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

CHAPTER XVIII

The Use of Hand Capture and Biological Sampling in Wildlife Damage Management

February 2018

Peer Reviewed Final

February 2023

THE USE OF HAND CAPTURE AND BIOLOGICAL SAMPLING IN WILDLIFE DAMAGE MANAGEMENT

EXECUTIVE SUMMARY

USDA-APHIS-Wildlife Services (WS) uses hand capture methods and tools for specific wildlife damage management projects. These types of projects can include removing wildlife from areas where their populations are overabundant or causing damage to resources such as aircraft and aquaculture. Other projects include picking up animals in distress (injured, entrapped inside a structure, or sick), monitoring wildlife for potential disease, and collecting eggs and nestlings from species in areas where they could inflict damage, such as gulls and geese nesting on or near airports. An annual average of about 8,500 animals were captured using hand methods and tools, and 51,000 eggs were gathered between FY11 and FY15. Birds were involved in 59% of the hand capture activities of WS, mammals 23%, and reptiles, amphibians, and fish 18%. Using hand capture in wildlife damage management projects by WS includes direct hand capture and the use of hand tools, such as catch poles, hand gathering scat samples, denning (the process of removing animals from dens), and the hand removal of beaver dams using rakes. Hand capture methods are usually not associated with the take of nontarget animals because capture is directed at a specific animal. Additionally, 55,000 biological samples (e.g., DNA, vector, swabs, etc.) were collected from animals to monitor for zoonotic diseases and other animal health interests. Biological samples were obtained using "*sharps*" such as syringes, needles, razors, and scalpels to collect tissue, hair, blood, and other biological samples from carcasses and live animals. Human health and safety and environmental risks of hand capture as a method in wildlife damage management are mostly limited to potential bites from animals to WS personnel directly handling animals. WS employees are trained appropriately to handle animals captured using hand methods and tools, minimizing this risk.

TABLE OF CONTENTS

1 INTRODUCTION

Personnel with the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) Program use hand capture methods and tools to take sick, injured, entrapped, or less mobile animals and to remove animals that are causing damage to property, agricultural resources, and natural resources. Most adult animals WS captures using hand tools, and methods are injured, incapacitated, or trapped inside a structure (e.g., a bird that flies through an open window or door and cannot escape). WS may take eggs, nestlings from nests, and young of burrowing rodents or denning predators to control populations in a given area or reduce damage to resources. WS may also remove beaver[1] dams using hand tools, such as rakes, and collect biological samples from animals.

WS personnel may immobilize or euthanize captured animals with the appropriate drugs per WS Directive 2.430[2] ("Controlled chemical immobilization and euthanasia substances") or another method in accordance with WS Directive 2.505 ("Lethal control of animals"), which discusses the lethal control of animals and the use of proper euthanasia methods. Animals may be translocated according to WS Directive 2.501 ("Translocation of wildlife") or transferred to wildlife rehabilitators or other agencies. Denning is a technique used to manage damage to livestock and other resources and/or reduce threats to human health and safety caused by predators or burrowing rodents (see Tischaefer 2020). Denning is conducted in accordance with WS Directive 2.425 ("Denning") and is only done for predators that excavate dens and burrowing rodents. Capturing animals using hand methods and tools is often the quickest way to resolve a problem and may create the least stress for an animal because, if capture is done promptly, stress and pain are not prolonged.

This human health and ecological risk assessment provides a qualitative evaluation of the potential risks and hazards to human health, nontarget fish and wildlife, and the environment resulting from the capture of wildlife using hand methods and tools, hand gathering wildlife, removing eggs, obtaining biological samples, and removing beaver dams by hand or with hand tools. The methods used in this risk assessment follow standard regulatory guidance and methodologies and generally conform to other Federal agencies such as the U.S. Environmental Protection Agency (USEPA) (National Research Council 1983; USEPA 2017).

1.1 Methods and Tools used for Hand Capture and Biological Sampling

Hand capture and the use of hand tools have specific functions and vary in use. Direct hand gathering, catch poles, and snake tongs are the primary methods used in hand capture. The primary hand tools that WS uses are rakes and cultivation prongs for beaver dam removal and shovels for denning. Collecting biological samples may occur with scalpels, knives, syringes, and other devices, tools that often easily cut, puncture, or scrape, thus getting the name "sharps." Sampling can include minimally invasive procedures such as tracheal, cloacal, or fecal swabs. Additionally, devices such as ladders and booms may be used to access animals or their nests.

- **Hand Gathering** – Hand gathering is used when picking up small or injured mammals, birds (including eggs and nest removal), reptiles (including eggs), amphibians, fish, and fecal samples. Hand gathering requires the most direct contact with an animal. WS personnel adhere to guidelines in WS Directive 2.635 ("Zoonotic diseases and personal protective equipment") when handling animals and collecting biological samples with their hands. WS

[1] Scientific names for species are given in the text only for species not discussed in the Wildlife Damage Management Methods Risk Assessment Introduction (Chapter 1).

[2] All WS Policy Directives referenced in this document can be found @ http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/wildlifedamage under Wildlife Damage – WS Program Directives.

personnel often wear personal protective equipment (PPE) such as gloves and protective clothing. Gloves, especially when handling animