g., radio-collared "Judas" pigs and disease monitoring) or relocated, and 5,815 dispersed. Methods used to take hoofed animals lethally included shooting from aircraft (14,393), firearms (shooting from ground with or without aids such as a spotlight) (10,405), traps including cage and corral traps (9,098), cable restraints (4,794), trailing dogs and shooting (155), nets (14), hand capture (5), and immobilization and euthanasia

drugs (1). No methods were used extensively to relocate target hoofed animals, but most were trapped (68), immobilized and freed (29), hand captured (7), and caught with cable restraints (1). Some swine were used as "Judas" pigs and released with radio collars. Hoofed mammals were hazed with a variety of sight repellents (2,405), sound repellents including pyrotechnics and shooting (2,386), aircraft (540), physical repellents such as paint balls and rubber ammunition (357), and hazing dogs (128).

Table 2b. The annual average number of target hoofed mammals controlled by WS in WDM between FY11 and FY15 throughout the USA.

FERAL SWINE AND OTHER HOOFED MAMMALS				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Feral Swine*	*Sus scrofa*	32,956	42	199
Collared Peccary (Javelina)	*Pecari tajacu*	14	9	52
Moose^	*Alces alces*	1	0.6	467
Axis Deer*	*Axis axis*	376	0	2,108
American Elk^	*Cervus canadensis*	2	0	579
Red Deer*	*Cervus elaphus*	1	0.2	0
Fallow Deer*	*Dama dama*	0.2	0	0
Mule Deer	*Odocoileus hemionus*	28	40	254
- Black-tailed Deer	*Odocoileus hemionus columbianus*	23	0.4	78
White-tailed Deer^	*Odocoileus virginianus*	5,308	3	1,345
- White-tailed Deer (captive) *	*Odocoileus virginianus*	81	0	0
Caribou	*Rangifer tarandus*	3	0	681
Philippine (*Sambar*) Deer *	*Rusa marianna*	50	0	0
Pronghorn (American Antelope)	*Antilocapra americana*	1	0.2	29
Feral Cattle*	*Bos primigenius*	2	0.2	23
Feral Goat*	*Capra aegagrus hircus*	12	10	0
Muskox	*Ovibos moschatus*	0	0	0.2
Bighorn Sheep	*Ovis canadensis*	6	0	0
Feral Sheep*	*Ovis aries*	0.4	0	0
TOTAL	**17 Sp. (1 captive pop.)+ 1 Ssp.**	**38,865**	**106**	**5,815**

* Introduced Species ^Introduced populations exist

Aquatic Rodent Damage Management (ARDM) includes management of damage to agriculture, property, natural resources, or human health and safety from the activity of beavers, nutria, and muskrats. Beaver dams posing the greatest risk for damage are generally newer, and their removal poses less of a risk for the alteration of wetlands than might the removal of older, established impoundments. Beavers were the most commonly removed of aquatic mammals for ARDM (Table 2c). Additionally, WS removed 10,037 beaver dams. Methods used to take aquatic mammals lethally were traps (19,581), firearms (5,133), cable restraints (2,569), toxicants (chlorophacinone and zinc phosphide) (1,187), hand-capture (15), and detector dogs followed by euthanasia (10). Most beaver dams were removed by hand (8,700) followed by the use of binary explosives (1,314), heavy equipment (17), and water spray (16). No method was used extensively to relocate aquatic mammals, but cage traps (125), cable restraints (3), and hand capture (1) were used. Very few were hazed, but most (44) with firearms and repellents (6) on airports.

Table 2c. The annual average number of target aquatic mammals controlled by WS in WDM between FY11 and FY15 throughout the USA.

AQUATIC RODENTS					
Species	**Scientific Name**	**Killed**	**Dams Removed**	**Freed**	**Dispersed**
Beaver^	*Castor canadensis*	24,400	10,047	125	10
Muskrat	*Ondatra zibethicus*	2,127	0	0.6	20
Nutria*	*Myocastor coypus*	1,968	0	3	21
TOTAL	**3 Species**	**28,495**	**10,047**	**129**	**51**

* Introduced Species ^Populations introduced in several areas of Nevada

Most TRLDM is conducted to protect property, but also agricultural crops, and human health and safety (e.g., plague and Hantavirus). Terrestrial Rodent and Lagomorph (*rabbits and hares*) Damage Management (TRLDM) involves many species of terrestrial rodents and lagomorphs. Because rodent and lagomorph populations are often cyclic and can be abundant in local areas, chemical management is frequently

employed over relatively small areas. Nonchemical methods used to take small numbers of these species include cage traps, quick-kill traps, firearms, snares, and glue boards. The WS Management Information System (MIS) is only recently requiring employees to estimate the number of terrestrial rodents and lagomorphs killed with chemicals and, thus, the number taken had to be estimated for many projects. Take was estimated for those projects that showed none as well as estimated for species with acres or burrows treated as the unit of measure. The species most commonly controlled are burrowing rodents which includes prairie dogs, ground squirrels, voles, marmots, woodchucks, and kangaroo rats (Table 2d) and terrestrial rodents and lagomorphs which includes tree squirrels, old world rats and mice, woodrats, deermice, cottontail rabbits, and jackrabbits (Table 2e). None of those taken in these categories were federally listed threatened or endanagered (T&E) species, but many have subspecies which are and care is taken to avoid these.

Table 2d. The annual average number of burrowing rodents involved in WDM conducted by WS in WDM between FY11 and FY15 throughout the USA.

BURROWING RODENTS				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Mountain Beaver (*Aplodontia*)	*Aplodontia rufa*	109	0	0
Black-tailed Prairie Dog	*Cynomys ludovicianus*	193,144	0.2	127
Gunnison's Prairie Dog	*Cynomys gunnisoni*	19,160	0	0
White-tailed Prairie Dog	*Cynomys leucurus*	2,181	0	0
Woodchuck	*Marmota monax*	4,864	12	47
Yellow-bellied Marmot	*Marmota flaviventris*	1,802	6	0.6
Hoary Marmot	*Marmota caligata*	0.8	0	0.2
California Ground Squirrel	*Otospermophilus beecheyi*	9,644	1	17
Rock Squirrel	*Otospermophilus variegatus*	430	3	0
Paiute Ground Squirrel	*Urocitellus mollis*	832	0	0
Richardson's Ground Squirrel	*Urocitellus richardsonii*	1,908	0	81
Wyoming Ground Squirrel	*Urocitellus elegans*	83	0	0
Uinta Ground Squirrel	*Urocitellus armatus*	95	0	0
Belding's Ground Squirrel	*Urocitellus beldingi*	4,730	0	0
Columbian Ground Squirrel	*Urocitellus columbianus*	1,476	0	0
Arctic Ground Squirrel	*Urocitellus parryii*	0	0	0.2
Thirteen-Lined Ground Squirrel	*Ictidomys tridecemlineatus*	1,062	1	0
Mexican Ground Squirrel	*Ictidomys mexicanus*	1,487	0	0
Spotted Ground Squirrel	*Xerospermophilus spilosoma*	0.2	0	0
Round-tailed Ground Squirrel	*Xerospermophilus tereticaudus*	7,754	0	0
Cascade Golden-Mantled Ground Squirrel	*Callospermophilus saturatus*	0.2	0	0
Golden-Mantled Ground Squirrel	*Callospermophilus lateralis*	0.4	0	0
Eastern Chipmunk	*Tamias striatus*	20	0.6	0
Least Chipmunk	*Neotamias minimus*	0.2	0	0
Yellow-Faced Pocket Gopher	*Cratogeomys castanops*	3,189	0	0
Attwater's Pocket Gopher	*Geomys attwateri*	234	0	0
Desert Pocket Gopher	*Geomys arenarius*	1	0	0
Knox Jone's Pocket Gopher	*Geomys knoxjonesi*	9	0	0
Plains Pocket Gopher	*Geomys bursarius*	1,093	0	0
Texas Pocket Gopher	*Geomys personatus*	1	0	0
Botta's Pocket Gopher	*Thomomys bottae*	5,030	0	0
Camas Pocket Gopher	*Thomomys bulbivorous*	463	0	0
Northern Pocket Gopher	*Thomomys talpoides*	2,847	0	0
Western (*Mazama*) Pocket Gopher	*Thomomys mazama*	5	0	0
Sagebrush Vole	*Lemmiscus curtatus*	576	0	0
California Vole	*Microtus californicus*	0.2	0	0
Gray-tailed Vole	*Microtus canicaudus*	4,000	0	0
Long-tailed Vole	*Microtus longicaudus*	158	0	0
Montane Vole	*Microtus montanus*	999	0	0
Prairie Vole	*Microtus ochrogaster*	7,095	32	0
Tundra Vole	*Microtus oeconomus*	0.4	0	0.2
Meadow Vole	*Microtus pennsylvanicus*	13,413	0.8	0
Woodland (*Pine*) Vole	*Microtus pinetorum*	4,466	0	0
Southern Red-backed Vole	*Myodes gapperi*	0	0.2	0
Northern Red-backed Vole	*Myodes rutilus*	0.4	0	0
Ord's Kangaroo Rat	*Dipodomys ordii*	1,672	0	0
TOTAL	**46 Species**	**296,035**	**57**	**273**

Burrowing rodents can cause extensive damage in parks, right-of-ways, airports, agricultural fields and other developed areas. Their burrowing activities usually cause extensive damage in addition to their feeding activities. Between FY11 and FY15, the annual average number of burrowing rodent species taken was estimated at 296,035 lethally (estimate based on burrows or acres treated), 57 captured and relocated or freed, and 273 hazed (Table 2d). Of the lethal take, black-tailed prairie dog take was 193,144 (Table 2d). The USFWS (2015) estimated 2.1 million acres exist of black-tailed prairie dogs. To estimate take, we used 15/acre taken with toxicants, to be conservative, whereas the USFWS typically estimates 10. At 15 per acre, the estimated population would be 31,500,000 for black-tailed prairie dogs. WS would take less than 1% of the population at a population density of 10 or 15/acre. Additionally, it should be noted that prairie dogs have a realistic repopulation rate of 30% per year (Collins et al. 1984), which shows that WS would not impact their population by taking less than 1%. Take of the other rodents was minimal compared to populations. The methods used to lethally take the burrowing rodent species in TRLDM included toxicants (zinc phosphide, strychnine, chlorophacinone, and diphacinone) (204,667), fumigants (62,831), firearms (22,616), traps (4,589), by hand or with hand tools (dens) (1,299), and cable restraints (33). In TRLDM, most burrowing rodents are not freed (relocated) or dispersed (Table 2d). However, traps (55), hand capture (2), and a cable restraint (1) were used in relocation. Few are hazed since they will only return to their burrow or possibly escape to other habitat, but sound (228) and sight (45) repellents were used.

Terrestrial rodent and rabbit species are managed, under TRLDM, at airports, to protect agricultural crops, and property. These are typically not a damage threat to aircraft *per se*, but these species are attractive to predators that are a strike threat such as coyotes and raptors. In addition, these species can also cause foreign object debris (FOD) damage to aircraft and property damage from gnawing and feeding activities.

Table 2e. The annual average number of target terrestrial rodents and rabbits controlled by WS in WDM between FY11 and FY15 throughout the USA.

TERRESTRIAL RODENTS AND RABBITS				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Western Gray Squirrel	*Sciurus griseus*	8	6	0
Eastern Gray Squirrel^	*Sciurus carolinensis*	142	11	0.6
Eastern Fox Squirrel^	*Sciurus niger*	155	17	5
Red Squirrel	*Tamiasciurus hudsonicus*	3	2	1
Douglas Squirrel	*Tamiasciurus douglasii*	12	10	0
Southern Flying Squirrel	*Glaucomys volans*	0.2	1	0
N. Giant (*Gambian*) Pouched Rat*	*Cricetomys gambianus*	2	0.4	0
Desert Woodrat	*Neotoma lepida*	0.4	0	0
Dusky-footed Woodrat	*Neotoma fuscipes*	0.2	0	0
Eastern Woodrat	*Neotoma floridana*	2	0	0
Mexican Woodrat	*Neotoma mexicana*	2	0	0
Bushy-tailed Woodrat	*Neotoma cinerea*	8	0.4	0
North American Deermouse	*Peromyscus maniculatus*	211	0.8	0
White-footed Deermouse	*Peromyscus leucopus*	18,719	160	0
House Mouse*	*Mus musculus*	25,532	21	0
Brown (*Norway*) Rat*	*Rattus norvegicus*	534	1	601
Pacific (*Polynesian*) Rat*	*Rattus exulans*	2,331	0	0
Black Rat*	*Rattus rattus*	6,562	4	0
North American Porcupine	*Erethizon dorsatum*	117	35	30
Desmarest's Hutia	*Capromys pilorides*	77	0	0
Eastern Cottontail^	*Sylvilagus floridanus*	1,150	11	199
Mountain Cottontail	*Sylvilagus nuttallii*	77	0	0
New England Cottontail	*Sylvilagus transitionalis*	0	1	0
Desert Cottontail	*Sylvilagus audubonii*	6,229	13	38
Swamp Rabbit	*Sylvilagus aquaticus*	4	0	0.2
Feral (*European*) Rabbit*	*Oryctolagus cuniculus*	45	1	0.4
Snowshoe Hare	*Lepus americanus*	0.2	0.6	1
White-tailed Jackrabbit	*Lepus townsendii*	41	0	3
Black-tailed Jackrabbit^	*Lepus californicus*	1,488	0.8	86
TOTAL	**29 Species**	**63,452**	**297**	**965**

* Introduced Species ^ Translocated from former range within North America to areas where invasive

Between FY11 and FY15, the annual average number of terrestrial rodents and lagomorphs was 63,452 lethally taken, 297 relocated and 965 dispersed (Table 2e). This level of take for any of these species, which are mostly very abundant, would have no noticeable effect on the population.

WS conducts WDM less frequently for several other species including insectivores (bats, armadillos, moles, and shrews) and exotic invasive species (monkeys). Most related damage management is achieved through the provision of technical assistance (i.e., discussing self-management options with those affected). Insectivores damage property and crops (during forays for insects), and are a concern in terms of human health and safety. Most bats are taken inside structures and freed outdoors or euthanized for rabies testing, if necessary. Invasive species cause damage to many resources including damage to natural resources. Monkeys were introduced to the islands of Puerto Rico where they damage agricultural crops and native wildlife, and are a threat to human health and safety. WS took 24 species and unknown bat species between FY11 and FY15 with 866 lethally taken, 63 freed or relocated, and 24 hazed (Table 2f). WS used firearms (695), traps (139), fumigants (17), hand capture and nets (15), and cable restraints (2) to lethally take these species. Bats were frequently caught by hand or with dip nets in houses (61) where they are a human health and safety concern and then freed outdoors if they appear healthy (Table 2f); additionally, armadillos were relocated from cage trap (2) and hand capture (1) events. Most armadillos managed were hazed at airports with sound-scare devices including firearms (22) and bats with visual repellents (3).

Table 2f. The average number of target mammals other than predators, hoofed animals, rodents, and rabbits controlled by WS in WDM between FY11 and FY15 throughout the USA.

OTHER MAMMALS				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Nine-banded Armadillo	*Dasypus novemcinctus*	260	3	21
Patas Monkey*	*Erythrocebus patas*	221	0	0
Rhesus Monkey*	*Macaca mulatta*	281	0	0
Asian House (*Musk*) Shrew*	*Suncus murinus*	0.2	0	0
Elliot's Short-tailed Shrew	*Blarina hylophaga*	0.8	0	0
Northern Short-tailed Shrew	*Blarina brevicauda*	0.6	0	0
North American Least Shrew	*Cryptotis parva*	14	0	0
Cinereus (*Masked*) Shrew	*Sorex cinereus*	4	0	0
American Pygmy Shrew	*Sorex hoyi*	0.2	0	0
Vagrant Shrew	*Sorex vagrans*	14	0	0
Eastern Mole	*Scalopus aquaticus*	17	0	0
Broad-footed Mole	*Scapanus latimanus*	0.2	0	0
Coast Mole	*Scapanus orarius*	19	0	0
Townsend's Mole	*Scapanus townsendii*	17	0	0
Brazilian (*Mexican*) Free-tailed Bat	*Tadarida brasiliensis*	3	8	0
Big Brown Bat	*Eptesicus fuscus*	2	42	0.8
Eastern Red Bat	*Lasiurus borealis*	0	0.8	0
Eastern (*Tri-colored*) Bat	*Pipistrellus subflavus*	1	0.2	0
Pallid Bat	*Antrozous pallidus*	0	0.2	0
Little Brown Myotis	*Myotis lucifugus*	3	4	2
Cave Myotis	*Myotis velifer*	0.2	0	0
Long-legged Myotis	*Myotis volans*	0	0.6	0
Dark-nosed Small-footed Myotis	*Myotis melanorhinus*	0	0.2	0
Yuma Myotis	*Myotis yumanensis*	0.2	0	0
Unidentified Bat	Chiroptera (30 possible species)	8	4	0
TOTAL	**24 Spp. + 1 Spp. Group**	**866**	**63**	**24**

* Introduced Species

2.2 Bird Damage Management Programs

Species are grouped below in terms of taxonomic similarities and the bird damage management program they fall under as the methods are similar. To some degree, most species of birds are targeted at airports where they are a strike hazard and the potential for catastrophic incident involving the loss of life. WDM at airfields includes the control of birds, mammals, and other wildlife and is labeled wildlife hazard management (WHM). WHM at airports often focuses on large or flocking birds since risk from these

species are greater than from single or smaller birds. Most bird WDM at airports is achieved through hazing, though some are taken with firearms and traps if they do not respond to hazing such as raptors.

Some birds are also managed in other WDM efforts to protect property, crops, livestock, natural resources, human health and safety. NEPA coverage of birds[5] tend to be all-encompassing (all Bird Damage Management (BDM) in state), but some have focused on BDM at airports, feedlots, or other resource being protected or could be by grouping such as blackbird damage management. Much depends on the scope of BDM projects in a state and their complexity. However, if all birds in a state are covered, generally EAs discuss the species and species groups involved, including: blackbirds, pigeons and doves, larids (gulls and terns), waterfowl, corvids (ravens, crows, and jays), raptors, waterbirds, wading birds, shorebirds, gallinaceous (grouse-like) birds, aerialists (nightjars, swifts, and swallows), non-passerine forest birds (woodpeckers, kingfishers, and invasive parrots), grassland passerine species, woodland passerine species, and other invasive passerine species. In addition, programs are sometimes based on the category of invasive species which include many species in the different categories, but most are included with their subgroup,most passerine invasive species are featured in the last table. In Tables 3a-3n, invasive/introduced species or populations are noted.

WS BDM programs have helped manage damage from 379 species, 4 subspecies, and 1 escaped hybrid falcon within FY11 to FY15. Of these, damage from 280 species was managed via lethal removal. The average annual lethal take by WS was 3,358,911 and included European starlings (48%), brown-headed cowbirds (23%), red-winged blackbirds (14%), common grackles (4%), and rock pigeons (3%), and 275 other species (8%). Most lethal take for the top 5 species occurred at feedlots where large flocks often congregate in winter, consuming and contaminating large amounts of feed, and threaten livestock health. The average annual nonlethal take (mostly trapped and relocated) was 8,290 birds. Of this, the most frequent species relocated included Canada geese (28%), red-tailed hawks (14%), American kestrels (8%), Laysan albatrosses (7%), double-crested cormorants (7%), and mourning doves (5%). this represents 69% of the total nonlethal take. In addition to target lethal and nonlethal take, an annual average of 112,212 eggs were destroyed and 22,895,922 target birds dispersed during FY11-FY15.

Flocks of native blackbirds, grackles, and cowbirds; and invasive European starlings cause substantial losses to livestock operations through feed consumption and contamination, and can cause disease in livestock. These species can also be problematic at airports, can cause damage to property and crops, and their roosts can pose nuisance problems from noise and droppings, as well as disease threats to humans such as psittacosis, salmonellosis and histoplasmosis. Table 3a lists 10 species of blackbirds causing damage that WS managed between FY11 and FY15. These also frequently occur in mixed flocks. Among these species, an average annual total of 3,005,712 were taken lethally, 837 eggs[6] were removed, 316 were captured and freed or relocated, and 11,848,439 were dispersed (Table 3a). The methods used to take blackbirds lethally included the toxicants (2,785,521) DRC-1339, Avitrol, and sodium laurel sulfate, cage traps (126,911), firearms (91,471), nets (1,538) and hand-gathering (273). Eggs and nests were gathered by hand (776 eggs), with hand tools (32), and with water spray (32). Cage traps were used to relocate blackbirds (310) cable restraints (3), and nets (1). Methods used for dispersing blackbirds were sound-scare devices including firearms[7] (11,088,794), vehicles, lasers, lights, and other sight-repellent methods

[5] More detailed analysis of these programs can be found at the APHIS home website (@ http://www.aphis.usda.gov/wps/portal/aphis/home), then selecting Wildlife Damage, NEPA, and finally the list of documents available. These documents, mostly Environmental Assessments (EAs) analyze different species categories, programs, and methods used in bird damage management.

[6] Eggs were estimated using typical averages for these species from active nests taken where eggs were not recorded.

[7] Firearms are often used to disperse birds with standard ammunition. In some cases, birds are shot to reinforce the harassment.

(652,633), physical repellents (72,205), and chemical repellents (30,928). Additionally, dogs (571) and physical barriers (26) were used to haze blackbirds. For take in all categories, numbers of birds managed were estimated by population modeling or expert opinion.

Table 3a. The annual average number of target starlings and blackbirds controlled by WS in WDM between FY11 and FY15 throughout the USA.

BLACKBIRDS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
European Starling*	*Sturnus vulgaris*	45,000,000	1,619,228	496	274	8,104,948
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	9,000,000	831	0	20	9,055
Tricolored Blackbird	*Agelaius tricolor*	300,000	0	0	0	2,960
Red-winged Blackbird	*Agelaius phoeniceus*	99,000,000	476,629	5	8	1,590,089
Brown-headed Cowbird	*Molothrus ater*	91,000,000	765,170	0	13	144,213
Rusty Blackbird	*Euphagus carolinus*	700,000	0	0	0	10
Brewer's Blackbird	*Euphagus cyanocephalus*	15,000,000	7,560	15	0.2	38,026
Common Grackle	*Quiscalus quiscula*	55,000,000	126,189	303	0.8	126,292
Greater Antillean Grackle	*Quiscalus niger*	na	65	0	0	0
Boat-tailed Grackle	*Quiscalus major*	2,000,000	524	5	0	65,209
Great-tailed Grackle	*Quiscalus mexicanus*	5,000,000	9,516	13	0	52,794
Mixed Blackbirds	All above except Antil. Grackle	N/A	0	0	0	1,714,843
TOTAL	**11 Spp.**	**RMBO 2013**	**3,005,712**	**837**	**316**	**11,848,439**

* Introduced Species N/A = Not applicable na – not available

Pigeon and dove damage management includes several invasive species such as feral domestic pigeons, Eurasian collared-doves, island collared-doves, spotted doves, and zebra doves and several native species such as white-crowned pigeons, mourning doves[8], white-winged doves, and common ground-doves. These species are often grouped together because they flock and are a hazard at airports. Feral pigeons and Eurasian collared-doves also cause damage at CAFOs and to property such as buildings. WS conducted WDM focusing on 11 species of pigeons and doves between FY11 and FY15 (Table 3b). Pigeons and doves involved in damage included feral domestic pigeons, mourning doves, zebra doves and spotted doves. In addition, invasive Eurasian collared-dove numbers are increasing rapidly in the United Satets (Sauer et al. 2017) and WS expects increasing needs for related WDM, as evidenced in the MIS and take (Table 3b).

Table 3b. The annual average number of target pigeons and doves controlled by WS in WDM between FY11 and FY15 throughout the USA.

PIGEONS AND DOVES							
Species	**Scientific Name**	**Est. USA Pop.**	**Est. USA Harvest**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Rock Pigeon*	*Columba livia*	9,100,000	na	94,598	284	87	186,158
White-crowned Pigeon	*Patagioenas leucocephala*	600,000#	na	0	0	0	228
Band-tailed Pigeon	*Patagioenas fasciata*	800,000	14,520	0.2	0	0	0
Island Collared-Dove*	*Streptopelia bitorquata*	na	na	156	6	14	613
Eurasian Collared-Dove*	*Streptopelia decaocto*	8,000,000#	na	3,659	0.4	4	4,864
Spotted Dove*	*Streptopelia chinensis*	na	na	6,617	0	9	35,018
Zebra (*Barred Ground-*) Dove*	*Geopelia striata*	na	na	17,096	0	2	68,246
Common Ground-Dove	*Columbina passerina*	2,000,000	na	0.2	0	0	8
Mourning Dove^	*Zenaida macroura*	96,000,000	15,328,300	18,141	88	400	210,135
Zenaida Dove	*Zenaida aurita*	na	na	0	0	0	1
White-winged Dove	*Zenaida asiatica*	4,000,000	1,746,720	101	0	2	44,011
TOTAL	**11 Spp.**	**RMBO 2013**	**USFWS 2012/14/16**	**140,368**	**378**	**518**	**549,282**

* Introduced Species na – not available # Global population

^ 132 of the 18,126 taken lethally were in HI where invasive species

Between FY11 and FY15, BDM included 140,368 pigeons and doves taken lethally, with 378 eggs collected. Nonlethal management included 518 pigeons and doves freed or relocated following capture, and 549,282 dispersed. Methods used to take pigeons and doves lethally included firearms (94,033), traps (30,894),

[8] Mourning Doves are invasive in Hawaii.

toxicants (13,136), nets (2,038), and hand capture (266). Methods used to disperse pigeons and doves were sound-scare devices including firearms (410,753), sight repellents (135,495), hazing dogs (1,362), physical repellents (719), chemical repellents (340), and barriers (1). Nest and eggs were removed by hand (315) and firearms (in hard to reach places; 12). Additionally, nicarbazin, a reproductive inhibitor reducing hatchability of the eggs, was used and prevented an estimated 50 eggs from hatching (included in egg removal column of Table 3b). Birds were captured and relocated or released primarily from cage trapping (491), netting projects (21), and hand capture (6).

WS WDM for larid damage includes activities focusing on jaegers, gulls, noddies, terns, and skimmers. These species are often grouped together because many are large flocking birds and are a hazard at airports and a risk to property, and human health and safety. Table 3c lists 31 species of larids that were managed by WS between FY11 and FY15. Total average annual take for larid species was 23,440 taken lethally, 63,267 eggs and their nests destroyed, 21 captured and relocated or freed, and an estimated 5,592,266 dispersed (Table 3c).

Table 3c. The annual average number of target larids controlled by WS in WDM between FY11 and FY15 throughout the USA.

LARIDS						
Species	**Scientific Name**	**Est. N. Amer. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
White Tern	*Gygis alba*	na	0	0	0	39
Black Skimmer	*Rynchops niger*	100,000	0	0	0	148
Black-legged Kittiwake	*Rissa tridactyla*	3,100,000	0	0	0	439
Red-legged Kittiwake	*Rissa brevirostris*	290,000	2	0	0	67,662
Bonaparte's Gull	*Chroicocephalus philadelphia*	250,000	63	0	0	8,167
Laughing Gull	*Leucophaeus atricilla*	830,000	5,264	8,045	0	727,693
Franklin's Gull	*Leucophaeus pipixcan*	2,500,000	311	0	0	23,212
Heermann's Gull	*Larus heermanni*	520,000	2	0	0	634
Mew Gull	*Larus canus*	240,000	182	684	4	5,846
Ring-billed Gull	*Larus delawarensis*	2,500,000	6,053	42,157	3	2,479,140
California Gull	*Larus californicus*	620,000	1,762	401	0.2	214,567
Great Black-backed Gull	*Larus marinus*	350,000	438	243	0	94,857
Glaucous-winged Gull	*Larus glaucescens*	570,000	3,761	2,235	0.2	379,290
Western Gull	*Larus occidentalis*	120,000	258	65	0.2	3,459
Glaucous Gull	*Larus hyperboreus*	270,000	12	0	0	209
Thayer's Gull	*Larus thayeri*	15,000	0	0	0	9
American Herring Gull	*Larus smithsonianus*	370,000	5,250	9,433	13	1,558,684
Lesser Black-backed Gull	*Larus fuscus*	na	0	0	0	9
Gull-billed Tern	*Gelochelidon nilotica*	15,000	16	0	0	317
Caspian Tern	*Hydroprogne caspia*	110,000	10	1	0	13,548
Royal Tern	*Thalasseus maximus*	150,000	3	0	0	1,735
Sandwich Tern	*Thalasseus sandvicensis*	100,000	3	0	0	473
Least Tern	*Sternula antillarum*	57,000	0.4	3	0.2	9,798
- California Least Tern[T&E]	*Sternula antillarum browni*	20,000	0	0	0	65
Common Tern	*Sterna hirundo*	750,000	4	0	0	712
Arctic Tern	*Sterna paradisaea*	1,000,000	0.2	0.2	0	33
Forster's Tern	*Sterna forsteri*	140,000	2	0	0	762
Whiskered Tern	*Chlidonias hybrida*	na	0	0	0	115
Black Tern	*Chlidonias niger*	300,000	41	0	0	598
Pomarine Jaeger	*Stercorarius pomarinus*	na	0	0	0	6
Parasitic Jaeger	*Stercorarius parasiticus*	na	0.8	0	0	15
Long-tailed Jaeger	*Stercorarius longicaudus*	na	2	0	0	25
TOTAL	**31 Spp. + 1 Ssp.**	**Wetlands Intl. 2012**	**23,440**	**63,267**	**21**	**5,592,266**

na – not available T&E –Threatened and endangered species (Federal only)

The most common larids involved in management were laughing gulls, ring-billed gulls, herring gulls, and glaucous-winged gulls. Methods to take larids lethally included the use of firearms (22,255), hand gathering of primarily young (716), nets (188), cage traps (177), and DRC-1339 (102). Methods used to destroy

eggs/nests were hand gathering and hand tools (30,927) and egg oiling (32,340)[9]. Methods and estimated larids dispersed were sound-scare repellents (5,476,503), sight repellents (106,013), physical repellents (8,172), hazing dogs (1,437), and methyl anthranilate (140). The few that were relocated were moved after capture with nets (13), by hand (7), and with cage traps (1).

Table 3d. The annual average number of target waterfowl controlled by WS in WDM between FY11 and FY15 throughout the USA.

WATERFOWL							
Species	**Scientific Name**	**Est. N. Amer. Pop.**	**Est. USA Harvest**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Black-bellied Whistling Duck	*Dendrocygna autumnalis*	100,000	N/A	22	0	0.2	356
Taiga Bean-Goose	*Anser fabalis & serrirostris* (split)	na	N/A	0.2	0	0	0
Greater White-fronted Goose	*Anser albifrons*	840,000	261,999	41	0	0	35,664
Feral Domestic Graylag Goose*	*Anser anser* and others	N/A	N/A	82	42	29	3
Snow Goose	*Chen caerulescens*	4,300,000	375,147	28	0	0	130,598
Ross's Goose	*Chen rossii*	1,000,000	59,377	0.8	0	0	1
Brant	*Branta bernicla*	340,000	18,342	256	0	0.2	4,791
Cackling Goose	*Branta hutchinsii*	1,000,000	2,474,408	10	2	0	85,329
Canada Goose	*Branta canadensis*	4,700,000		22,722	17,265	2,307	635,732
Hawaiian Goose[T&E]	*Branta sandvicensis*	na	N/A	0	0	0	1,405
Mute Swan*	*Cygnus olor*	N/A	N/A	1,793	314	6	89
Trumpeter Swan	*Cygnus buccinator*	46,000	N/A	1	0	0	234
Tundra Swan	*Cygnus columbianus*	200,000	N/A	1	0	0.4	575
Feral Domestic Muscovy Duck*	*Cairina moschata*	N/A	N/A	34	0	18	0.6
Wood Duck	*Aix sponsa*	3,500,000	1,289,672	33	0	11	1,762
Gadwall	*Anas strepera*	3,200,000	1,865,257	44	0	28	4,859
Eurasian Wigeon	*Anas penelope*	na	699,828	0	0	0	7
American Wigeon	*Anas americana*	2,100,000		38	2	9	12,723
American Black Duck	*Anas rubripes*	550,000	95022	39	0	4	3,145
Mallard	*Anas platyrhynchos*	9,200,000	4,010,456	2,504	132	334	96,098
- Feral Domestic Mallard*	*Anas platyrhynchos*	N/A	9,233	209	63	49	683
Hawaiian Duck[T&E]	*Anas wyvilliana*	na	N/A	0	0	0	1,028
Mottled Duck	*Anas fulvigula*	700,000	59,974	23	0	0	452
Blue-winged Teal	*Anas discors*	8,900,000	1,274,414	117	0	8	7,028
Cinnamon Teal	*Anas cyanoptera*	260,000		12	0	2	405
Northern Shoveler	*Anas clypeata*	4,600,000	866,316	74	0	1	39,644
Northern Pintail	*Anas acuta*	4,400,000	641,604	35	1	7	20,589
Eurasian Teal	*Anas crecca*	10,000	1,890829	0	0	0	2
Green-winged Teal	*Anas carolinensis*	2,900,000		121	3	13	11,325
Canvasback	*Aythya valisineria*	690,000	134,354	1	0	0	2,134
Redhead	*Aythya americana*	1,400,000	289,638	13	0	0	7,312
Ring-necked Duck	*Aythya collaris*	1,500,000	536,706	25	0	0	2,616
Greater Scaup	*Aythya marila*	4,300,000	74,291	61	71	0.6	14,991
Lesser Scaup	*Aythya affinis*	3,000,000	343,565	29	2	0	33,675
Spectacled Eider[T&E]	*Somateria fischeri*	360,000	N/A	0	0	0	38
King Eider	*Somateria spectabilis*	500,000	12,066	0	0	0	12
Common Eider	*Somateria mollissima*	1,300,000		3	0	2	6
Harlequin Duck	*Histrionicus histrionicus*	160,000	N/A	2	0	0.2	246
Surf Scoter	*Melanitta perspicillata*	350,000	50,240	3	0	0	1,572
White-winged Scoter	*Melanitta fusca*	140,000		0	0	0	517
Black Scoter	*Melanitta americana*	410,000		0.2	0	0	530
Long-tailed Duck	*Clangula hyemalis*	1,000,000	22,699	6	0	0	2,043
Bufflehead	*Bucephala albeola*	1,000,000	218,250	35	0	0	17,895
Common Goldeneye	*Bucephala clangula*	1,200,000	86,032	8	0	0.4	4,981
Barrow's Goldeneye	*Bucephala islandica*	200,000		14	0	0	2,887
Hooded Merganser	*Lophodytes cucullatus*	1,100,000	100,579	35	0	0	3,048
Common Merganser	*Mergus merganser*	1,300,000	33,699	47	0	0.2	2,731
Red-breasted Merganser	*Mergus serrator*	240,000		4	0	0	84,303
Ruddy Duck	*Oxyura jamaicensis*	480,000	52,017	38	0	0	624
TOTAL	**48 Spp. + 1 Domestic Ssp.**	**Wetlands Intl 2012**	**USFWS**	**28,564**	**17,897**	**2,830**	**1,276,689**

* Introduced Species N/A = Not applicable na – not available T&E –Threatened and endangered species (Federal only)

[9] As a result of permitting, many WS state offices count both eggs and nests so much of it is double counted. However, where it was found, they were removed and the number of eggs was estimated for active nests taken

Methods to take waterfowl lethally included live traps which include drive/herd traps (15,991), firearms (10,933), hand capture (777), alpha-chloralose (A-C; 629), and nets (233). Hand gathering (9,239 eggs), egg oiling (8,654), and firearms (2) were used to remove nests and eggs. Methods to take waterfowl which were released or relocated included drive/herd and cage traps (2,544), nets (58), hand capture (159), and A-C (72). Methods used for dispersing waterfowl included sound-scare devices (1,031,564), visual repellents including vehicles and lasers (183,566), paint balls and other physical repellents (32,240), dogs (19,359), and chemical repellents (9,958).

Duck, goose, and swan (i.e., waterfowl) damage management is focused largely on reducing hazards to aviation. Extensive damage to property, crops, and human health and safety is also addressed by WS. In addition, waterfowl are the focus of considerable disease surveillance activity by the USDA, APHIS, WS Wildlife Disease Program and its partners due to their migratory behavior and the related risk for their spreading avian and zoonotic diseases from flyways adjacent to those in North America (Gilbert et al. 2006, Xiao et al. 2007). Table 3d lists 48 species of waterfowl causing damage or threats that were managed between FY11 and FY15. Common waterfowl involved in BDM included Canada geese, mallard, and invasive mute swans with the average annual total for all species being 28,564 taken lethally, 17,897 eggs and their nests destroyed, 2,830 captured and relocated or freed, and an estimated 1,276,689 hazed (Table 3d). Comparatively, Table 3d gives estimated breeding population and hunter harvest for waterfowl that occurs annually. With stable populations, it gives the sense of harvest that can occur since annual recruitment allows for high harvests and populations are often conservatively determined.

Corvids (ravens, crows, magpies, and jays) often cause significant losses at confined animal feeding operations (CAFOs) by taking feed, and killing newborn and incapacitated (e.g., a cow calving) livestock. They can also cause damage to property, crops, and human health. Table 3e lists 10 species of corvids causing damage that was managed by WS between FY11 and FY15. The most common species taken included American crows, common ravens, and black-billed magpies. The average annual number of corvids taken included 21,198 taken lethally, 204 eggs removed, 79 captured and freed or relocated, and 1,291,028 dispersed (Table 3e). Methods to take corvids lethally included DRC-1339 (12,499), firearms (8,494), traps (167), and by hand and net (37). Methods used for dispersing corvids were sound repellents (1,084,153), visual repellents (199,350), physical repellents (7,501), and hazing dogs (24). Eggs and nest were taken by hand (201) and with firearms (3) and birds were captured and released with nets (71), cage traps (5), and from hand capture (3).

Table 3e. The annual average number of target corvids controlled by WS in WDM between FY11 and FY15 throughout the USA.

CORVIDS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Gray Jay	*Perisoreus canadensis*	4,300,000	0	0	0	7
Steller's Jay	*Cyanocitta stelleri*	1,900,000	47	0	0	1
Blue Jay	*Cyanocitta cristata*	12,000,000	0.6	0	0.4	15
California Scrub-Jay[>]	*Aphelocoma californica*	1,500,000*	1	0	2	0.4
Black-billed Magpie	*Pica hudsonia*	2,700,000	371	17	1	653
Yellow-billed Magpie	*Pica nuttalli*	90,000	0.2	0	0	36
American Crow	*Corvus brachyrhynchos*	17,000,000	11,031	87	72	1,205,925
Northwestern Crow	*Corvus caurinus*	300,000	36	0	0	22,316
Fish Crow	*Corvus ossifragus*	450,000	75	0	0.2	6,224
Common Raven	*Corvus corax*	1,700,000	9,636	100	3	55,851
TOTAL	**10 Spp.**	**RMBO 2013**	**21,198**	**204**	**79**	**1,291,028**

[>] Western scrub-jay was split into California and Woodhouse's scrub-jays in 2016, but all take were in the range of the California scrub-jay.

Raptor damage management usually does not involve large numbers of birds because they are not as numerous and the related damage is less common and intense. Raptors include hawks, eagles, falcons, ospreys, caracaras, and owls. These species are often grouped together because they are large, are a hazard

at airports, and cause damage to livestock and property. They sometimes pose a human health and safety concern where nest defense frightens or injures people. Table 3f lists 39 species of raptors causing damage that was managed by WS between FY11 and FY15. In addition, a hybrid falcon that eluded its owner at an airport where it was used to haze wildlife had to be hazed away from aircraft until it could be caught. The most common raptors involved in BDM included black and turkey vultures, red-tailed hawks, and American kestrels with an average annual total for all raptors of 8,668 taken lethally, 82 eggs taken (many of these are taken to rehabilitators), 2,762 captured and freed or relocated, and an estimated 195,654 dispersed (Table 3f). Methods used for taking raptors lethally included firearms (5,591) cage traps (3,056), cable restraints (12), and by hand and with nets (8). Raptors were relocated after being caught in raptor traps (2,266), in cable restraints such as bal chatri traps (425), by hand, especially nestlings (55), with nets (187) shot by air cannons, firearms (net guns), and by hand (dip nets). Methods used for dispersing raptors included sound-scare devices (171,693), sight repellents including people and vehicles (20,955), paint balls (physical harassment; 3,905), hazing dogs (40), and barriers (1). Eggs and nests for the most part were hand gathered (78) or oiled (3).

Table 3f. The annual average number of target raptors controlled by WS in WDM between FY11 and FY15 throughout the USA.

RAPTORS						
Species	**Scientific Name**	**Estimated U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Turkey Vulture	*Cathartes aura*	5,000,000	1,536	0.2	2	75,239
Black Vulture	*Coragyps atratus*	5,100,000+	4,769	1	3	49,361
Western Osprey	*Pandion haliaetus*	110,000	66	50	5	1,497
White-tailed Kite	*Elanus leucurus*	2,000,000#	1	0	0.6	66
Swallow-tailed Kite	*Elanoides forficatus*	150,000#	0	0	0	17
Sharp-shinned Hawk	*Accipiter striatus*	180,000	6	0	11	28
Cooper's Hawk	*Accipiter cooperii*	600,000	41	0.8	171	118
Northern Goshawk	*Accipiter gentilis*	90,000	0	0	0	8
Northern Harrier	*Circus cyaneus*	500,000	142	2	30	2,880
Bald Eagle	*Haliaeetus leucocephalus*	300,000#	0	0	12	43,663
Mississippi Kite	*Ictinia mississippiensis*	300,000	91	2	1	735
Common Black Hawk	*Buteogallus anthracinus*	2,000,000#	0	0	0	0.2
Harris's Hawk	*Parabuteo unicinctus*	50,000	0.8	0.6	0	3
Red-shouldered Hawk	*Buteo lineatus*	1,100,000	25	0	20	181
Broad-winged Hawk	*Buteo platypterus*	900,000	0.6	0	1	29
Hawaiian Hawk[T&E]	*Buteo solitarius*	N/A	0	0	0	12
Swainson's Hawk	*Buteo swainsoni*	420,000	78	0	114	2,665
Zone-tailed Hawk	*Buteo albonotatus*	2,000,000#	0	0	0	0.4
Red-tailed Hawk	*Buteo jamaicensis*	1,500,000	1,116	18	1,180	11,796
Rough-legged Hawk	*Buteo lagopus*	500,000#	42	0	29	774
Ferruginous Hawk	*Buteo regalis*	70,000	23	0	18	715
Golden Eagle	*Aquila chrysaetos*	80,000	0	0	0.8	68
Barn Owl^	*Tyto alba*	160,000	186	3	171	269
Snowy Owl	*Bubo scandiacus*	100,000 +	3	0	86	155
Great Horned Owl	*Bubo virginianus*	3,000,000	18	4	182	66
Barred Owl	*Strix varia*	2,000,000	3	0	7	15
Great Gray Owl	*Strix nebulosa*	13,000	0.2	0	0.2	6
Northern Hawk Owl	*Surnia ulula*	30,000	0	0	0.2	12
Northern Pygmy-Owl	*Glaucidium gnoma*	40,000	0	0	0.2	0
Burrowing Owl	*Athene cunicularia*	700,000	1	0	12	20
Boreal Owl	*Aegolius funereus*	1,700,000#	0	0	0	0.2
Long-eared Owl	*Asio otus*	6,000	0	0	0.2	0
Short-eared Owl	*Asio flammeus*	200,000	12	0	16	727
Crested Caracara	*Caracara cheriway*	2,000,000#	9	0	0	46
American Kestrel	*Falco sparverius*	1,700,000	489	0.8	665	5,194
Merlin	*Falco columbarius*	140,000	9	0	7	108
Gyrfalcon	*Falco rusticolus*	4,000	0	0	0	1
Prairie Falcon	*Falco mexicanus*	70,000	0.4	0	9	46
Peregrine Falcon	*Falco peregrinus*	140,000#	0.2	0	8	132
Hybrid Falcon* (*escape*)	*Falco spp.*	N/A	0	0	0	1
TOTAL	**39 Spp. + 1 Hybrid**	**RMBO 2013**	**8,668**	**82**	**2,762**	**195,654**

* Introduced # Global population + North America population N/A = Not applicable na – not available

^ Introduced species in Hawaii - 162 of the 186 taken lethally were in HI where invasive species.

Waterbirds causing damage or threats that are managed by WS include loons, grebes, seabirds, pelicans, boobies, cormorants, cranes, coots, rails, and kingfishers. These species are often grouped together because of their affinity for water, especially where it can be found near airports. In addition, many are large and some exhibit flocking behavior making them a significant hazard to aviation. Some also cause significant damage to aquaculture, crops, and property. Table 3g lists at least 26 species of waterbirds causing damage or threats that were managed by WS between FY11 and FY15. The most common waterbirds involved in BDM were double-crested cormorants, and to a much lesser extent, Laysan albatrosses. The total average annual take for all species was 19,774 taken lethally, 21,342 eggs removed, 1,232 captured and relocated or freed, and an estimated 235,225 dispersed (Table 3g). Methods for taking waterbirds lethally included firearms (19,741) and hand-capture (32). Methods for taking eggs included oiling (18,998) and by hand (2,345). Methods to capture and relocate or free waterbirds were hand capture (1,118) and traps (114). Methods used for dispersing waterbirds were sound repellents (mainly pyrotechnics and firearms; 208,116), sight repellents (26,573), dogs (442) and paint balls (92).

Table 3g. The annual average number of target waterbirds controlled by WS in WDM between FY11 and FY15 throughout the USA.

WATERBIRDS						
Species	**Scientific Name**	**Est. N. Amer. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Red-throated Loon	*Gavia stellata*	40,000	0.4	0	0.2	23
Pacific Loon	*Gavia pacifica*	900,000	1	0	0.2	279
Common Loon	*Gavia immer*	610,000	0	0	0.8	116
Laysan Albatross	*Phoebastria immutabilis*	na	0	86	603	920
Fork-tailed Storm Petrel	*Oceanodroma furcata*	na	0	0	0	4
Hawaiian Petrel[T&E]	*Pterodroma sandwichensis*	na	0	0	0	0.4
Wedge-tailed Shearwater	*Puffinus pacificus*	na	0	0	24	4
Newell's Shearwater[T&E]	*Puffinus newelli*	na	0	0	0.6	0
Pied-billed Grebe	*Podilymbus podiceps*	100,000	22	0	0.2	93
Red-necked Grebe	*Podiceps grisegena*	45,000	0.6	1	0	188
Horned Grebe	*Podiceps auritus*	200,000	0.8	2	0.4	307
Eared Grebe	*Podiceps nigricollis*	3,700,000	2	0	0.4	10
Western & Clark's Grebe	*Aechmophorus occidentalis & clarkii*	130,000	0.2	0	0.4	7,708
American White Pelican	*Pelecanus erythrorhynchos*	157,000	50	224	0	8,146
Brown Pelican	*Pelecanus occidentalis*	320,000	3	0	1	1,992
Magnificent Frigatebird	*Fregata magnificens*	na	0	0	0	95
Great Frigatebird	*Fregata minor*	na	0	0	0	593
Brandt's Cormorant	*Phalacrocorax penicillatus*	100,000	0.8	0	0	44
Pelagic Cormorant	*Phalacrocorax pelagicus*	10,000	1	67	0	1,877
Neotropic Cormorant	*Phalacrocorax brasilianus*	163,000	0	0	0	85
Double-crested Cormorant	*Phalacrocorax auritus*	1,100,000	19,674	20,962	601	212,591
Anhinga	*Anhinga anhinga*	25,000	17	0	0	92
Common Murre	*Uria aalge*	na	0	0	0	38
Pigeon Guillemot	*Cepphus columba*	na	0	0	0	1
Marbled Murrelet[T&E]	*Brachyramphus marmoratus*	na	0	0	0	19
Parakeet Auklet	*Aethia psittacula*	na	1	0	0	0
TOTAL	**27 Spp.***	**RMBO 2013**	**19,774**	**21,342**	**1,232**	**235,225**

* Both Clark's and western grebes were likely in BDM activities but were not differentiated in the MIS na – not available
T&E –Threatened and endangered species (Federal only)

Wading bird damage management includes herons, egrets, storks, bitterns, ibises, spoonbills, and flamingos. These species are often grouped together because they are very large flocking birds and are a hazard at airports, and several also cause extensive damage to property, crops, and human health and safety. A typical concern to people arises from noise and potential disease when a nesting area, a rookery, is built in a residential area since many are colonial nesters. Table 3h lists 24 species of wading birds that were controlled between FY11 and FY15. The most common wading birds involved in BDM included the western cattle egrets, American coots, and sandhill cranes with the average annual total for all species being 9,944 taken lethally, 2,399 eggs taken, 28 captured and relocated or freed, and 341,983 hazed (Table 3h). Methods used to take them lethally included firearms (7,567), A-C (1,787) for American coots, by hand (566) and nets (27). Eggs were taken by hand/hand tools (2,399). The primary method to capture and

relocate or free waterbirds was capture by hand (28). Methods used for dispersing wading birds were sound scare devices (313,758), sight repellents (26,143), dogs (1,996), paint balls (75), and chemical repellents (10).

Table 3h. The annual average number of target wading birds controlled by WS in WDM between FY11 and FY15 throughout the USA.

WADING BIRDS						
Species	**Scientific Name**	**Est. N. Amer. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
American Flamingo	*Phoenicopterus ruber*	40,000	0	0	0	2
Wood Stork[T&E]	*Mycteria americana*	17,000	0	0	0	109
American White Ibis	*Eudocimus albus*	210,000	140	0	0	30,081
Glossy Ibis	*Plegadis falcinellus*	20,000	10	0	0	1,230
White-faced Ibis	*Plegadis chihi*	150,000	10	0	0	4,608
Roseate Spoonbill	*Platalea ajaja*	100,000	0.8	0	0	153
American Bittern	*Botaurus lentiginosus*	3,000,000	0.4	0	0	6
Least Bittern	*Ixobrychus exilis*	130,000	0	0	0	0.4
Yellow Bittern	*Ixobrychus sinensis*	na	18	417	0	1,839
Black-crowned Night-Heron	*Nycticorax nycticorax*	75,000	31	0	0.2	867
Yellow-crowned Night-Heron	*Nyctanassa violacea*	75,000	33	0	0	118
Green Heron	*Butorides virescens*	na	24	0	0	111
Western Cattle Egret^	*Bubulcus ibis*	1,000,000	5,607	1,928	26	101,505
Great Blue Heron	*Ardea herodias*	140,000	588	31	0.6	13,028
Great Egret	*Ardea alba*	270,000	327	0	0.2	13,076
Reddish Egret	*Egretta rufescens*	5,000	0	0	0	2
Tricolored Heron	*Egretta tricolor*	293,000	3	0	0	92
Little Blue Heron	*Egretta caerulea*	225,000	16	23	0	1,531
Snowy Egret	*Egretta thula*	100,000	150	0	0	4,920
Common Gallinule	*Gallinula galeata*	1,000,000	2	0	0	10
Hawaiian Coot[T&E]	*Fulica alai*	na	0	0	0	0.6
American Coot	*Fulica americana*	6,000,000	2,965	0	0.4	24,606
Sandhill Crane	*Grus canadensis*	670,000	20	0	0.2	144,087
Whooping Crane[T&E]	*Grus americana*	400	0	0	0.2	0.6
TOTAL	**24 Spp.**	**Wetlands Intl 2012**	**9,944**	**2,399**	**28**	**341,983**

^ Introduced species in Hawaii na – not available T&E –Threatened and endangered species (Federal only)

Shorebird damage management includes avocets, curlews, godwits, plovers, sandpipers, stints, yellowlegs, and other species. These species are a taxonomic group. They are typically flocking, associated with water often found near airports, and are a hazard at airports. They also have several species monitored for disease, the species that migrate long distances, especially through areas where an outbreak of a disease of concern has occurred. Table 3i lists 49 species of shorebirds that were controlled between FY11 and FY15. The most common shorebirds involved in BDM included killdeer, upland sandpipers, pacific golden-plovers, and ruddy turnstones, all associated with airports. The total average annual take for all shorebird species by WS was 2,894 taken lethally, 108 eggs[10] taken, 7 captured and relocated or freed, and 345,786 dispersed (Table 3i). Both the killdeer and upland sandpiper nest in habitat (grasslands and rocky areas) typically found on most airports and are the species taken most. The primary methods to take shorebirds lethally were firearms (2,878) and by hand (13). Eggs were removed by hand (106) and egg oiling (1). The method for capturing and releasing or relocating shorebirds was hand capture (6), primarily used to free trapped young from deep pits. Methods used to disperse shorebirds included pyrotechnics and other sound repellents (174,837), vehicles and other sight repellents (165,199), dogs (5,283), and paint balls (465).

[10] Rounding error can occur for data by species versus by method and can add up differently, differing by at most one or two.

Table 3i. The annual average number of target shorebirds controlled by WS in WDM between FY11 and FY15 throughout the USA.

SHOREBIRDS						
Species	**Scientific Name**	**Est. N. Amer. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Black Oystercatcher	*Haematopus bachmani*	10,000	0	0	0	11
American Oystercatcher	*Haematopus palliates*	11,000	0.4	2	0	19
Black-necked Stilt	*Himantopus mexicanus*	100,000	36	0	0	1,604
- Hawaiian Black-necked Stilt[T&E]	*Himantopus mexicanus knudseni*	na	0	0	0	765
American Avocet	*Recurvirostra americana*	100,000	4	6	0	8,190
American Golden-Plover	*Pluvialis dominica*	395,000	22	0	0	718
Pacific Golden-Plover	*Pluvialis fulva*	35,000	2	0	0.4	222,923
Gray (*Black-bellied*) Plover	*Pluvialis squatarola*	250,000	13	0	0	5,088
Semipalmated Plover	*Charadrius semipalmatus*	150,000	26	12	2	7,255
Wilson's Plover	*Charadrius wilsonia*	15,500	0	0	0	2,565
Lesser Sand-Plover	*Charadrius mongolus*	na	0	0	0	0.4
Killdeer	*Charadrius vociferus*	1,000,000	2,101	87	2	21,936
Snowy Plover	*Charadrius nivosus*	22,100	0	0	0	1
Mountain Plover	*Charadrius montanus*	20,000	0	0	0	55
American Woodcock	*Scolopax minor*	3,000,000	1	0	0	8
Wilson's Snipe	*Gallinago delicata*	2,000,000	30	0	0	394
Short-billed Dowitcher	*Limnodromus griseus*	240,000	3	0	0	1,159
Long-billed Dowitcher	*Limnodromus scolopaceus*	500,000	2	0	0	813
Hudsonian Godwit	*Limosa haemastica*	77,000	5	0	0	83
Bar-tailed Godwit	*Limosa lapponica*	130,000	0	0	0	1
Marbled Godwit	*Limosa fedoa*	170,000	1	0	0	1,936
Whimbrel	*Numenius phaeopus*	270,000	16	0	0	3,771
Bristle-thighed Curlew	*Numenius tahitiensis*	10,000	0	0	0	87
Long-billed Curlew	*Numenius americanus*	110,000	22	0	0	13,558
Upland Sandpiper	*Bartramia longicauda*	500,000	381	0	2	2,973
Greater Yellowlegs	*Tringa melanoleuca*	100,000	22	0	0	1,299
Lesser Yellowlegs	*Tringa flavipes*	400,000	21	0	0	850
Solitary Sandpiper	*Tringa solitaria*	150,000	0.8	0	0	44
Wandering Tattler	*Tringa incana*	10,000	0	0	0	5
Willet	*Tringa semipalmata*	250,000	10	0	0	1,298
Common Sandpiper	*Actitis hypoleucos*	na	0	0	0	1
Spotted Sandpiper	*Actitis macularius*	150,000	0.6	0	0	74
Ruddy Turnstone	*Arenaria interpres*	310,000	0	0	0.2	14,958
Black Turnstone	*Arenaria melanocephala*	95,000	0	0	0	248
Surfbird	*Calidris virgata*	70,000	0	0	0	44
Sanderling	*Calidris alba*	300,000	12	0	0	8,142
Semipalmated Sandpiper	*Calidris pusilla*	2,200,000	16	0	0	3,173
Western Sandpiper	*Calidris mauri*	3,500,000	7	0	0	9,580
Least Sandpiper	*Calidris minutilla*	700,000	77	0	0	4,283
White-rumped Sandpiper	*Calidris fuscicollis*	1,100,000	3	0	0	30
Baird's Sandpiper	*Calidris bairdii*	300,000	0	0	0	5
Pectoral Sandpiper	*Calidris melanotos*	1,200,000	5	0	0	226
Sharp-tailed Sandpiper	*Calidris acuminata*	160,000	0	0	0	0.2
Rock Sandpiper	*Calidris ptilocnemis*	140,000	1	0	0	29
Dunlin	*Calidris alpina*	1,300,000	53	0	0	5,342
Stilt Sandpiper	*Calidris himantopus*	820,000	0	0	0	2
Buff-breasted Sandpiper	*Calidris subruficollis*	35,000	0.2	0	0	120
Wilson's Phalarope	*Phalaropus tricolor*	1,500,000	0	0	0	31
Red-necked Phalarope	*Phalaropus lobatus*	2,500,000	0	0.8	0	88
Red Phalarope	*Phalaropus fulicarius*	1,200,000	0	0	0	0.6
TOTAL	**49 Spp. + 1 Ssp.**	**Wetlands Intl 2012**	**2,894**	**108**	**7**	**345,786**

na – not available T&E –Threatened and endangered species (Federal only)

Gallinaceous (chicken-like) bird damage management includes feral domestic poultry, quail, francolins, grouse, and turkeys. These species are a taxonomic group. Most are controlled at airports because they can be flocking and most are large. Some also can cause damage to crops and property. Table 3j lists 19 species of gallinaceous birds that were controlled between FY11 and FY15. The most common gallinaceous birds involved in BDM during this time included feral chickens, francolins, red junglefowl (wild chicken that gave rise to the domestic chicken), and ring-necked pheasants. The average annual total number of gallinaceous birds lethally taken was 8,507, 13 eggs taken, 177 captured and relocated or freed, and 16,311 hazed (Table 3j). Methods used to take gallinaceous birds lethally included the use of firearms (6,409), cage traps (1,569), hand gathering (518), nets (10), and cable restraints (2). The only method to take eggs was

by hand (13). Methods used to capture and release gallinaceous birds were nets (131), cage traps (43), and hand capture (5). Methods used for dispersing gallinaceous birds were sight repellents (11,381), sound repellents (4,888), hazing dogs (22), and physical repellents (20). Most lethal take, including red junglefowl, feral chickens, francolins, and most ring-necked pheasants occurred in Hawaii where they are all invasive species (90%). Additionally, WS trapped 106 greater sage-grouse for a telemetry study in Wyoming.

Table 3j. The annual average number of target gallinaceous birds controlled by WS in WDM between FY11 and FY15 throughout the USA.

GALLINACEOUS BIRDS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Helmeted Guineafowl*	*Numida meleagris*	N/A	0.8	0	0	0
Scaled Quail	*Callipepla squamata*	3,000,000	0	0	0	26
California Quail^	*Callipepla californica*	2,700,000	0.2	0	0	6
Gambel's Quail	*Callipepla gambelii*	3,900,000	3	0	0	62
Northern Bobwhite^	*Colinus virginianus*	5,800,000	0.2	0	0	57
Wild Turkey^	*Meleagris gallopavo*	7,800,000#	317	2	45	2,798
Ruffed Grouse	*Bonasa umbellus*	18,000,000#	0	0	0	2
Spruce Grouse	*Falcipennis canadensis*	11,000,000	0	0	0	4
Greater Sage-Grouse	*Centrocercus urophasianus*	150,000	0	0	106	0
Sharp-tailed Grouse	*Tympanuchus phasianellus*	300,000	2	0	0	92
Willow Ptarmigan	*Lagopus lagopus*	8,000,000	0.2	0	0	3
Chukar Partridge*	*Alectoris chukar*	500,000	4	0	0	14
Black Francolin*	*Francolinus francolinus*	N/A	1,868	0	0	2,547
Gray Francolin*	*Francolinus pondicerianus*	N/A	2,007	0	0	4,401
Erckel's Francolin*	*Francolinus erckelii*	N/A	311	0	0	361
Gray Partridge*	*Perdix perdix*	600,000	4	0	0	42
Red Junglefowl*	*Gallus gallus*	N/A	477	7	0	425
- Feral Domestic Chicken*	*Gallus gallus domesticus*	N/A	2,547	4	7	3,909
Ring-necked Pheasant*	*Phasianus colchicus*	14,000,000	953	0	19	1,557
Common (*Indian*) Peafowl*	*Pavo cristatus*	N/A	13	0	0.2	5
TOTAL	**19 Spp. + 1 Domestic Ssp.**	**RMBO 2013**	**8,507**	**13**	**177**	**16,311**

* Introduced Species ^ Translocated from former range within North America to areas where invasive # Global population
+ N. Amer. population N/A – Not applicable

Aerialists include nighthawks, nightjars, swifts, martins, and swallows. These species are grouped together because they feed on insects by flying through the air and opening their mouths to catch them. As a result, many feed over runways where they are a strike threat. In addition, many of the swallows build nests on buildings and other structures where they cause damage. Table 3k lists 10 species and 1 group that were controlled between FY11 and FY15. A few more are found in the USA, but were not recorded as being taken. The most common aerialists involved in BDM include cliff swallows, barn swallows, and purple martins.

Table 3k. The annual average number of target aerialist (nighthawks, swifts, and swallows) controlled by WS in WDM between FY11 and FY15 throughout the USA.

AERIALISTS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Lesser Nighthawk	*Chordeiles acutipennis*	3,000,000	0.4	0	0	0
Common Nighthawk	*Chordeiles minor*	14,000,000	68	0.6	2	279
Common Poorwill	*Phalaenoptilus nuttallii*	1,800,000	0	0	1	0
Chimney Swift	*Chaetura pelagica*	7,700,000	0.6	3	0.4	711
White-throated Swift	*Aeronautes saxatalis*	800,000	0	0	0	14
Rivoli's (*Magnificent*) Hummingbird	*Eugenes fulgens*	2,000,000#	0	0	0.2	0
Bank Swallow	*Riparia riparia*	4,000,000	102	51	0	19,945
Tree Swallow	*Tachycineta bicolor*	7,000,000	81	0	0	25,225
Violet-green Swallow	*Tachycineta thalassina*	4,700,000	0.2	1	0.2	1,079
Purple Martin	*Progne subis*	6,000,000	56	0	0	14,875
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	13,000,000	4	4	0	114
Barn Swallow	*Hirundo rustica*	28,000,000	857	1,467	2	138,240
American Cliff Swallow	*Petrochelidon pyrrhonota*	30,000,000	2,370	3,531	1	160,058
Cave Swallow	*Petrochelidon fulva*	1,000,000	84	0.8	0	768
TOTAL	**14 Spp.**	**RMBO 2013**	**3,623**	**5,058**	**7**	**361,308**

Global population

The average annual total number of aerialists taken included 3,623 taken lethally, 5,058 eggs and their nests destroyed, 7 captured and relocated or freed, and 361,308 hazed (Table 3k). Methods used to take aerialists lethally included firearms (3,336), hand capture (274), nets (9), and cage traps (3). Eggs were taken by hand (3,437), using high-pressure water spray (1,574), with firearms[11] (47), and oiling the eggs (1). Methods used for dispersing aerialists were sound repellents including pyrotechnics and firearms (342,882), sight repellents (15,585), physical repellents including paint balls and water spray (2,798), Rejex-It® (methyl anthranilate) repellent (30), and dogs (12). Aerialists were captured and freed or relocated using hand capture with or without dip nets (7).

Cuckoos, kingfishers, woodpeckers, and invasive parrots, all other non-passerine (song) birds, for the purposes of this document are grouped together and referred to as forest birds. They can cause damage, but typically not as extensive as other species. These species are grouped together because they are the remaining non-passerine birds that can cause damage to property and agriculture such as crops. These species are typically not as hazardous as other wildlife at airports, but can be where habitat is adjacent to an air operating area. Additionally, the parrots are invasive species and the rose-ringed parakeet, especially in Hawaii, can be problematic. The most extensive damage is caused by woodpeckers, drilling holes into structures, and monk parakeets with their nesting structures on electrical poles which can cause fires and outages. Table 3l lists 13 species that were controlled by WS between FY11 and FY15. A few more are found in the USA, but were not recorded as taken.

Table 3l. The annual average number of target other non-passerine birds (cuckoos, kingfishers, woodpeckers and parrots) controlled by WS in WDM between FY11 and FY15 throughout the USA.

OTHER NONPASSERINE FOREST BIRDS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Greater Roadrunner	*Geococcyx californianus*	650,000	0.2	0	0	0
Belted Kingfisher	*Megaceryle alcyon*	860,000	1	0	0	347
Acorn Woodpecker	*Melanerpes formicivorus*	1,500,000	3	0	0	0
Gila Woodpecker	*Melanerpes uropygialis*	400,000	68	0	0	0.4
Golden-fronted Woodpecker	*Melanerpes aurifrons*	580,000	2	0	0	0
Red-bellied Woodpecker	*Melanerpes carolinus*	10,000,000	0.2	0	0	0
Downy Woodpecker	*Picoides pubescens*	11,000,000	2	0	0	0.2
Hairy Woodpecker	*Picoides villosus*	3,900,000	0.6	0	0	0
Northern Flicker	*Colaptes auratus*	4,100,000	77	3	0	65
Pileated Woodpecker	*Dryocopus pileatus*	1,300,000	1	0	0	0
Monk Parakeet*	*Myiopsitta monachus*	20,000,000#	3	0	0	51
Yellow-headed Amazon*	*Amazona oratrix*	N/A	0.2	0	0	0
Rose-ringed Parakeet*	*Psittacula krameri*	N/A	697	0	0.6	5,291
TOTAL	**13 Spp.**	**RMBO 2013**	**855**	**3**	**0.6**	**5,755**

* Introduced Species # Global population N/A – Not applicable

The most common forest birds involved in BDM include rose-ringed parakeets, northern flickers, Gila woodpeckers, and belted kingfishers with the average annual total for all species being 855 taken lethally, 3 eggs taken, 1 captured and relocated or freed, and 5,755 hazed (Table 3l). Methods employed to take forest birds lethally included firearms (835), traps (18), and by hand (3). Methods used for dispersing woodpeckers were sound repellents (3,989), sight repellents (1,760), physical repellents (4), and chemical repellents (2). Eggs were taken by hand (3). As can be seen, few other non-passerine forest birds are taken.

The next group is passerine species (songbirds) that are mostly associated with grasslands as most are found in sparsely wooded or open areas, habitat usually found on airports is where most work with these species is conducted. These species are the tyrant flycatchers, shrikes, larks, pipits, longspurs, embezerids (new world sparrows), and icterids (not including blackbirds here (above); meadowlarks, bobolinks,

[11] Firearms and paint balls are often used to destroy nests/eggs where they are not able to be reached.

dickcissels, and orioles). Management of these species usually does not involve large numbers of birds taken lethally, but rather dispersed particularly from airports. Species which nest on airports are the exception because they are hard to disperse, especially once nesting has begun. These species are grouped together because they can cause significant losses at airports with only minor damage potential to other resources. Table 3m lists 35 species of birds that were controlled between FY11 and FY15.

Table 3m. The annual average number of target grassland passerine groups (tyrant flycatchers, shrikes, larks, pipits, longspurs, emberizids, and icterids excluding the blackbirds above) controlled by WS in WDM between FY11 and FY15 throughout the USA.

GRASSLAND PASSERINE GROUPS						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Black Phoebe	*Sayornis nigricans*	1,000,000	0	0	0	43
Eastern Phoebe	*Sayornis phoebe*	24,000,000	0.4	0.2	0.6	0
Say's Phoebe	*Sayornis saya*	3,700,000	1	2	0	3
Vermilion Flycatcher	*Pyrocephalus rubinus*	20,000,000	0	0	0.2	0
Western Kingbird	*Tyrannus verticalis*	20,000,000	346	22	21	4,604
Scissor-tailed Flycatcher	*Tyrannus forficatus*	8,700,000	151	1	0.8	972
Eastern Kingbird	*Tyrannus tyrannus*	23,000,000	38	0.8	0	157
Gray Kingbird	*Tyrannus dominicensis*	2,000,000	0	0	0	2
Loggerhead Shrike	*Lanius ludovicianus*	4,800,000	15	0	1	176
Great Gray (*Northern*) Shrike	*Lanius excubitor*	2,000,000+	0	0	4	18
Horned Lark	*Eremophila alpestris*	55,000,000	2,109	0	0	76,729
American Pipit	*Anthus rubescens*	300,000	19	0	0	5,852
Lapland Longspur	*Calcarius lapponicus*	5,000,000	5	0	0	1,608
Snow Bunting	*Plectrophenax nivalis*	14,000,000+	13	0	0	2,259
California Towhee	*Melozone crissalis*	5,200,000	16	0	7	1
Abert's Towhee	*Melozone aberti*	800,000	0	0	0.8	0
Chipping Sparrow	*Spizella passerina*	86,000,000	0.2	0	4	30
Field Sparrow	*Spizella pusilla*	7,400,000	3	0	0	34
Vesper Sparrow	*Pooecetes gramineus*	18,000,000	0	0	0	12
Lark Sparrow	*Chondestes grammacus*	6,800,000	0.4	0	0	14
Lark Bunting	*Calamospiza melanocorys*	8,900,000	355	0	0	7,550
Savannah Sparrow	*Passerculus sandwichensis*	70,000,000	65	0	41	4,558
Grasshopper Sparrow	*Ammodramus savannarum*	30,000,000	4	0	0.6	125
American Tree Sparrow	*Spizelloides arborea*	6,000,000	0	0	0	4
Fox Sparrow	*Passerella iliaca*	9,000,000	0.6	0	0	121
Song Sparrow	*Melospiza melodia*	75,000,000	0	1	6	141
Lincoln's Sparrow	*Melospiza lincolnii*	10,000,000	4	0	0	508
White-crowned Sparrow	*Zonotrichia leucophrys*	24,000,000	179	0	1	86
Golden-crowned Sparrow	*Zonotrichia atricapilla*	4,000,000	0.4	0	0.2	2
Dark-eyed Junco	*Junco hyemalis*	71,000,000	3	0	1	236
Dickcissel	*Spiza americana*	19,000,000	1	0	0	6
Bobolink	*Dolichonyx oryzivorus*	5,800,000	5	0	0	701
Eastern Meadowlark^	*Sturnella magna*	21,000,000	1,196	0	0.2	18,751
Western Meadowlark^	*Sturnella neglecta*	71,000,000	1,012	1	0	45,774
Bullock's Oriole	*Icterus bullockii*	6,000,000	0	0	0	0.6
TOTAL	**35 Spp.**	**RMBO 2013**	**5,542**	**28**	**89**	**171,078**

^ Introduced species in Hawaii + North America population

The grassland passerine species mostly involved in BDM included horned larks, eastern and western meadowlarks, lark buntings, and western kingbirds with an average annual total for grassland passerines of 5,542 taken lethally, 28 eggs along with their nests removed, 89 captured and freed or relocated, and 171,078 dispersed (Table 3m). Methods used to take passerines associated with grasslands lethally included firearms (5,316), cage traps (221), by hand (4) and drop nets (1). Eggs were removed by hand (28). Birds were relocated or freed by cage traps (86) or after they were caught by hand (3). Methods used to disperse grassland passerine species were sound-scare devices (136,733), sight repellents (30,191), hazing dogs (3,853), and physical repellents (300).

Another group of passerine species is birds that are mostly associated with forests and includes waxwings, wrens, nuthatches, mockingbirds, thrashers, thrushes, finches, wood-warblers, and cardinals. The forest passerine species are mostly birds that associate with habitat associated with woodland areas, but can be

found in and around airports where most work with these species is conducted. Their management usually does not involve large numbers of birds taken lethally, but rather dispersed particularly from airports and some from crops, especially waxwings, robins, and finches. These species are grouped together because they can cause losses at airports and crops with only minor damage potential to other resources. Several of these species have invasive populations on Hawaii where they are controlled for airports and to protect native species. Table 3n lists 32 species of birds and the unidentifiable bird category that were controlled between FY11 and FY15. The most forest passerine species involved in BDM included House Finches (most taken lethally, 89%, were invasive on Hawaii), American robin, and northern cardinals (all lethally taken were invasive on Hawaii) with an average annual total of 3,752 taken lethally, 261 eggs removed, 125 captured and freed or relocated, and 96,037 dispersed (Table 3n). Methods used to take forest passerines lethally included firearms (3,260), cage traps (438), and hand capture (27). Eggs were removed by hand (175) and with firearms (12). Birds were relocated or freed mostly by cage traps (104), nets (15) or caught by hand (6). The most common methods used for dispersing passerine species were sound-scare devices (32,650), sight repellents (47,313), hazing dogs (137), and physical repellents (130).

Table 3n. The annual average number of forest or riparian associated passerine groups (bushtits, nuthatches, wrens, dippers, thrushes, mockingbirds, thrashers, waxwings, fringillids (finches), wood-warblers, and cardinalids) controlled by WS in WDM between FY11 and FY15 throughout the USA.

FOREST-RIPARIAN PASSERINES						
Species	**Scientific Name**	**Est. U.S. Pop.**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Bohemian Waxwing	*Bombycilla garrulus*	700,000	0.4	0	0	1,711
Cedar Waxwing	*Bombycilla cedrorum*	23,000,000	7	0	0	1,648
Carolina Wren	*Thryothorus ludovicianus*	13,000,000	0	0	0.2	0
House Wren	*Troglodytes aedon*	29,000,000	0	0	2	0
White-breasted Nuthatch	*Sitta carolinensis*	7,900,000	0.2	0	0	0
Gray Catbird	*Dumetella carolinensis*	24,000,000	0.4	0	5	0.8
Northern Mockingbird	*Mimus polyglottos*	27,000,000	72	6	21	1,341
Brown Thrasher	*Toxostoma rufum*	4,500,000	0.4	0	0	0.8
Curve-billed Thrasher	*Toxostoma curvirostre*	1,100,000	0.2	0	0	0
Varied Thrush	*Ixoreus naevius*	15,000,000	0	0	0	2
Eastern Bluebird	*Sialia sialis*	19,000,000	8	0	0	119
Western Bluebird	*Sialia mexicana*	4,500,000	0.2	0	0	32
Mountain Bluebird	*Sialia currucoides*	3,700,000	0	0	0	10
Swainson's Thrush	*Catharus ustulatus*	28,000,000	0	0	0	7
American Robin	*Turdus migratorius*	160,000,000	272	158	18	19,272
American Dipper	*Cinclus mexicanus*	160,000	0	2	0	0
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	200,000	1	0	0	0
Purple Finch	*Haemorhous purpureus*	2,200,000	0.6	0	0	1
House Finch^	*Haemorhous mexicanus*	34,000,000	3,194	20	1	51,686
Common Redpoll	*Acanthis flammea*	30,000,000	0	0	0	301
Red Crossbill	*Loxia curvirostra*	5,600,000	0	0	0	4
White-winged Crossbill	*Loxia leucoptera*	4,000,000	0	0	0	3
American Goldfinch	*Spinus tristis*	28,000,000	5	0	0.6	1,861
Lesser Goldfinch	*Spinus psaltria*	3,900,000	0.8	0	0	816
Pine Siskin	*Spinus pinus*	14,000,000	0	0	0	183
Common Yellowthroat	*Geothlypis trichas*	47,000,000	0	0	0.2	0
American Yellow Warbler	*Setophaga petechia*	34,000,000	0	0	0	12
Pine Warbler	*Setophaga pinus*	12,000,000	0	0	0	56
Yellow-rumped Warbler	*Setophaga coronata*	38,000,000	0	0	0	19
Northern Cardinal^	*Cardinalis cardinalis*	90,000,000	163	0	77	1,141
Blue Grosbeak	*Passerina caerulea*	18,000,000	0.2	0	0	0
Indigo Bunting	*Passerina cyanea*	77,000,000	0	0	0	2
Unidentifiable Bird	Unknown Bird	N/A	0	75	0	15,808
TOTAL	**32 Spp. + Unknown Birds**	**RMBO 2013**	**3,725**	**261**	**125**	**96,037**

N/A – Not applicable ^ Invasive species in Hawaii –163 Northern Cardinals and 2,920 House Finches

In addition to the above species, Table 3n also includes birds that were not identified during control operations. Sometimes birds cannot be identified quickly, especially in hazing operations. This is typical when birds are far away at an airport and hazed and are just seen as a big flock of birds. Nests between some species gets difficult and so some WS Specialists just mark it as unidentified (e.g., House Finch vs

House Sparrow in the rafters of a ceiling especially when nests are vacant). In all, a total of 75 eggs taken and 15,808 birds hazed were unidentified. All of these were at airports and included in the passerine table as it is likely that many of these would have been in this table or the next. Some of these birds, though, were larger birds such as waterfowl.

Invasive or introduced species were denoted in the above categories and included several species. This category of birds is Other Invasive Passerine Species and includes all invasive species that are small passerines and not already discussed above. Most of these species were taken on Hawaii. However, most house sparrows were taken on the USA mainland and a common myna was taken in Florida (this is expected to increase as their population does there), and black drongos, Eurasian tree sparrows, some chestnut-breasted mannikins on Guam where they are invasive species. These species are grouped together because they are invasive and threaten native fauna by competing for resources or spreading disease to the reduced populations of native species (usually spread *via* mosquitos). These species are also found at airports where they are a strike threat, especially because they are flocking. Some also damage crops and property. Table 3o lists 16 species that were controlled between FY11 and FY15. The most common of these invasive species involved in BDM included chestnut-breasted mannikins (*also known as black-head munias*), nutmeg mannikins (*also known as scaly-breasted mannikins*), Java sparrows, house sparrows, common mynas, and red-crested cardinals with an average annual total of 76,094 taken lethally, 335 eggs destroyed, 98 captured and freed or relocated, and 569,081 dispersed (Table 3o). Methods used to take these other invasive species lethally included firearms (63,747), cage traps (10,228), Avitrol® (1,880), nets (202), and hand capture (37). Eggs were taken by hand (332) and with firearms (3). The few that were freed were caught in nets (81), cage traps (16), and caught by hand (1). Methods used for dispersing these invasive passerine species were sight repellents (296,059), sound-scare devices (267,499), hazing dogs (5,389), and chemical repellents (133).

Table 3o. The annual average number of other target invasive species (parrots and passerines) controlled by WS in WDM between FY11 and FY15 throughout the USA, but primarily Hawaii. Population estimates are not given as these are introduced species.

OTHER INVASIVE PASSERINE SPECIES					
Species	**Scientific Name**	**Killed**	**Eggs**	**Freed**	**Dispersed**
Eurasian Skylark	*Alauda arvensis or japonica*	597	0	0	27,655
Red-whiskered Bulbul	*Pycnonotus jocosus*	0	0	0	9
Red-vented Bulbul	*Pycnonotus cafer*	1,033	0	0	5,906
Black Drongo	*Dicrurus macrocercus*	0.2	0	0	0
Japanese White-eye	*Zosterops japonicus*	0	0	0	11
Common Myna	*Acridotheres tristis*	7,023	1	0	93,319
Common Waxbill	*Estrilda astrild*	749	0	0	13,189
Red Avadavat	*Amandava amandava*	1,179	0	0	8,601
Chestnut Mannikin	*Lonchura atricapilla*	26,781	0	0	237,475
Nutmeg Mannikin	*Lonchura punctulata*	19,969	0	0	138,183
Warbling Silverbill	*Lonchura malabarica*	353	0	0	3,400
Java Sparrow	*Lonchura oryzivora*	7,335	0	0	8,235
Saffron Finch	*Sicalis flaveola*	8	0	0	559
Red-crested Cardinal	*Paroaria coronata*	4,006	0	0	15,523
House Sparrow	*Passer domesticus*	6,758	334	88	17,016
Eurasian Tree Sparrow	*Passer montanus*	303	0	10	0
TOTAL	**16 Spp.**	**76,094**	**335**	**98**	**569,081**

2.3 Reptile Damage Management Programs

Reptile damage management programs have always been a minor part of WS WDM until the Brown Tree Snake Program began on Guam in 1993. Brown tree snakes reached densities of 15,000/mi^2, but have declined with the decimation of many food sources. Since that program started, efforts have been made in Puerto Rico and Florida to remove invasive reptiles from local areas. Most reptiles lethally taken are invasive species and are removed to protect native ecosystems and their fauna, public health and safety, and property. Native reptiles are also taken where they could be a danger (e.g., rattlesnake bites), or to protect

aquaculture or other resources. However, most native species are not taken lethally, but relocated. For example, many snakes are just indoors or next to a house where they pose a threat or a perceived threat to people (many people have a snake phobia).

The primary categories of reptiles include crocodilians, turtles, lizards, and snakes. The first table includes crocodilians, turtles and lizards. Many of these species are considered invasive with most of them being found in Florida and Puerto Rico. Invasive reptiles can cause declines of native fauna. The invasive species are denoted in Table 4a with an asterisk. Table 4a lists 30 species and 1 group (turtles from Florida and Missouri[12]) that were controlled between FY11 and FY15. Many more reptiles are found in the USA and technical assistance was given for many of these, but no take for these species was recorded. The most common species involved in WDM included green iguanas, black spiny-tailed iguanas, brown basalisks, pond sliders, and common snapping turtles. WS mostly took exotic lizards with an average annual total of 1,761 taken lethally, 518 eggs removed, 241 captured and freed or relocated, and 4 dispersed (Table 4a). Methods used to take these other invasive species lethally included firearms (1,564), traps (194), and by hand (3). Eggs were taken by hand (518). The few that were freed were caught traps (173) and by hand (69). The few exotic reptiles dispersed were with pyrotechnics (3) and sight repellents (1) showing the lack of dispersing them.

Table 4a. The annual average number of target reptiles, other than snakes, controlled by WS in WDM between FY11 and FY15 throughout the USA.

CROCADILIAN, TURTLE AND LIZARD SPECIES					
Species	**Scientific Name**	**Killed**	**Eggs**	**Freed**	**Dispersed**
American Alligator^	*Alligator mississippiensis*	0.8	0	6	2
Spectacled Caiman*	*Caiman crocodilus*	0.6	0	1	0.4
Gopher Tortoise	*Gopherus polyphemus*	0	0	0.6	0
Spotted Turtle	*Clemmys guttata*	0	0	0.4	0
Blanding's Turtle	*Emydoidea blandingii*	0	0	0.2	0
Eastern Box Turtle	*Terrapene carolina*	0	0	9	0
Florida Box Turtle	*Terrapene bauri*	0	0	0.4	0
Ornate Box Turtle	*Terrapene ornata*	0	0	0.2	0
Pond (*Yellow-bellied*) Slider^	*Trachemys scripta*	11	0	69	0
Northern Painted Turtle	*Chrysemys picta*	0	0	67	0
Chicken Turtle	*Deirochelys reticularia*	0	0	0.4	0
Northern (*Common*) Map Turtle	*Graptemys geographica*	0	0	0.2	0
Florida Red-bellied Cooter	*Pseudemys nelsoni*	0	0	0.4	0
Common Snapping Turtle^	*Chelydra serpentina*	5	0	52	0
Eastern Mud Turtle	*Kinosternon subrubrum*	0	0	2	0
Striped Mud Turtle	*Kinosternon baurii*	0	0	8	0
Common Musk Turtle (*Stinkpot*)	*Sternotherus odoratus*	0	0	10	0
Florida Softshell	*Apalone ferox*	0	0	1	0
Spiny Softshell	*Apalone spinifera*	0	0	2	0
Unidentified Turtles	Order Testudines (24 possible spp.)	0	0	9	0
African Rainbow Lizard*	*Agama agama*	0	0	0	0.2
Black (*Gray's*) Spinytail Iguana*	*Ctenosaura similis*	673	0	0	0
Mexican Spiny-tailed Iguana*	*Ctenosaura pectinata*	0.2	0	0	0
Green Iguana*	*Iguana iguana*	1,057	518	0.4	1
Mountain (*Yarrow's*) Spiny Lizard	*Sceloporus jarrovii*	0	0	0.2	0
Brown Basalisk*	*Basiliscus vittatus*	11	0	0	0
Common Five-lined Skink	*Plestiodon fasciatus*	0	0	0.6	0
Eastern Glass Lizard	*Ophisaurus ventralis*	0	0	0.2	0
Gila Monster	*Heloderma suspectum*	0	0	0.8	0
Argentine Black-and-white Tegu*	*Salvator merianae*	0.6	0	0.2	0
Nile Monitor.*	*Varanus niloticus*	2	0	0	0
TOTAL	**30 Species + 1 Group**	**1,761**	**518**	**241**	**4**

* Introduced Species ^Some introduced populations

[12] The MIS allowed the use other turtles and snakes and were not identified in the system and employees were no longer working for WS that knew what the species were.

The other category of reptiles includes venomous and nonvenomous snakes. Some species are invasive including the brown tree snake, boas and pythons. Invasive snakes can cause declines in native fauna which occurred on Guam where the brown tree snake caused the extirpation/extinction of 9 of 11 native forest birds and serious decline in many other native species (Hall 1996). Brown tree snakes are also a threat to human health and safety, cause power outages, and caused a loss of cultural lore (Hall 1996). The majority of other snakes are captured in and around residences where people are concerned including two northern Mexican gartersnakes, a recently listed threatened species, captured on roadways and moved to safe areas. Table 4b lists 37 species, 1 subspecies (a threatened species), and 1 group (snakes from Florida and Missouri[14]) that were controlled between FY11 and FY15. The most common species involved in WDM included primarily the brown tree snake, and to a much lesser extent western diamond-backed rattlesnake with an average annual total for all snakes of 21,536 taken lethally, 268 captured and freed or relocated, and 1 dispersed (Table 4b).

Table 4b. The annual average number of target snakes controlled by WS in WDM between FY11 and FY15.

SNAKE SPECIES				
Species	**Scientific Name**	**Killed**	**Freed**	**Dispersed**
Red-tailed Boa*	*Boa constrictor*	0	0.2	0
Brown Tree Snake*	*Boiga irregularis*	21,491	144	0
Sonoran Whipsnake	*Coluber bilineatus*	0	0.2	0
North American Racer	*Coluber constrictor*	0	0.4	0
Coachwhip	*Coluber flagellum*	0	1	0.2
Eastern Ratsnake	*Pantherophis alleghaniensis*	0	0.4	0
Red Cornsnake	*Pantherophis guttatus*	0	0.6	0
Western (*Black, Texas*) Ratsnake	*Pantherophis obsoletus*	0.4	8	0
Gray Ratsnake	*Pantherophis spiloides*	0	0.4	0
Eastern Foxsnake	*Pantherophis vulpinus*	0	0.8	0
Yellow-bellied (*Prairie*) Kingsnake	*Lampropeltis calligaster*	0	0.2	0
Eastern (*Common*) Kingsnake	*Lampropeltis getula*	2	0.6	0
Speckled Kingsnake	*Lampropeltis holbrooki*	0	0.2	0
Gophersnake	*Pituophis catenifer*	16	21	0.2
Plain-bellied Watersnake	*Nerodia erythrogaster*	0	0.4	0
Southern (Banded) Watersnake	*Nerodia fasciata*	0	1	0
Diamond-backed Watersnake	*Nerodia rhombifer*	0	0.4	0
Northern Watersnake	*Nerodia sipedon*	0.6	0.6	0
Dekay's Brownsnake	*Storeria dekayi*	0	0.2	0
Black-necked Gartersnake	*Thamnophis cyrtopsis*	0	1	0
Terrestrial Gartersnake	*Thamnophis elegans*	0.2	0.2	0
- North Mexican Gartersnake[T&E]	*- Thamnophis eques megalops*	0	0.4	0
Two-striped Gartersnake	*Thamnophis hammondii*	0.2	0	0
Plains Gartersanke	*Thamnophis radix*	6	0	0
Eastern Ribbonsnake	*Thamnophis sauritus*	0	0.4	0
Common Gartersnake	*Thamnophis sirtalis*	0.2	3	0
Eastern Hog-nosed Snake	*Heterodon platirhinos*	0	0.2	0
Unidentified Nonvenomous Snake	Order Squamata (48 poss.-17 max.).	0	3	0.6
Copperhead	*Agkistrodon contortrix*	0.8	0.2	0
Cottonmouth	*Agkistrodon piscivorus*	2	1	0
Eastern Diamondback Rattlesnake	*Crotalus adamanteus*	0	0.4	0
Western Diamondback Rattlesnake	*Crotalus atrox*	8	65	0
Black-tailed Rattlesnake	*Crotalus molossus*	0	4	0
Western Rattlesnake	*Crotalus oreganus*	0.4	0.2	0
Red Diamond Rattlesnake	*Crotalus ruber*	0	0.2	0
Mojave Rattlesnake	*Crotalus scutulatus*	0	7	0
Prairie Rattlesnake	*Crotalus viridis*	8	0.2	0.2
Indian (*Burmese*) Python*	*Python bivittatus*	0.4	0.2	0
Ball Python*	*Python regius*	0	0.4	0
TOTAL	**37 Spp.+ 1 Subsp. (+3.6 Spp. Unid.)**	**21,536**	**268**	**1**

* Introduced Species T&E –Threatened and endangered species (Federal only)

Methods used to take snakes lethally were acetaminophen baits (12,624), cage traps (7,592), hand capture (1,306), and firearms (10). It must be noted that detector dogs are used on Guam to find high risk snakes (e.g., in cargo) and this continues to decrease as areas are made snake-free, at least temporarily; between FY11 and FY15, an annual average of only 3 snakes were caught with detector dogs but these were in

material at ports where they would likely have been shipped to new areas. The few snakes that were freed were caught in cage traps (145) and by hand (123). Few snakes are dispersed, but sight repellents were used (1) showing the lack of dispersing them.

2.4 Amphibian Damage Management Programs

Amphibian damage management programs have always been a minor part of WS WDM until a Coqui Frog Program began on Hawaii where they are a human health and safety concern from noise (90-100 decibels). The coqui frog, an invasive species from Puerto Rico, can reach densities that exceed 8,000 frogs/acre in Hawaii (Beard et al. 2008). At high densities, the frogs can consume 280,000 prey items (arthropods) per acre per night and, thus, could compete with native species for food items (Beard 2007). It is possible for WS to become involved in additional projects involving introduced species such as the bullfrog which is responsible for the decline of many native species where it has been introduced; native of eastern U.S., but introduced nationwide. Most amphibians taken lethally are invasive species and are taken to protect the native ecosystems and its fauna, public and pet health and safety, and property. Most native species are not taken lethally.

The only category of amphibian involved in WDM projects were frogs and toads (Order Salientia). Invasive amphibians can cause the decline of native fauna, pose a threat to pets and children from toxins in their skin (marine toad), and cause noise problems for people in areas with dense populations. Table 5 lists 5 species that were controlled between FY11 and FY15. Many more amphibians are found in the USA and technical assistance was given for many of these, but WS did not take any additional species. The most common species involved in WDM included only the marine toad, with the total average annual take for all species of 62 taken lethally and 3 captured and relocated or freed (Table 5). Methods used to take frogs and toads lethally included hand capture (60) and firearms (2). Eggs were not taken. The few that were freed were caught by hand (4); some are caught indoors and relocated outside or native species are relocated from drying ponds. All marine toads taken were in dog kennels on Guam used for the detector dogs.

Table 5. The annual average number of target amphibians controlled by WS in WDM between FY11 and FY15 throughout the USA. No eggs or burrows were taken for amphibians.

AMPHIBIAN SPECIES			
Species	**Scientific Name**	**Killed**	**Freed**
American Toad	*Anaxyrus americanus*	0	0.2
Great Plains Toad	*Anaxyrus cognatus*	0	3
Southern Toad	*Anaxyrus terrestris*	0	0.2
Marine (Giant, Cane) Toad*	*Rhinella marina*	60	0
AmericanBullfrog**	*Lithobates catesbeianus*	2	0
TOTAL	**5 Species**	**62**	**3**

* Introduced Species ** All bullfrogs were taken in West where introduced. Native in eastern USA.

2.5 Fish Damage Management Programs

Fish damage management programs have always been a minor part of WS WDM until the Northern Pikeminnow Program began on the Columbia River between Oregon and Washington at dams to protect endangered salmonids in the early 1990s. It would be possible for WS to conduct additional projects to protect native species as introduced fish have been noted in the decline of many fish, amphibians, and other species. The majority of fish taken by WS is overabundant species that increased as a result of human disturbance, invasive species to protect native species, or are in ponds on airports where they attract wading birds and other piscivorous species. The majority of native, nonabundant fish are relocated (e.g., in pools drying out after floods). Table 6 lists 7 species and 1 group (3 possible species of sucker in Wyoming) that were controlled between FY11 and FY15. The most common fish species involved in WDM included the northern pikeminnow, bluegill, and goldfish and the annual average total (Table 6) taken

lethally was 49,028 and freed (56). Methods to take fish lethally included fishing poles (48,501), nets (502), cage traps (21) and firearms (3). The few that were freed were captured with nets (40), fishing poles (12), and hand capture (4).

Table 6. The annual average number of target fish controlled by WS in WDM between FY11 and FY15 throughout the USA.

FISH			
Species	**Scientific Name**	**Killed**	**Freed**
Goldfish*	*Carassius auratus*	112	0
Grass Carp*	*Ctenopharyngodon idella*	1	0
Common Carp*	*Cyprinus carpio*	24	0
Northern Pikeminnow**	*Ptychocheilus oregonensis*	48,501	12
Unidentified Suckers	*Catostomus* spp. (3 possible)	40	0
Brown Trout*	*Salmo trutta*	0	40
Striped (*Flathead*) Mullet	*Mugil cephalus*	0	4
Bluegill	*Lepomis macrochirus*	350	0
TOTAL	**7 Species + 1 Species Group**	**49,028**	**56**

* Introduced Species ** Overabundant native species from habitat changes

2.6 Disease Management Programs

Wildlife may serve as reservoirs for disease and parasites. Diseased animals living near areas of human activity may transmit those diseases to livestock, people, or pets. These diseases may transfer to people directly through physical contact or may be transmitted to people via environmental contamination by feces and even tainted food products such as fresh produce or meat products. Between FY11 and FY15, WS collected an annual average of 13,408 mammal, 4,515 bird, and 6 other (reptile, fish, and invertebrate) disease samples in 7,473 work tasks to determine the presence of a wide variety of diseases.

Mammals are a source of many diseases associated with people and livestock. Feral swine are potential reservoirs for approximately 30 viral and bacterial diseases (Davidson and Nettles 1997, Samuel et al. 2001, Williams and Barker 2001) and 37 parasites (Forrester 1991) that are transmissible to people. Brucellosis, salmonellosis, toxoplasmosis, trichinosis, tuberculosis, and tularemia are some of the "zoonotic diseases" (i.e., diseases that could be transmitted to people from animals) that can be carried by feral swine (Hubalek et al. 2002, Seward et al. 2004, Stevens 2010), but actual transmission of diseases to people is thought to be rare (Amass 1998). However, over 200 people in the USA became ill with three deaths were reported after people ate spinach leaves that were contaminated with E. coli that was identified as originating from feral swine feces deposited in California spinach fields (U.S. Food and Drug Administration 2007, Rouhe and Sytsma 2007).

Other species of mammals, such as predators and bats can transmit diseases to people and livestock. Transmittable diseases include the rabies virus (bats, raccoons, skunks, foxes, coyotes); leptospirosis (canines, raccoons, opossums); *Neospora caninum* (feral dogs, coyotes, and fox); and *Toxoplasma gondii* (domestic cats) (Adler et al. 2010, Centers for Disease Control 2011, McAllister 2014). Where outbreaks occur, WS could establish a disease management program. These are mostly conducted with other federal and state agencies.

Feral pigeons and starlings have been suspected in the transmission of 29 different diseases to humans, (Davis et al. 1971, Weber 1979). 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).

2.7 Insect and Insect Vector Management Programs

Insect management programs are a minor part of WS WDM. The first is prey-base management at airfields. Insects can attract wildlife hazardous at airfields. By controlling insects around an airfield, wildlife strikes have been reduced at some facilities. Another program has been to reduce the transmission of plague in prairie dog towns by controlling fleas. Plague is a disease that affects humans and other mammals caused by the bacterium, *Yersinia pestis*. Burrowing rodents are a reservoir for the disease and the primary host species. Humans usually get plague after being bitten by a rodent flea that is carrying the plague bacterium or by handling an animal infected with plague. WS is conducting plague management for the protection of the black-footed ferret (*Mustela nigripes*).

Between FY11 and FY15, WS conducted a light trap monitoring and caught an average of 8 insects during the program giving an indication of the relative need for a spraying program. Plague management was much more active for the protection of black-footed ferrets. WS treated an annual average of 3,686 acres to minimize the chance of an outbreak.

3 RISKS TO NONTARGET SPECIES

A risk of using WDM methods is the take of nontarget species which is a concern among professional wildlife biologists and the public. Most nontarget species taken by WDM methods typically have something in common with the target species such as weight, diet, or habitat use. The higher the similarities between target and nontarget species, the higher the potential of being affected by the use of WDM methods used. Most methods used by WS have the potential for taking nontarget species. WS tracks the number of nontarget species with each method. However, it is not always possible to tell whether a method such as fencing or propane cannons caused inadvertent problems to nontarget species. Some methods have higher risks than others, despite being among the more effective tools to resolve a problem. Finally it should be noted that several species are targeted on a property and taken with an unanticipated method (e.g., a crow in a raptor trap at an airport), not targeted at the time of the take, or the targeted individual animal was not taken but the right species was (e.g., smaller mountain lion than being targeted); these are unintentional targets. However, these are included in the nontarget category since it is relatively a small number. Take of

nontarget species, as with target species, is considered carefully in determining the risk of the specific method and risk to the species population. If it is a target species as well, the combined take is considered.

Between FY11 and FY15, WS unintentionally took 258 different species lethally and nonlethally. During this time, WS lethally took 2,946 nontarget species with 21 different methods, freed 8,438 nontarget species taken with 11 methods, and accidentally dispersed 28 nontarget species with 2 methods in carrying out WDM activities. This represents only 0.1% of the lethal take, but 43% of the animals freed or relocated; the nontarget species hazed was less than 0.01% of the total or inconsequential. The most common methods for nontarget species lethal take, those with more than 100 animals taken, included body grip traps (925), neck snares (786), foothold traps (524), M-44s (sodium cyanide) (362), and DRC-1339 (245). Those taken, but freed where more than 100 were taken included fishing devices (4,636), cage traps (2,866), body grip traps (534), foothold traps (258), and neck snares (113).

3.1 Nontarget Mammals

Nontarget mammals could be taken by a variety of methods and in several WDM programs. Between FY11 and FY15, WS took 82 known mammalian species, 3 subspecies, and an unknown species (it was either a domestic cow or dog). An annual average of 2,283 nontarget mammals were taken lethally and 2,669 taken nonlethally. These numbers represent 0.4% of the combined target and nontarget lethal mammal take and 20% of the combined target and nontarget nonlethal take. This is a minimal percentage of nontarget take.
Most nontarget predators, hoofed mammals, and other mammals, between FY11 and FY15 were taken during PDM activities (Table 7a). For example, raccoons, feral/free-roaming dogs, and striped skunks are often typical nontarget predators taken when trapping coyotes due to similar weights which can trigger capture devices). Coyotes, bears, and lions are common nontargets when trapping wolves (Table 7a). A few species are taken, primarily those that are aquatic such as otters, raccoons, and mink, while conducting ARDM, primarily beaver damage management. Finally, a few can be taken when trying to control a specific predator, especially with the smaller foothold traps or cage traps. Three T&E species were taken between FY11 and FY15 as nontarget species, the Mexican wolf (1 lethal take in 5 years), the Great Plains wolf (1 nonlethal in 5 years), and grizzly bears (2 freed in 5 years-often these are transferred to USFWS personnel to sample, mark with an ear tag or tattoo, and free).

Between FY11 and FY15, WS lethally took an annual average of 1,933 individuals from predator, hoofed mammal, and other mammal categories and freed an average of 2,285 of 41 species and 3 subspecies. Common capture methods that resulted in lethal take of predators included body grip traps (479), foothold traps (433), M-44s (354), neck snares (306), cage traps (28), and foot snares (1). Methods used where predators were ultimately released included cage traps (1,933), foothold traps (209), neck snares (45), body grip traps (12), and foot snares (6).

Most nontarget hoofed mammals are taken during PDM and FSDM activities, and numbers are typically minimal. The most common nontarget hoofed animals taken are peccaries, white-tailed deer, feral swine, and mule deer; just a few of the remaining species are taken and typically sporadically (Table 7a). Most hoofed mammals are not held by foothold traps in PDM, but neck snares can be a problem, especially when they do not have a break-away device attached. No T&E species were taken. In all, 13 species and an unknown domestic animal[13] were taken as nontarget species between FY11 and FY15. WS lethally took an annual average of 317 nontarget hoofed animals and freed an average of 71 between FY11 and FY15 (Table

[13] WS personnel could put domestic animal in the MIS and since employee was no longer employed by WS, was unable to document what domestic animal was taken, but was most likely a cow in WV.

7a). Most nontarget hoofed animals were taken with neck snares (298), foothold traps (9), M-44 (5), and cage traps (3). Nonlethal take involved neck snares (28), cage traps (22), foothold traps (18), and foot snares (2). Thus, nontarget take was minimal for these species.

Table 7a. The annual average number of nontarget predators, hoofed mammals, and the "other mammal" category from Section 2.1 above taken by WS in WDM between FY11 and FY15 throughout the USA.

Species	Scientific Name	Killed	Freed
NONTARGET PREDATORS			
Virginia Opossum	*Didelphis virginianus*	79	1,524
Feral/Free-roaming Cat*	*Felis catus*	11	218
Bobcat	*Lynx rufus*	24	36
Mountain Lion	*Puma concolor*	4	2
Coyote	*Canis latrans*	40	14
NorthwesternGray Wolf	*Canis lupus occidentalis*	1	0.6
- Mexican Gray Wolf[T&E]	*Canis lupus baileyi*	0.2	0.8
- Great Plains Wolf[T&E]	*Canis lupus nubilis*	0	0.2
- Feral/Free-Roaming Dog*	*Canis lupus familiaris*	51	59
Red Fox	*Vulpes vulpes*	77	17
Swift Fox	*Vulpes velox*	22	0.2
Kit Fox	*Vulpes macrotis*	13	1
Common Gray Fox	*Urocyon cinereoargenteus*	110	96
Black Bear	*Ursus americanus*	8	23
Grizzly Bear[T&E]	*Ursus arctos horiiibilis*	0	0.4
River Otter	*Lontra canadensis*	407	16
Fisher	*Martes pennanti*	0.6	6
Pine Marten	*Martes americana*	0	1
Least Weasel	*Mustela nivalis*	0	0.2
Long-tailed Weasel	*Mustela frenata*	0.2	0.6
Short-tailed Weasel	*Mustela erminea*	0.2	0.4
Mink	*Mustela vison*	3	6
Badger	*Taxidea taxus*	107	25
Ringtail	*Bassariscus astutus*	2	0.2
Raccoon	*Procyon lotor*	506	142
Hog-nosed Skunk	*Conepatus mesoleucus*	5	0
Hooded Skunk	*Mephitis macroura*	0.2	0.2
Striped Skunk	*Mephitis mephitis*	126	14
Western Spotted Skunk	*Spilogale gracilis*	1	0
TOTAL	**26 Species + 3 Subspecies**	**1,598**	**2,204**
NONTARGET HOOFED MAMMALS			
Feral Swine*	*Sus scrofa*	19	1
Collared Peccary (Javelina)	*Pecari tajacu*	183	21
White-tailed Deer	*Odocoileus virginianus*	86#	27
Mule Deer	*Odocoileus hemionus*	18	10
Moose	*Alces alces*	0.2	0
American Elk (captive)*	*Cervus canadensis*	0	0.2
Sika Deer*	*Cervus nippon*	3	2
Axis Deer*	*Axis axis*	0.4	0.2
Pronghorn (American Antelope)	*Antilocapra americans*	3	5
Blackbuck*	*Antilope cervicapra*	0.2	0
Domestic Goat*	*Capra aegagrus*	0.8	0.2
Domestic/Feral Sheep*	*Ovis aries*	2	2
Domestic Cattle*	*Bos primigenius*	1	2
Unidentified Pet/Livestock**	Domestic Animals	0	0.2
TOTAL	**13 Spp. + 1 Unknown Dom. Animal**	**317**	**71**
NONTARGET OTHER MAMMALS			
Nine-banded Armadillo	*Dasypus novemcinctus*	17	10
Northern Short-tailed Shrew	*Blarina brevicauda*	1	0
TOTAL	**2 Species**	**18**	**10**

* Introduced Species ** MIS allowed code # 0.8 captive deer T&E –Threatened and endangered species (Federal only)

Nine-banded armadillos and northern short-tailed shrews were the only species taken from the "other mammals" category (Table 7a). These were lethally taken with neck snares (13), body grip traps (3), and cage traps (1), and nonlethally taken with neck snares (6) and cage traps (4).

Most of the three nontarget aquatic rodents taken in WDM by WS are while conducting ARDM. The only species commonly taken as a nontarget is the muskrat. Between FY11 and FY15, WS took 148 nontarget aquatic rodents lethally and 34 that were freed with muskrats representing 92% of this take (Table 7b). Lethal take of nontarget aquatic rodents were from body-grip traps (132), foothold traps (13), neck snares (2), and cage traps (1). Nonlethal take included cage traps (33) and foothold traps (1). More are taken lethally than nonlethally because the sets are often lethal when activated, especially body-grip traps.

Table 7b. The annual average number of nontarget aquatic rodents, and terrestrial rodents and rabbits taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET AQUATIC RODENTS			
Species	**Scientific Name**	**Killed**	**Freed**
Beaver	*Castor canadensis*	0.8	1
Nutria*	*Myocastor coypus*	13	0
Muskrat	*Ondatra zibethicus*	134	33
TOTAL	**3 Species**	**148**	**34**
NONTARGET TERRESTRIAL RODENTS AND RABBITS			
Species	**Scientific Name**	**Killed**	**Freed**
Abert's Squirrel	*Sciurus aberti*	0	1
Western Gray Squirrel	*Sciurus griseus*	0	2
Eastern Gray Squirrel	*Sciurus carolinensis*	4	44
Eastern Fox Squirrel	*Sciurus niger*	0.8	19
Red Squirrel	*Tamiasciurus hudsonicus*	0.2	12
Woodchuck	*Marmota monax*	4	84
Yellow-bellied Marmot	*Marmota flaviventris*	0.6	0
California Ground Squirrel	*Otospermophilus beecheyi*	1	21
Rock Squirrel	*Otospermophilus variegatus*	0	5
Arctic Ground Squirrel	*Urocitellus parryii*	0.2	0
Thirteen-lined Ground Squirrel	*Ictidomys tridecemlineatus*	0	0.2
Golden-mantled Ground Squirrel	*Callospermophilus lateralis*	0	0.2
Eastern Chipmunk	*Tamias striatus*	1	4
Least Chipmunk	*Neotamias minimus*	0	0.2
Ord's Kangaroo Rat	*Dipodomys ordii*	0.2	0
Nearctic Brown Lemming	*Lemmus trimucronatus*	0.2	0
Meadow Vole	*Microtus pennsylvanicus*	1	0
Woodland (*Pine*) Vole	*Microtus pinetorum*	0	0.8
Eastern Woodrat	*Neotoma floridana*	0	1
White-toothed Woodrat	*Neotoma leucodon*	0.2	0
Bushy-tailed Woodrat	*Neotoma cinerea*	0.2	0.2
Cotton Deermouse	*Peromyscus gossypinus*	0.8	0
White-footed Deermouse	*Peromyscus leucopus*	0.8	0
Marsh Rice Rat	*Oryzomys palustris*	0.2	0
Brown (*Norway*) Rat*	*Rattus norvegicus*	2	3
Black (*Roof*) Rat*	*Rattus rattus*	0	0.2
North American Porcupine	*Erethizon dorsatum*	126	26
Eastern Cottontail	*Sylvilagus floridanus*	19	81
Mountain Cottontail	*Sylvilagus nuttallii*	1	0.6
New England Cottontail	*Sylvilagus transitionalis*	0	0.4
Appalachian Cottontail	*Sylvilagus obscurus*	0	5
Desert Cottontail	*Sylvilagus audubonii*	3	33
Swamp Rabbit	*Sylvilagus transitionalis*	0.4	0
Feral Domestic European Rabbit*	*Oryctolagus cuniculus*	1	0
Snowshoe Hare	*Lepus americanus*	0.2	5
White-tailed Jackrabbit	*Lepus townsendii*	3	0
Black-tailed Jackrabbit	*Lepus californicus*	31	2
European Hare*	*Lepus europaeus*	0	0.2
TOTAL	**38 Species**	**202**	**351**

* Introduced Species

Terrestrial rodents and rabbits can be taken during many of the WS WDM activities, but mostly while conducting PDM including cage trapping urban nuisance animals such as opossums, skunks, and raccoons in houses and while trapping and testing animals in cage traps for disease and during brown tree snake damage management. The most common species taken are porcupines, cottontails, and jackrabbits in PDM, gray, fox, and red squirrels in urban nuisance animal programs, woodchucks in trapping predators for disease sampling (rabies management), and Norway rats in brown tree snake damage management

(Table 7b). Numbers of terrestrial rodents and rabbits taken are usually minimal because most are not large enough to activate traps. No T&E species were taken among these, even though several listed T&E subspecies are among the groups listed (e.g., the Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*) is listed endangered and is a subspecies of cotton mouse, but the ones taken were not of this subspecies). In all, 38 were taken as nontarget species between FY11 and FY15 (Table 7c). WS lethally took an annual average of 202 nontarget terrestrial rodents and rabbits and freed an average of 351 between FY11 and FY15 (Table 7b). Methods that lethally took nontarget terrestrial rodents and rabbits were neck snares (148), foothold traps (39), body grip traps (8), cage traps (7), and chlorophacinone (1). Nonlethal nontarget take included cage traps (324), neck snares (20), and foothold traps (7). Thus, nontarget take was minimal and most were taken in traps that enabled their release.

3.2 Nontarget Birds

Nontarget birds are taken by several WDM methods in several WDM programs. These species and their populations are considered Between FY11 and FY15, WS took a total of 142 known species with an annual average of 365 nontarget birds lethally taken and 529 nonlethally. These numbers represent 0.01% of the combined target and nontarget avian lethal take and 6.0% of the nonlethal take. Nontarget birds in this group were taken lethally with DRC-1339 (245), cage traps (21), alpha chloralose (6), foothold traps (4), body grip traps (3), and M-44s (2) (Table 8a). Of the nonlethal take for these species, methods included cage traps (181), foothold traps (3), and cannon nets (2). This is a minor percentage of nontarget take. It should be noted that at least 50% of the nontarget lethal take was actually target species taken with a method that was not targeting them specifically.

Most nontarget blackbirds, corvids, pigeons and doves, and woodpeckers are taken when conducting BDM for birds to protect livestock and feed, and in cage and other live traps set for other species (Table 8a). The greatest nontarget take, is the unintentional target take of corvids, feral pigeons, and cowbirds at feedlots with DRC-1339 treatments. Though these species taken are listed on some DRC-1339 labels and may be targeted at a particular site, they may not be on the label used at a site, and therefore they are not targeted and are unintentional take. Some species, especially the corvids, may also be taken in other traps, such as pole traps at airports, where they are unintentionally taken with that method, but are targeted. No T&E were taken in this group of nontarget birds between FY11 and FY15.

The most common nontarget species taken between FY11 and FY15 were Rock Pigeons, American Crows, Mourning Doves, White-winged Doves, and Brown-headed Cowbirds (Table 8a). In all, WS lethally took an annual average of 282 of 14 species of blackbirds, corvids, pigeons and doves, and woodpeckers and freed an average of 186 of 20 species from these 4 groups (Table 8a). The methods that took them lethally were treatments with DRC-1339 (245), traps (28), alpha-chloralose (6), sodium cyanide (2), and paint balls (1), and nonlethally with traps (184) and nets (2).

Most nontarget raptors, gallinaceous birds, and aerialists are taken during BDM activities at airports and a few raptors and gallinaceous birds in PDM activities. The most common nontarget birds in these groups were Wild Turkeys, Turkey Vultures, and Tree Swallows; just a few of the remaining species are taken and typically only sporadically (Table 8b). Nontarget species were lethally taken in a variety of cage traps (18), and neck snares (11), and with sodium cyanide (1) between FY11 and FY15 while traps (52) and neck snares (1) captured them nonlethally. No T&E species were taken, but Bald (1) and Golden Eagles (2), and Peregrine Falcons (2) were taken. In all, 24 species from these 3 groups were taken as nontargets between FY11 and FY15. WS lethally took an annual average of 30 involving 14 species, freed an average of 52 of 22

species, and dispersed an average of 0.2 Cooper's Hawks between FY11 and FY15 (Table 8b). Thus, nontarget take was minimal.

Table 8a. The annual average number of nontarget blackbirds, corvids, pigeons and doves, and woodpeckers taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET BLACKBIRDS			
Species	**Scientific Name**	**Killed**	**Freed**
European Starling*	*Sturnus vulgaris*	7	1
Red-winged Blackbird	*Agelaius phoeniceus*	3	3
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	0	2
Common Grackle	*Quiscalus quiscula*	2	10
Great-tailed Grackle	*Quiscalus mexicanus*	6	0
Brown-headed Cowbird	*Molothrus ater*	12	0.4
TOTAL	**6 Species**	**30**	**16**
NONTARGET CORVIDS			
Species	**Scientific Name**	**Killed**	**Freed**
Steller's Jay	*Cyanocitta stelleri*	0	0.8
Blue Jay	*Cyanocitta cristata*	0.4	26
California Scrub-Jay	*Aphelocoma californica*	0	6
Black-billed Magpie	*Pica hudsonia*	0.4	4
American Crow	*Corvus brachyrhynchos*	84	2
Northwestern Crow	*Corvus caurinus*	0.2	0
Common Raven	*Corvus corax*	4	1
TOTAL	**7 Species**	**89**	**40**
NONTARGET PIGEONS AND DOVES			
Species	**Scientific Name**	**Killed**	**Freed**
Rock Pigeon*	*Columba livia*	154	0.2
Eurasian Collared-Dove*	*Streptopelia decaocto*	0.6	13
Inca Dove	*Columbina inca*	0	0.8
Common Ground Dove	*Columbina passerina*	0	2
Mourning Dove	*Zenaida macroura*	5	84
White-winged Dove	*Zenaida asiatica*	3	28
TOTAL	**6 Species**	**163**	**128**
NONTARGET WOODPECKERS			
Species	**Scientific Name**	**Killed**	**Freed**
Red-headed Woodpecker	*Melanerpes erythrocephalus*	0	0.2
Downy Woodpecker	*Picoides pubescens*	0	0.2
Northern Flicker	*Colaptes auratus*	0	0.2
TOTAL	**3 Species**	**0**	**0.6**

* Introduced Species

Most nontarget larids, wading birds, and shorebirds are taken in cage and other live traps set for other species or in ARDM (wading birds) in foothold traps or in BDM at airports. However, few of these species are taken lethally or nonlethally with only the Great Blue Heron averaging more than two annually between FY11 and FY15 (Table 8c). In all between FY11 and FY15, WS took an annual average of 18 nontarget larid, wading bird, and shorebird species with lethal take involving traps (7), firearms (1), and overhead wire-grids (1) and nonlethal take in traps (3) (Table 8c). No T&E species was taken between FY11 and FY15, but sometimes some are accidentally dispersed at airports while hazing other birds (this is typically considered a beneficial effect since the birds would not be struck by aircraft). However, nontarget take was minimal for these species.

Table 8b. The annual average number of nontarget raptors, gallinaceous birds, and aerialists taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET RAPTORS			
Species	**Scientific Name**	**Killed**	**Freed (Dispersed)**
Black Vulture	*Coragyps atratus*	4	1
Turkey Vulture	*Cathartes aura*	5	8
Western Osprey	*Pandion haliaetus*	0	0.2
Sharp-shinned Hawk	*Accipiter striatus*	0	2
Cooper's Hawk	*Accipiter cooperii*	1	5 (0.2)
Northern Harrier	*Circus hudsonius*	0	0.2
Bald Eagle	*Haliaeetus leucocephalus*	1	0.8
Red-tailed Hawk	*Buteo jamaicensis*	0.4	1
Golden Eagle	*Aquila chrysaetos*	2	0
Barn Owl^	*Tyto alba*	0	0.2
Eastern Screech-Owl	*Megascops asio*	0	0.2
Great Horned Owl	*Bubo virginianus*	0.4	0.8
Burrowing Owl	*Athene cunicularia*	0.2	0.8
Crested Caracara	*Caracara cheriway*	0.4	0.2
American Kestrel	*Falco sparverius*	0.8	6
Merlin	*Falco columbarius*	0	0.2
Peregrine Falcon	*Falco peregrinus*	0.2	2
TOTAL	**17 Species**	**15**	**29 (0.2)**
NONTARGET GALLINACEOUS BIRDS			
Species	**Scientific Name**	**Killed**	**Freed**
Northern Bobwhite	*Colinus virginianus*	0	1
Ruffed Grouse	*Bonasa umbellus*	0	2
Wild Turkey	*Meleagris gallopavo*	12	6
Ring-necked Pheasant*	*Phasianus colchicus*	0.4	0
Feral Domestic Chicken*	*Gallus gallus domesticus*	0	0.6
TOTAL	**5 Species**	**12**	**10**
NONTARGET AERIALISTS			
Species	**Scientific Name**	**Killed**	**Freed**
Purple Martin	*Progne subis*	0	1
Tree Swallow	*Tachycineta bicolor*	3	12
TOTAL	**2 Species**	**3**	**13**

* Introduced Species

Table 8c. The annual average number of nontarget larids (gulls/terns), wading birds, and shorebirds taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET LARIDS			
Species	**Scientific Name**	**Killed**	**Freed**
Pomarine Jaeger	*Stercorarius pomarinus*	0	0.2
Laughing Gull	*Leucophaeus atricilla*	0	0.2
Mew Gull	*Larus canus*	0.2	0
Glaucous-winged Gull	*Larus glaucescens*	0.4	0
Herring Gull	*Larus argentatus*	1	0.8
Caspian Tern	*Hydroprogne caspia*	0.2	0
Royal Tern	*Thalasseus maximus*	0.2	0
TOTAL	**7 Species**	**2**	**1**
NONTARGET WADING BIRDS			
Species	**Scientific Name**	**Killed**	**Freed**
American Bittern	*Botaurus lentiginosus*	0.4	0.2
Black-crowned Night-Heron	*Nycticorax nycticorax*	0	0.6
Great Blue Heron	*Ardea herodias*	4	0.8
Great Egret	*Ardea alba*	0.2	0
Snowy Egret	*Egretta thula*	0.2	0
Virginia Rail	*Rallus limicola*	0.2	0
Common Gallinule	*Gallinula galeata*	0.4	0.2
American Coot	*Fulica americana*	0.8	0
Sandhill Crane	*Grus canadensis*	0.6	0
TOTAL	**9 Species**	**7**	**2**
NONTARGET SHOREBIRDS			
Species	**Species**	**Killed**	**Freed**
Pacific Golden-Plover	*Pluvialis fulva*	0	0.2
Lesser Yellowlegs	*Tringa flavipes*	0.2	0
TOTAL	**2 Species**	**0.2**	**0.2**

Most nontarget larids, wading birds, and shorebirds are taken in cage and other live traps set for other species or in ARDM (wading birds) in foothold traps or in BDM at airports. However, few of these species are taken lethally or nonlethally with only the Great Blue Heron averaging more than two annually between FY11 and FY15 (Table 8c). In all between FY11 and FY15, WS took an annual average of 18 nontarget larid, wading bird, and shorebird species with lethal take involving traps (7), firearms (1), and overhead wire-grids (1) and nonlethal take in traps (3) (Table 8c). No T&E species was taken between FY11 and FY15, but sometimes some are accidentally dispersed at airports while hazing other birds (this is typically considered a beneficial effect since the birds would not be struck by aircraft). However, nontarget take was minimal for these species.

Most nontarget waterfowl and waterbirds are taken during ARDM and BDM activities, primarily for other waterfowl. The most common nontarget birds in these groups taken lethally or nonlethally in an average year were Mallards, Black-bellied Whistling-Ducks, and Canada Geese; just a few of the remaining species are taken and typically only sporadically. WS lethally took an annual average of 33 species from these groups, and freed an average of 40 between FY11 and FY15 (Table 8d). Most nontargets between FY11 and FY15 (Table 8d) were taken lethally in traps (26), with A-C (5) and firearms (2 – very similar species), and neck snares (1). Nonlethal take was limited mostly to A-C (24), traps (16), and neck snares (1). No T&E species was captured or freed between FY11 and FY15. In all, 26 species from these 2 groups were taken as nontargets between FY11 and FY15 (Table 8d). Thus, nontarget take was minimal.

Table 8d. The annual average number of nontarget waterfowl and waterbirds taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET WATERFOWL			
Species	**Scientific Name**	**Killed**	**Freed**
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	2	8
Greater White-fronted Goose	*Anser albifrons*	1	0.2
Ross's Goose	*Chen rossii*	0	0.2
Canada Goose	*Branta canadensis*	6	2
Trumpeter Swan	*Cygnus buccinator*	0.2	0
Wood Duck	*Aix sponsa*	2	2
Gadwall	*Anas strepera*	0.4	0
American Wigeon	*Anas americana*	0	5
American Black Duck	*Anas rubripes*	3	0.4
Mallard	*Anas platyrhynchos*	12	18
- Feral Duck*	*Anas platyrhynchos*	0.2	2
Blue-winged Teal	*Anas discors*	0	0.2
Northern Pintail	*Anas acuta*	0.2	0
Green-winged Teal	*Anas crecca*	0.4	0
Redhead	*Aythya americana*	0	1
Common Eider	*Somateria mollissima*	0.2	0
Long-tailed Duck	*Clangula hyemalis*	0.2	0
Hooded Merganser	*Lophodytes cucullatus*	2	0
Common Merganser	*Mergus merganser*	0.4	0
Red-breasted Merganser	*Mergus serrator*	0.2	0
Ruddy Duck	*Oxyura jamaicensis*	0	0.4
TOTAL	**20 Species + 1 Domestic Subsp.**	**30**	**39**
NONTARGET WATERBIRDS			
Species	**Scientific Name**	**Killed**	**Freed**
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	0.4	0
Pied-billed Grebe	*Podilymbus podiceps*	1	0
Brown Pelican	*Pelecanus occidentalis*	0.2	0
Brandt's Cormorant	*Phalacrocorax penicillatus*	1	0
Double-crested Cormorant	*Phalacrocorax auritus*	0.6	0
Ancient Murrelet	*Synthliboramphus antiquus*	0	0.6
TOTAL	**6 Species**	**3**	**0.6**

* Introduced species

The last group are nontarget other passerines and invasive passerines with most all taken in BDM for other species at airports. The take of these species is minimal with an annual average of 11 taken lethally, 250

taken nonlethally, and 28 dispersed; 17 species were taken lethally, 34 species and unidentified birds taken nonlethally, and 2 birds accidentally dispersed between FY11 and FY15 (Table 8e). The most common species included Dark-eyed Juncos, Savannah Sparrows, and Northern Mockingbirds. Between FY11 and FY15 (Table 8e), WS lethally took an annual average of 11 with traps and 1 from mist nets, freed an average of 250 from traps, and dispersed 28 with pyrotechnics. No T&E species were taken.

Table 8e. The annual average number of nontarget grassland, forest, and invasive passerines and unidentified birds taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET GRASSLAND PASSERINE GROUPS			
Species	**Scientific Name**	**Killed**	**Freed (Dispersed)**
Eastern Phoebe	*Sayornis phoebe*	0.2	0
Say's Phoebe	*Sayornis saya*	0.4	0
Western Kingbird	*Tyrannus verticalis*	0.2	21
Great Crested Flycatcher	*Myiarchus crinitus*	0	0.2
Loggerhead Shrike	*Lanius ludovicianus*	0.2	0.4
Horned Lark	*Eremophila alpestris*	0	0 (8)
Snow Bunting	*Plectrophenax nivalis*	0	0 (20)
Eastern Towhee	*Pipilo erythrophthalmus*	0.2	0.2
California Towhee	*Melozone crissalis*	0.4	0.4
Chipping Sparrow	*Spizella passerina*	0	0.4
Field Sparrow	*Spizella pusilla*	0	0.2
Savannah Sparrow	*Passerculus sandwichensis*	1	41
Grasshopper Sparrow	*Ammodramus savannarum*	0	2
Song Sparrow	*Melospiza melodia*	0	9
White-crowned Sparrow	*Zonotrichia leucophrys*	0	0.6
White-throated Sparrow	*Zonotrichia albicollis*	0	0.4
Dark-eyed Junco	*Junco hyemalis*	0	91
Eastern Meadowlark	*Sturnella magna*	1	0.8
Western Meadowlark^	*Sturnella neglecta*	0.4	0
Baltimore Oriole	*Icterus galbula*	0.4	0
Hooded Oriole	*Icterus cucullatus*	0	0.2
TOTAL	**21 Species**	**4**	**168 (28)**
NONTARGET FOREST AND RIPARIAN PASSERINE GROUPS			
Species	**Scientific Name**	**Killed**	**Freed**
Tufted Titmouse	*Baeolophus bicolor*	0	0.2
Carolina Chickadee	*Poecile carolinensis*	0.4	0
Cactus Wren	*Campylorhynchus brunneicapillus*	0	0.4
House Wren	*Troglodytes aedon*	0	0.2
White-breasted Nuthatch	*Sitta carolinensis*	0	0.2
Gray Catbird	*Dumetella carolinensis*	0.4	3
Northern Mockingbird^	*Mimus polyglottos*	2	27
Brown Thrasher	*Toxostoma rufum*	0	0.8
Curve-billed Thrasher	*Toxostoma curvirostre*	0	0.2
Eastern Bluebird	*Sialia sialis*	1	20
Wood Thrush	*Hylocichla mustelina*	0	0.2
American Robin	*Turdus migratorius*	0.6	6
American Dipper	*Cinclus mexicanus*	0.2	0
Purple Finch	*Haemorhous purpureus*	0	7
House Finch^	*Haemorhous mexicanus*	0	10
Ovenbird	*Seiurus aurocapilla*	0	0.2
Palm Warbler	*Setophaga palmarum*	0	0.2
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	0	2
Black-headed Grosbeak	*Pheucticus melanocephalus*	0	0.8
Northern Cardinal^	*Cardinalis cardinalis*	0.2	2
TOTAL	**20 Species**	**5**	**80**
NONTARGET INVASIVE PASSERINES AND UNIDENTIFIED BIRDS			
Species	**Scientific Name**	**Killed**	**Freed**
House Sparrow	*Passer domesticus*	2	0.8
Unidentifiable Birds	N/A	0	1
TOTAL	**1 Species + 1 Unidentified Birds**	**2**	**2**

^ Introduced on HI.

3.3 Nontarget Reptiles, Amphibians, and Fish

Nontarget reptiles, amphibians, and fish were taken with a few WDM methods in few WDM programs. Nontarget reptiles were primarily from ARDM (alligators and aquatic turtles), rabies management (terrestrial turtles and snakes), and brown tree snake damage management (mangrove monitors).

Table 9. The annual average number of nontarget reptiles, amphibians, and fish taken by WS in WDM between FY11 and FY15 throughout the USA.

NONTARGET REPTILES			
Species	**Scientific Name**	**Killed**	**Freed**
American Alligator	*Alligator mississippiensis*	7	10
Gopher Tortoise	*Gopherus polyphemus*	0	0.4
Eastern Box Turtle	*Terrapene carolina*	0	21
Florida Box Turtle	*Terrapene bauri*	0	1
Pond (*Yellow-bellied*) Slider^	*Trachemys scripta*	23	30
Northern Painted Turtle	*Chrysemys picta*	8	19
Southern Painted Turtle	*Chrysemys dorsalis*	0.8	2
False Map Turtle	*Graptemys pseudogeographica*	0.2	0.6
River Cooter	*Pseudemys concinna*	0.6	0.2
Texas Cooter	*Pseudemys texana*	1	0
Common Snapping Turtle^	*Chelydra serpentina*	236	481
Alligator Snapping Turtle	*Macrochelys temminckii*	0	0.8
Common Musk Turtle (*Stinkpot*)	*Sternotherus odoratus*	0.2	2
Smooth Softshell	*Apalone mutica*	0.2	0
Spiny Softshell	*Apalone spinifera*	3	0
Unidentified Turtle (4 spp. possible SC)	*N/A*	2	5
Mangrove Monitor	*Varanus indicus*	0	15
Southern (*Banded*) Watersnake	*Nerodia fasciata*	0	0.2
Common Gartersnake	*Thamnophis sirtalis*	0.2	0
Cottonmouth	*Agkistrodon piscivorus*	1	0
Western Diamondback Rattlesnake	*Crotalus atrox*	0	0.2
TOTAL	**20 Species (1 Group, but no new sp.)**	**283**	**588**
NONTARGET AMPHIBIANS			
Species	**Scientific Name**	**Killed**	**Freed**
American Bullfrog	*Lithobates catesbeianus*	0.2	0.6
TOTAL	**1 Species**	**0.2**	**0.6**
NONTARGET FISHES			
Species	**Scientific Name**	**Killed**	**Freed**
Bowfin	*Amia calva*	0	1
Chiselmouth**	*Acrocheilus alutaceus*	0	927
Common Carp* **#	*Cyprinus carpio*	3	111
Peamouth**	*Mylocheilus caurinus*	0	927
Redside Shiner**	*Richardsonius balteatus*	0	232
White Sucker	*Catostomus commersonii*	0.2	0
Largescale Sucker**	*Catostomus macrocheilus*	0	185
Mountain Sucker**	*Catostomus platyrhynchus*	0	5
Black Bullhead	*Ameiurus melas*	0.2	0
Yellow Bullhead	*Ameiurus natalis*	0.2	0
Brown Bullhead	*Ameiurus nebulosus*	0.2	0
Channel Catfish	*Ictalurus punctatus*	0.4	11
Rainbow Trout (Steelhead)^**	*Oncorhynchus mykiss*	0	325
- Steelhead[T&E]	*Oncorhynchus mykiss*	0	325
Sockeye (Red) Salmon **	*Oncorhynchus nerka*	0	148
Chinook (King) Salmon**	*Oncorhynchus tshawytscha*	0	417
Mountain Whitefish**	*Prosopium williamsoni*	0	232
Prickly Sculpin**	*Cottus asper*	0	111
Northern Pike	*Esox lucius*	0	0.2
Bluegill^ **##	*Lepomis macrochirus*	0	186
Smallmouth Bass**	*Micropterus dolomieu*	0	42
Largemouth Bass^	*Micropterus salmoides*	1	1
Yellow Perch**	*Perca flavescens*	0	232
Walleye**	*Sander vitreus*	0	232
Unident. Fish (13 possible spp. SC)^	Class Chondrichthyes & Osteicthyes	0.4	0
TOTAL	**23 Species+ 1 Group (2 spp. max)**	**6**	**4,650**

* Introduced Species ^ Some are introduced species (numbers not tracked) T&E –Threatened and endangered species (Federal only)

** # estimated from those caught - All released in Columbia River Program

3 killed and 0.2 released and ## 0.6 released not caught in Columbia River program

Between FY11 and FY15, WS took a total of 20 nontarget reptile species with an annual average of 283 lethal and 588 nonlethal takes (Table 9). The lethal take was primarily from traps (276) and neck snares (7) and the nonlethal take was from traps (576) and neck snares (12). The few nontarget amphibians taken (0.8) were in ARDM and the rabies damage manage programs in traps (Table 9). Most nontarget fish were taken with fishing poles (4,636), but released in the Northern Pikeminnow Program on the Columbia River (Table 9); these were estimated for the last five years because only the numbers of nontarget fish caught were recorded in the MIS as Fish (Other) and not the species. The remaining fish, primarily common carp and channel catfish, were taken in ARDM, turtle damage management in aquaculture ponds, and other projects with traps. A total of 6 fish were taken lethally and 4,650 nonlethally. No T&E were taken. This is a minimal take of nontargets, especially considering that most were freed.

4 RISKS TO PEOPLE, PETS, AND THE ENVIRONMENT FROM WILDLIFE DAMAGE MANAGEMENT

A standard concern among the public as well as WS personnel is hazards to the public, pets, and the environment from the use of WDM methods. WS Specialists use a set of standard operating procedures to reduce potential safety impacts from WDM 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 wildlife damage situation, while having minimal, if any, impact to people and the environment. WS Specialists are professionally trained to use WDM techniques, especially those that are hazardous to WS personnel, the public, pets, and the environment. Several WDM methods have the potential to be hazardous including firearms, pyrotechnics, traps, and toxicants. This is the focus of the risk assessment and will be discussed for the different methods used in WDM. Between FY11 and FY15, no known injuries were recorded to the public. From FY13[14] to FY15, WS personnel annually averaged 79 Office of Workman's Compensation (OWCP) claims (Table 10). Considering the number personnel (~1,900), this would be a minimal number overall and less for those conducting field activities (59/year). Thus, it is believed that risks are fairly minimal.

On the other hand, a peripheral factor pertinent to assessing the risk of adverse effects of WS WDM activities is 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 wildlife 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 WDM would be conducted by other entities such as private individuals. Private WDM activities are less likely to be as selective for target species, and less likely to be accountable. Additionally, private activities may not involve professional trained WDM personnel or may include the use of unwise or illegal methods to control wildlife. For example, aluminum phosphide applied under a mobile home improperly accidentally killed four children and hospitalized five others in Texas (Newsome and Nottingham 2017); in Utah, two children were killed after the private pesticide applicator improperly applied too much aluminum phosphide for voles (Blum 2014).

There are similar risks to animals. For example, a raccoon was stuck on a fence after it had wandered off with the illegal trap that was used to capture it (Rogers 2016). In Kentucky a corporation was fined for illegally using carbofuran to destroy unwanted predators including coyotes and raptors at a private hunting club (Porter 2004). The use of a pesticide not according to its label, the illegal importation or sale of counterfeit pesticide products, and pesticide uses off-label are commonplace and the USEPA (2017) along with most state agencies have websites to try to minimize such problems. Therefore, WS and others

[14] FY13 was the first year that OWCP claims and their causes was available at the national level. Prior to that, OWCP claims were tracked at the state level and tracked differently in each state. Thus, FY13 was the first year used for analysis.

(Treves and Naughton–Treves 2005) believe that it is in the best interest of the public, pets, and the environment that a professional WDM 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.

Table 10. The annual average number of injuries incurred by APHIS WS personnel from FY13 to FY15 throughout the USA.

APHIS – WS INJURIES IN THE FIELD AND OFFICE FROM FY13 TO FY15		
INJURIES WHILE AFIELD OR DOING RESEARCH		
Injury	**No.**	**Types**
Strained Muscles/Ligaments	17.0	Knee/leg/ankle (8.3), spine/chest (4.7), arm/shoulder/wrist (4.0)
- Moving Animal Carcass	1.0	Bear/deer/swine/beaver
- Removing Beaver Dam	0.7	Beaver dam removal by hand/hand tools
- Torn Ligament/Tendon	0.7	Knee – ACL/medial meniscus
- Repetitive Injuries/Strains	0.7	Trigger finger
- From Trap	0.3	Finger sprain setting cage trap
Compression/Contusion Injuries	5.3	Arm/shoulder (2.3), knee/leg/foot (1.7), head/spine/chest (1.3)
- From Trap	2.3	Hand/arm: 1.3 foothold*, 0.7 quick-kill
- From Firearm	0.7	Shoulder/spine from repeated shooting from aircraft
- Using Landing Net	0.3	Fell while trying to capture bird
- On Heavy Equipment	0.3	Possibly associated with beaver dam removal
Mammal - Bite/Attack	4.0	Bite 1.3 dog, 0.7 cat, 0.3 bear, bat, skunk, rat, coyote; Fracture 0.3 swine
- Potential Rabies Exposure	3.7	Contact with animals via lacerations, needle punctures, solution in eye
- Rabies Vaccine	0.7	Adverse reaction
Laceration/Puncture	6.3	Hand/arm (5.3), head (0.7), leg (0.3)
- From Trap	1.3	Hand: 0.7 foothold, 0.3 cage, and 0.3 unknown
- From Cable Restraint	0.3	Neck snare cut finger
Fracture	4.0	Hand (1.3), foot (1.3), leg (0.7) tooth (0.7)
Insect Bite	3.0	Tick (carry Lyme's disease/other maladies)
Foreign Body	2.0	Gravel or pokes to eye (1.3), firearm powder (0.3), metal shaving (o.3)
Illness	1.7	Poison ivy/oak rash (1.0), beaver work: *giardia* (0.3), heat stroke (0.3)
Firearm	1.0	Foot shot w/ air rifle; burned eye from shot blast; hearing trauma
Concussion	1.0	Head injury
Inhalation	0.7	Sodium cyanide exposure (M-44)
Unknown	0.3	No data on incident
TOTAL FIELD	**59.0**	
INJUIRIES IN OFFICE, WAREHOUSE OR HOME		
Injury	**No.**	**Types**
Compression/Contusion Injuries	2.7	Arm/shoulder/hand (1.3), leg/foot (0.7), spine/chest (0.7)
Strained Muscles/Ligaments	2.3	Arm/shoulder (1.3), spine/chest (1.0)
Laceration/Puncture	2.0	Hand/arm (1.7), head (0.3)
Illness	1.3	Stress (0.7), stroke (0.3), muscle spasm (0.3)
Inhalation	1.0	Chlorine gas, cleaning supplies, mold
Foreign Body	0.7	Weed whacker (0.3), metal shaving (0.3)
Burn	0.7	Arm, buttocks
Fracture	0.3	Foot
TOTAL OFFICE	**11.0**	
VEHICLE ACCIDENTS		
Injury	**No.**	**Types**
Automobile	6.7	Head, neck, back injuries
All-Terrain Vehicle (ATV)	1.3	Head, neck, shoulder and arm trauma
Aircraft	1.0	One accident was fatal for pilot and crewman
TOTAL VEHICLE	**9.0**	
GRAND TOTAL	**79**	

*Scrape from foothold trap closing on hand resulted in contusion which later turned into a staph infection

Another benefit from having professional assistance to resolve wildlife damage is the fact that WS, often in assistance with other federal and state agencies, can monitor and control, if necessary, particular wildlife diseases that can have an impact on humans, pets, and livestock such as rabies and *Salmonella enterica* bacterium. Disease surveillance and control inherently can benefit people, pets, and livestock and WS conducts programs for them.

5 RISKS TO HUMANENESS

The issue of humaneness, as it relates to the killing, capturing, or hazing of wildlife, is a complex concept which usually involves pain or stress. Humaneness is an individual's perception of the pain or stress (*suffering typically entails one or both and a time period*) inflicted on an animal from an action, but what constitutes humaneness can vary widely from one person to the next. The humaneness of WDM methods will be considered in risk assessments as these risks can be considered by some to be an integral part of a risk assessment. Thus, this will be discussed in WS Methods Risk Assessments where applicable with some background information discussed here.

Pain occurs in animals, but assessing the pain experienced by animals can be challenging (California Department of Fish and Game 1991, AVMA 2007). The American Veterinary Medical Association (AVMA) defines pain as being, "*that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways*" (AVMA 2007). The key component of this definition is the perception of pain. The AVMA (2007) notes that "pain" should not be used for stimuli, receptors, reflexes or pathways because these factors may be active without pain perception. For pain to be experienced, the cerebral cortex and subcortical structures must be functional. If the cerebral cortex is nonfunctional because of hypoxia, depression by drugs, electric shock or concussion, pain is not experienced.

Stress has been defined as the effect of physical, physiologic or emotional factors (stressors) that induce an alteration in an animal's base or adaptive state. Responses to stimuli vary among animals based on an animal's experience, age, species and current condition. Not all forms of stress result in adverse consequences for the animal and some forms of stress serve a positive, adaptive function for the animal. Stress describes the response of animals to harmless stimuli, which initiate responses that are beneficial to the animal. Neutral stress is the term for response to stimuli which have neither harmful nor beneficial effects to the animal. Distress results when an animal's response to stimuli interferes with its well-being and comfort (AVMA 2007). The AVMA (2007) noted that distress "*… can occur without pain …*" and *"... pain can occur without suffering* [distress] *…*" 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 2004), as in the case of shooting or drug-induced euthanasia. It is the goal of professional WDM programs to minimize distress in animals to the maximum extent practicable.

Pain, anxiety, and stress caused by restraint and physical exertion due to struggling to escape can manifest physiologically through the sympathetic nervous system and interplay among hormones produced by the hypothalamus, pituitary and adrenal glands. Pain and stress can be measured through short-term increases in cortisol from the adrenal glands, heart rate, blood pressure, body temperature, and breathing rate, and a long-term loss of body weight. Although humans cannot be 100% certain that animals can experience pain-like or distress-like states, operating on the precautionary principle provides for assuming that animals suffer pain and stress ensures that we take appropriate steps to minimize that risk and treat the animal with respect (Kreeger et al. 1990, Iossa et al. 2007, Sneddon et al. 2014).

The AVMA (2013) states if a life is to be taken it should be done with respect and emphasis on making the death as painless and distress free as possible given the circumstances. Euthanasia methods induce a humane death and attempts to minimize stress and anxiety prior to unconsciousness. Although the use of AVMA-approved euthanasia methods are considered the methods of choice, the AVMA (2013) recognizes that for wildlife in the field, this may not always be possible and the most appropriate euthanasia method may be a gunshot to the brain or similar method that is not always considered an ideal euthanasia method. Additionally, at times it may be much more appropriate not to transport an animal for euthanasia when pain,

distress, and suffering would be increased, and use a less than ideal method to euthanize the animal (Yeates 2010, AVMA 2013).

AVMA (2013) recognizes that there is "…an inherent lack of control over free-ranging wildlife, accepting that firearms may be the most appropriate approach to their euthanasia, and acknowledging that the quickest and most humane means of terminating the life of free-ranging wildlife in a given situation may not always meet all criteria established for euthanasia (i.e., distinguishes between euthanasia and methods that are more accurately characterized as humane killing)…. Because of the variety of situations that may be encountered, it is difficult to strictly classify methods for termination of free- ranging wildlife as acceptable, acceptable with conditions, or unacceptable. Furthermore, classification of a given method as a means of euthanasia or humane killing may vary by circumstances. These acknowledgments are not intended to condone a lower standard for the humane termination of wildlife. The best methods possible under the circumstances must be applied, and new technology and methods demonstrated to be superior to previously used methods must be embraced. … Multiple federal, State, and local regulations apply to the euthanasia of wildlife. In the USA, management of wildlife is primarily under State jurisdiction. However, some species (e.g., migratory birds, endangered species, marine mammals) are protected and managed by federal agencies or through collaboration between State and federal agencies. Within the context of wildlife management, personnel associated with State and federal agencies and Native American tribes may handle or capture individual animals or groups of animals for various purposes, including research. During the course of these management actions, individual animals may become injured or debilitated and may require euthanasia; in other cases, research or collection protocols dictate that some of them be killed. Sometimes population management requires the lethal control of wildlife species, and, the public may identify and/or present individual animals to state or federal personnel because they are orphaned, sick, injured, diseased (e.g., rabid), or becoming a nuisance."

In recent years, the number of individuals and organizations concerned about animal welfare and animal rights has increased substantially (George et al. 2016). While the goal of some animal welfare and rights groups is to ban trapping, the use of toxicants, and other lethal methods altogether, many groups are concerned with reducing the pain and suffering of animals that are captured or killed by WDM methods, as well as potential risks to nontarget animals and pets. Animal welfare organizations and private individuals are concerned that some methods used to capture wildlife may cause unnecessary pain and suffering in animals.

Several researchers and organizations have attempted to develop objective, comparable, and statistically relevant methods for evaluating traumatic damage and stress in captured animals (Olsen et al. 1986, Onderka et al. 1990, Phillips 1996, Engeman et al. 1997, International Organization for Standardizations (ISO) 1999). These systems provide points for various types of physical trauma, with those points summed for total scores. Scoring of each sample is typically conducted by one or more experienced veterinarians, and the summed scores compared among the veterinarians and the trap type. The concern with scoring methods is that results may be subjective and dependent on the evaluators, and may not be directly comparable among studies (Onderka et al. 1990, Engeman et al. 1997), nor do they include behavioral and physiological responses (Powell and Proulx 2003). Total scores also do not reflect the incremental contribution of individual scores. However, these systems can provide a systematic method for evaluating animal welfare that can be readily compared within a particular study.

In 1991, with the encouragement of animal rights and welfare groups, the European Union (EU), the European Economic Community at that time, promulgated a trade regulation banning fur imports from countries deemed to be using inhumane traps. This ban was subsequently modified to permit imports from

countries using traps that have been evaluated according to international standards for humaneness. In 1996 the Association of Fish and Wildlife Agencies (AFWA), working cooperatively with federal and private partners, embarked on a goal to develop voluntary Best Management Practices (BMPs) for trapping furbearers in the USA (Batcheller et al. 2000). The stated purpose and intent of AFWA in developing the BMPs was to: "*Scientifically evaluate traps and trapping systems used for capturing furbearers in the United States*." AFWA determined the best methods by species[15], but was primarily targeting harvest by private fur trappers and not take in WDM activities. Evaluations of trap performance were based on animal welfare, efficiency, capture rate, selectivity, practicality, safety, mechanical function, cost, quality, durability, weight, and maintenance requirements (Fall 2002). Science-based literature and research on the variety of traps and snares were used by AFWA to develop the BMPs. The evaluation of BMPs continues and BMPs are updated as research results warrant (AFWA 2016). The BMPs (AFWA 2016) have been provided to state and federal wildlife agencies as well as trappers and the public in the form of a general overview for traps and trapping, and specifically the most efficient and humane methods for trapping 24 furbearer species in the USA. The goals were to promote regulated trapping as a modern wildlife management tool, identify practical traps and trapping techniques while continuing to improve efficiency, selectivity, and the welfare of trapped animals through research, to provide specifications for traps that meet BMP criteria for individual species in various regions of the US, to provide wildlife management and trap industry professionals with information to evaluate trapping systems in the US; and to instill public confidence in and maintain public support for wildlife management and trapping through distribution of science-based information. These standards were developed by the major fur-exporting countries (Canada, Russia, and the USA), and the 2008 Agreement on International Humane Trapping Standards (AIHTS) was subsequently signed by Canada, Russia, and the EU. The US did not sign the agreement because the primary authority for managing furbearing animals rests with the states and tribes, not the federal government. However, federal agencies continue to cooperate with AFWA to meet the intent of the agreement to improve animal welfare in US trapping and to avoid the EU trade ban. Evaluations are updated periodically as new information and devices become available and are based on animal welfare, efficacy, selectivity, practicality and safety (AFWA 2016). WS recognizes the value of BMPs and uses these guidelines as a basis for policy formulation, recognizing that some devices used in WDM are not commercially available and that not all devices recommended in the BMP guidelines for general public use meet the more stringent performance requirements for durability and efficacy under a range of environmental conditions required for use in WS WDM (WS Directive 2.450).

Selectivity of wildlife damage methods is related to the issue of humaneness in that greater selectivity results in less potential suffering of nontarget animals. Methods vary in their selectivity for nontarget animals. The selectivity of each method is augmented by the skill and discretion of the WS employee applying the technique and on specific measures and modifications designed to reduce or minimize nontarget captures. All WS employees are trained in techniques to minimize the risk of capturing nontarget wildlife. Section 4.2.1.2 discussed the proposed program's potential for affecting nontarget species.

Research, which has been used to develop the BMPs, suggests that with methods such as restraint in foothold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements of fox indicate that this is the case for fox that have been held in traps, snares, and chased by dogs (Kreeger et

[15] Furbearers with AFWA (2016) trapping BMPs include Virginia opossum, beaver, muskrat, nutria, Canada lynx, bobcat, coyote in Eastern U.S., coyote in Western U.S. (both eastern and western United States populations have own BMPs since eastern coyotes are larger as a result of hybridizing with wolves), gray wolves, red fox, swift/kit fox, arctic fox, gray fox, river otter, fisher, American marten, weasel (least, long-tailed, and short-tailed), mink, American badger, ringtail, raccoon, and striped skunk. These are individual documents for each species and can be found at the AFWA website (2016).

al. 1990). Marks (2010) used blood chemistry indicators to compare stress to red foxes associated with use of padded-jaw traps, treadle snares, shooting, cage traps and use of dogs to chase foxes into nets. Physiological data indicated restraint by treadle snare was more stressful for fox than capture in traps, and both methods resulted in higher stress indicators than cage traps, being chased by dogs into netting, and shooting. Marks (2010) noted that use of TTDs may help to reduce stress in animals captured in traps and snares. The situation is likely to be similar for other animals caught in traps, snares, cable restraints or chased by dogs. Use of traps that are demonstrated to minimize suffering and pain such as those recommended in trapping BMPs as well as frequent trap checks, can increase public acceptance of trapping and perceptions of the humaneness of this method (Proulx and Barrett 1989, Andelt et al. 1999). Using experienced and skilled trappers to educate new trappers in the effective use of more humane and selective traps can also improve the overall practice and humaneness of trapping.

The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology. WS personnel are concerned about animal welfare and select methods that consider not only the welfare of the animals captured, but also the welfare of humans, pets, and livestock as well as other protected resources such as T&E species. WS is aware that techniques like snares, traps and toxicants are controversial, but also believes that these activities are being conducted as humanely and responsibly as practical. WS and the WS-National Wildlife Research Center (NWRC) are striving to bring additional nonlethal damage management alternatives into practical use and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when nonlethal damage management methods are not practical or effective. WS supports the most humane, selective and effective damage management techniques and would continue to incorporate advances into program activities. WS field employees conducting WDM are highly experienced professionals, skilled in the use of management methods and committed to minimizing pain and suffering. WS Program Directives, standard operating procedures and training work to ensure that WS WDM methods are used in a manner that is as humane and selective as possible. Other practices which help to improve the efficacy, selectivity and humaneness of WS use of WDM methods include implementing the BMPs where appropriate for WDM actions and compliance with regulations determining trap check intervals. Whenever possible and practical, WS employs euthanasia methods recommended by the AVMA (2007, 2013), even though the AVMA euthanasia methods were developed principally for companion animals and slaughter of food animals, and not for free-ranging wildlife and what is considered acceptable for professional wildlife damage managers (Julien et al. 2010). Finally, the killing of wildlife during the breeding season has the potential to result in young becoming orphaned. When WS conducts WDM activities during the spring and early summer months, this is considered and young are removed as possible.

6 RISK ASSESSMENT PROCEDURES

WDM nonchemical and chemical methods fall into 3 categories: resource management, physical exclusion, and wildlife management methods. Resource management methods include habitat and prey base management (which can use chemical and nonchemical methods) and monitoring the resource. Physical exclusion involves nonchemical methods to exclude wildlife from resources. Wildlife management methods include a large number of methods and are subdivided into frightening devices (mechanical), chemical repellents, capture/take methods (mechanical), immobilization, euthanasia, and sterilization drugs (chemical), and chemical toxicants. For each WDM method identified in Table 1, the potential risks to people (WS personnel and the public), pets, nontarget wildlife, and the environment are characterized in quantitative or qualitative terms. Qualitative terms include high, medium, low, or no risks. Quantitative risks actually involve the use of numbers from WDM activities in the USA and are based on data between FY11

and FY15 or other time frame. Where known, injuries to the personnel, public, pets, nontarget wildlife, and the environment are included. In this risk assessment, nonchemical methods will be discussed first, including a basic discussion of use, target and nontarget animals taken with the method, and a human health and ecological risk assessment of each. Chemical methods will be discussed in their own stand-alone documents. For chemical methods, the guidance used in the human health risk assessment (HHRA) to assess potential human health effects from chemicals follow standard regulatory guidance and methodologies (National Research Council, 1983; USEPA 2013a). The methods used in the environmental risk assessment (ERA) to assess potential ecological risk to the environment and nontarget wildlife follow similar guidance. The risk assessment procedures for nonchemical methods will be similar.

The risk assessment starts with looking at the WS use pattern for the method followed by the problem formulation (identifying a hazard) and performing exposure assessments (identifying potentially exposed populations and determining potential exposure pathways for these populations), and, specifically for chemicals, a toxicity assessment (the dose-response assessment). Lastly, the information from the exposure assessment, and toxicity assessment for chemicals, will be used to characterize risk (determining whether there is adverse health and eco-risk).

7 RISK ASSESSMENT PREVIEW

The following are the Risk Assessment Chapters that comprise the overall WS Methods Risk Assessment:

Chapter I. Introduction to Methods Used in Wildlife Damage Management
Chapter II. The Use of Cage Traps in Wildlife Damage Management
Chapter III. The Use of Cable Devices in Wildlife Damage Management
Chapter IV. The Use of Foothold Traps in Wildlife Damage Management
Chapter V. The Use of Aircraft in Wildlife Damage Management
Chapter VI. The Use of Firearms in Wildlife Damage Management
Chapter VII. The Use of Sodium Cyanide in Wildlife Damage Management
Chapter VIII. The Use of Carbon Monoxide in Wildlife Damage Management
Chapter IX. The Use of Aluminum Phosphide in Wildlife Damage Management
Chapter X. The Use of Zinc Phosphide in Wildlife Damage Management
Chapter XI. The Use of GonaCon in Wildlife Damage Management
Chapter XII. The Use of Lead in Wildlife Damage Management
Chapter XIII. The Use of Nets in Wildlife Damage Management
Chapter XIV. The Use of Quick-Kill Traps in Wildlife Damage Management
Chapter XV. The Use of Dogs in Wildlife Damage Management
Chapter XVI. The Use of DRC-1339 in Wildlife Damage Management
Chapter XVII. The Use of Egg Addling in Wildlife Damage Management
Chapter XVIII. The Use of Hand Capture and Disease Sampling in Wildlife Damage Management
Chapter XIX. The Use of Sodium Nitrite in Wildlife Damage Management
Chapter XX. The Use of Strychnine in Wildlife Damage Management
Chapter XXI. The Use of Immobilization and Euthanasia Drugs in Wildlife Damage Management
Chapter XXII. The Use of Vaccinia in Wildlife Damage Management
Chapter XXIII. The Use of Sodium Fluoroacetate in Wildlife Damage Management
Chapter XXIV. The Use of Explosives/Pyrotechnics in Wildlife Damage Management
Chapter XXV. The Use of Non-Chemical (Physical/Visual/Sound) Repellents in Wildlife Damage Management
Chapter XXVI. The Use of Chemical Repellents in Wildlife Damage Management
Chapter XXVII. The Use of Anticoagulants in Wildlife Damage Management

Chapter XXVIII. The Use of Bromethalin in Wildlife Damage Management
Chapter XXIX. The Use of Exclusion in Wildlife Damage Management
Chapter XXX. The Use of Acetaminophen in Wildlife Damage Management
Chapter XXXI. The Use of Avitrol in Wildlife Damage Management
Chapter XXXII. Carcass Disposal in Wildlife Damage Management
Chapter XXXIII. The Use of Miscellaneous Wildlife Damage Methods (Exclusion, Fishing, Insecticide, Nicarbazin, Sodium Laurel Sulfate)

8 LITERATURE CITED

Adler, B., and A. de la Peña Moctezuma. 2010. Leptospira and leptospirosis. Vet. Microbio. 140:287-296.

Amass, S. 1998. Swine diseases that have affected humans. Purdue Animal Issues Briefing, Purdue Univ., West Lafayette, Ind.

American Veterinary Medical Association (AVMA). 2007. AVMA guidelines on euthanasia (formerly report of the AVMA panel on euthanasia), June 2007. J. Amer. Veterinary Med. Assoc., Schamburg, Ill. 36 pp.

_____ AVMA. 2013. AVMA guidelines for the euthanasia of animals: 2013 edition. 2013. AVMA, Schamburg, Ill. 102 pp. @ https://www.avma.org/KB/Policies/Documents/euthanasia.pdf. *Accessed 4/6/2017*.

Andelt, W.F., R.L. Phillips, R.H. Schmidt, and R.B. Gill. 1999. Trapping furbearers: An overview of the biological and social issues surrounding a public policy controversy. Wildl. Soc. Bull. 27:33-64.

Animal and Plant Health Inspection Service (APHIS). 2015. WS Vision, Mission and Goals. USDA-APHIS, June 5. @ https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_program_overview/ct_about_mission. *Accessed 1/18/2017.*

Association of Fish and Wildlife Agencies (AFWA). 2016. Furbearer Management: Best Management Practices for Trapping in the United States. @ http://fishwildlife.org/?section=best_management_practices. *Accessed 1/17/2017.*

Batcheller, G. R., T. A. Decker, D. A. Hamilton, and J. F. Organ. 2000. A vision for the future of furbearer management in the United States. Wildl. Soc. Bull. 28(4):833-840.

Beard, K. H. 2007. Diet of the invasive frog, *Eleutherodactylus coqui*, in Hawaii. *Copeia* 2007:281-291.

Beard, K. H., R. Al-Chokhachy, N. C. Tuttle, and E. M. O'Neill. 2008. Population density growth rates of *Eleutherodactylus coqui* in Hawaii. J. Herpetol. 42:626-636.

Blum, D. 2014. Dead tourists and a dangerous pesticide. Wired: Science. March 14th. @ https://www.wired.com/2014/03/dead-tourists-and-a-dangerous-pesticide/. *Accessed 1/17/2017.*

California Department of Fish and Game. 1991. Final Environmental Document - Bear Hunting Sections 265, 365, 366, 367, and 367.5. Title 14 Calif. Code of Regs. Cal. Fish and Game, State of Calif., April 25, 1991. 13 pp.

California Department of Fish and Game. 2004. Draft environmental document - Bear hunting. Sections 265, 365, 366, 367, 367.5, 401, 708 Title 14 California Code of Regulations, January 30, 2004. Calif. Dept. Fish and Game, Sacto., Calif.

Center for Disease Control (CDC). 2011. Rabies. @ https://www.cdc.gov/rabies/transmission/index.html. Accessed 03/28/2017.

Clark, L. 2003. A review of pathogens of agricultural and human health interest found in Canada Geese. Proc. Wildl. Damage Manage. Conf. 10:326-334.

Colorado Parks and Wildlife. 2015. Furbearer management report 2014-2015 harvest year. CPW, Report by J. A. Apker. 20 pp.

Davidson, W. R., and V. R. Nettles. 1997. Field Manual of Wildlife Diseases in the Southeastern United States. 2nd ed. Southeastern Coop. Wildl. Disease Study. Univ. Georgia. Athens. 417 pp.

Davis, J. W., R. C. Anderson, L. Karstad, and D. O. Trainer. 1971. Infectious and Parasitic Diseases of Wild Birds. Iowa State Univ. Press, Ames. 364 pp.

Engeman, R.M., H.W. Krupa, and J. Kern. 1997. On the use of injury scores for judging the acceptability of restraining traps. J. Wildl. Res. 2:124-127.

Forrester, D. J. 1991. Parasites and Diseases of Wild Mammals in Florida. Univ. Fla. Press, Gainesville. 455 pp.

George, K. A., K. M. Slagle, R. S. Wilson, S. J. Moeller, and J. T. Bruskotter. 2016. Changes in attitudes towards animals in the United States from 1978-2014. Biol. Conserv. 201:237-242.

Hall, T. C. 1996. Operational control of the brown tree snake on Guam. Vertebr. Pest Conf. 17:234-240.

Hubalek, Z., F. Treml, Z. Juricova, M. Hundy, J. Halouzka, V. Janik, D. Bill. 2002. Serological survey of the wild boar (Sus scrofa) for tularemia and brucellosis in south Moravia, Czech Republic. Vet. Med. – Czech. 47(2-3): 60-66.

International Organization for Standardization (ISO). 1999. Animal (mammal) traps, Part 5: Methods for testing restraining traps. ISO/DIS 10990-5, Geneva, Switzerland.

Iossa G., C.D. Soulsbury, and S. Harris. 2007. Mammal trapping: A review of animal welfare standards of killing and restraining traps. Animal Welfare 16:335-352.

Julien, T. J., S. M. Vantassel, S. R. Groepper, and S. E. Hyngstrom. 2010. Euthanasia methods in field settings for wildlife damage management. Human-Wildlife Interactions 42: 158-164.

Kreeger, T.J., P.J. White, U.S. Seal, and J.R Tester. 1990. Pathological responses of red foxes to foot hold traps. J. Wildl. Manage. 54:147-160.

Marks, C.A. 2010. Haematological and biological responses of red foxes (Vulpes vulpes) to different capture methods and shooting. Animals Welfare 19:223-234.

McAllister, M.M. 2014. Successful vaccines for naturally occurring protozoal diseases of animals should guide human vaccine research: a review of protozoal vaccines and their designs. Parasitology 141(5):624-640.

Montana Fish, Wildlife and Parks. 2017. Harvest and hunting statistics: Furbearer trapping and harvest reports. MFWP. @ http://fwp.mt.gov/hunting/planahunt/harvestReports.html. *Accessed 4/7/2017.*

National Research Council. 1983. Risk assessment in the Federal government: managing the process, National Academies Press: 206.

Newsome, J., and S. Nottingham. 2017. Four children die when pesticide, water mix creates toxic gas. CNN. Tues., January 3rd. @ http://www.cnn.com/2017/01/02/us/amarillo-texas-pesticide-deaths/index.html. *Accessed 1/17/2017.*

Olsen, G.H., S.B. Linhart, R.A. Holmes, G.J. Dasch, and C.B. Male. 1986. Injuries to coyotes caught in padded and unpadded steel foothold traps. Wildlife Society Bulletin 14:219-223.

Onderka, D.K., D.L. Skinner, and A.W. Todd. 1990. Injuries to coyotes and other species caused by four models of footholding devices. Wildlife Society Bulletin 18:175-182.

Phillips, R.L., K.S. Gruver, and E.S. Williams. 1996. Leg injuries to coyotes captured in three types of foothold traps. Wildlife Society Bulletin 24:260-263

.

Powell, R.A. and G. Proulx. 2003. Trapping and marking terrestrial mammals for research: Integrating ethics, performance criteria, techniques, and common sense. Journal Institute for Laboratory Animal Research 44:259-276.

Proulx, G. and M.W. Barrett. 1989. Animal welfare concerns and wildlife trapping: Ethics, standards, and commitments. Trans. W. Sect. Wildl. Soc. 25:1-6.

Porter, S. 2004. Corporation fined for poisoning Bald Eagle in KY. Wildl. Law News Q. 2:14.

Roberts, N. M. and S.M. Crimmins. 2010. Bobcat population status and management in North America: Evidence of a large-scale population increase. J. Fish & Wildl. Manage. 1(2):169-174.

Rocky Mountain Bird Observatory (RMBO)[16]. 2013. PIF Population Estimates Database. RMBO name change to Rocky Mountain Bird Conservancy. @ http://rmbo.org/pifpopestimates/. *Accessed 1/10/2017.*

Rogers, T. 2016. Trap found on raccoon in Boca Raton illegal, inhumane. WPTV, West Palm Beach. @ http:// www.wptv.com/news/region-s-palm-beach-county/boca-raton/trap-found-on-raccoon-in-boca-raton-illegal-inhumane. *Accessed 1/17/2017*.

Rouhe, A and M. Sytsma. 2007. Feral Swine Action Plan for Oregon. Prepared for Ore. Invasive Spp. Council. Portland St. Univ. 28 pp.

Samuel, W. M., M. J. Pybus, and A. A. Kocan, eds. 2001. Parasitic Diseases of Wild Mammals. Iowa State Univ. Press, Ames. 559 pp.

Sauer, J. R., D. K. Niven, J. E. Hines, D. J. Ziolkowski, Jr, K. L. Pardieck, J. E. Fallon, and W. A. Link. 2017. The North American Breeding Bird Survey, results and analysis 1966 - 2015. USGS Patuxent Wildl. Res. Center, Laurel, MD Version 2.07.2017.

Seward, N. W., K. C. VerCauteren, G. W. Witmer, and R. M. Engeman. 2004. Feral swine impacts on agriculture and the environment. Sheep & Goat Research J. 19: 34-40.

Sneddon, L.U., R.W. Elwood, S.A. Adamo, and M.C. Leach. 2014. Defining and assessing animal pain. Animal Behavior 97:201-212.

Stevens, R. L. 2010. The Feral Hog in Oklahoma. Samuel Robert Noble Found., Ardmore, OK.

[16] RMBO name changed to Rocky Mountain Bird Conservancy in 2015.

Treves, A., and L. Naughton-Treves. 2005. Evaluating lethal control in the management of human-wildlife conflict. Pp. 86-106. *In* People and Wildlife: Conflict or Coexistence. R. Woodroffe, S. Thirgood, A. Rabinowitz, eds. Univ. Cambridge Press, United Kingdom.

U.S. Environmental Protection Agency (USEPA). 2016. Pesticide Science and Assessing Pesticide Risks. @ https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks. *Accessed 1/18/2017.*

_____ USEPA. 2017. Avoid illegal household pesticide products. USEPA, Wash., D.C. @ https://www.epa.gov/safepestcontrol/avoid-illegal-household-pesticide-products. *Accessed 1/17/2017.*

U.S. Fish and Wildlife Service (USFWS). 2012. Migratory bird hunting activity and harvest for the 2010 and 2011 hunting seasons. USFWS, Laurel, MD. @ https://www.fws.gov/birds/surveys-and-data/reports-and-publications.php. *Accessed 4/7/2017.*

_____ USFWS. 2014. Migratory bird hunting activity and harvest for the 2012-13 and 2013-14 hunting seasons. USFWS, Laurel, MD. @ https://www.fws.gov/birds/surveys-and-data/reports-and-publications.php. *Accessed 4/7/2017*.

____ USFWS. 2015. Black-tailed prairie dog (Cynomys ludovicianus). USFWS, Mtn.-Prairie Region. July. @ https://www.fws.gov/mountain-prairie/es/blackTailedPrairieDog.php. *Accessed 4/7/2017.*

_____ USFWS. 2016. Migratory bird hunting activity and harvest for the 2014-15 and 2015-16 hunting seasons. USFWS, Laurel, MD. @ https://www.fws.gov/birds/surveys-and-data/reports-and-publications.php. *Accessed 4/7/2017*.

U.S. Food and Drug Administration. 2007. Investigation of an Escherichia coli O157:H7 outbreak associated with Dole pre-packaged spinach. FDA Final Report on 2006 Spinach Outbreak. P 07-51.

Weber, W. J. 1979. Health Hazards from Pigeons, Starlings, and English Sparrows. Thompson Publ. Fresno, Calif.

Wetlands International. 2012. Waterbird Population Estimates. Wetlands Intl. Global Office, Wageningen, The Netherlands. @ http://wpe.wetlands.org/. *Accessed 1/10/2017.*

Williams, E. S., and I. K. Barker, eds. 2000. Infectious Diseases of Wild Mammals. 3rd ed. Iowa State Univ. Press, Ames. 576 pp.

Yeates J. 2010. Death is a welfare issue. J Agric Environ Ethics 23:229–241.

9 PREPARERS

9.1 APHIS-WS Methods Risk Assessment Committee

Writers for "Risk Assessments for Methods Used in Wildlife Damage Management":

Primary Writer: Thomas Hall
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Fort Collins, CO
Education: BS Biology (Natural History) and BA Psychology – Fort Lewis College; MS Wildlife Ecology – Oklahoma State University
Experience: Special expertise in wildlife biology, identification, ecology, and damage management. Thirtyone years of service in APHIS Wildlife Services including research and operations in CO and WY for research and OR, GU, CA, OK,

and NV for operations conducting a wide variety of programs including bird damage research and management, livestock protection (predators and birds), invasive species management, wildlife hazard management at airports, property and natural resource protection including waterfowl, brown tree snake, feral swine, rodent, and beaver damage management. Expert in preparing environmental documents for WS programs to comply with the National Environmental Policy Act and the Endangered Species Act.

Editors/Contributors for "Risk Assessments for Methods Used in Wildlife Damage Management":

Reviewer: Timothy Algeo
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Concord, NH
Education: BS Biology – Johnson State College; MS Wildlife Conservation – University of Massachusetts; Ph.D. Natural Resources and Environmental Studies – University of New Hampshire
Experience: Special expertise in wildlife biology, ecology, wildlife disease, and wildlife damage management. Nineteen years of service with APHIS Wildlife Services

Reviewer: Michael Green
Position: USDA-APHIS-Wildlife Services (WS), Environmental Coordinator, Fredrick, MD
Education: BS Wildlife and Fisheries Sciences, University of Tennessee
Experience: Special expertise in wildlife biology, ecology, and damage management. Eleven years of work experience with WS in MD and VA. Experienced in a wide range of program activities including nutria eradication, airport wildlife management, and wildlife damage management to protect livestock, aquaculture, public safety, and natural resources. Served as staff biologist in WS Headquarters for 2 years.

Editor: Andrea Lemay
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Biological Scientist, Raleigh, NC
Education: BS Plant and Soil Science (Biotechnology) - University of Massachusetts; MS Plant Pathology -North Carolina State University
Experience: Twelve years of service in APHIS conducting risk analysis. Four years of experience in preparing environmental analyses in compliance with the National Environmental Policy Act.

Editor: Fan Wang-Cahill
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Environmental Health Specialist
Riverdale, MD
Education: B.S. Biology and M.S. Hydrobiology - Jinan University, Guangzhou, China; Ph.D. Botany (Ultrastructure/Cell Biology) – Miami University
Experience: Joined APHIS in 2012, preparing human health risk assessments and providing assistance on environmental compliance. Prior experience before joining APHIS includes 18 years environmental consulting experience specializing in human health risk assessments for environmental contaminants at Superfund, Resource Conservation and Recovery Act (RCRA), and state-regulated contaminated facilities.

Editor: Jim Warren
Position: USDA-APHIS-Policy and Program Development (PPD), Environmental and Risk Analysis Services (ERAS), Environmental Toxicologist, Little Rock, AR
Education: B.S. Forest Ecology and M.S. Entomology – University of Missouri; Ph.D. Environmental Toxicology – Clemson University
Experience: Seven years of experience working for APHIS preparing ecological risk assessments and providing assistance on environmental compliance. Prior experience before joining APHIS includes other government and private sector work regarding ecological risk assessments related to various environmental regulations.

Editor: Ryan Wimberly
Position: USDA-APHIS-WS, Operational Support Staff, Staff Wildlife Biologist, Madison, TN

Education: BS Wildlife Management and Ecology – Northwest Missouri State University
Experience: Special expertise in wildlife biology, ecology, and damage management. Sixteen years of service with APHIS Wildlife Services, including operations and research, conducting a wide variety of programs, including bird damage research and management, livestock protection, invasive species management, wildlife hazard management at airports, property, and natural resource protection. Expert in preparing environmental documents for WS programs to comply with the National Environmental Policy Act and the Endangered Species Act.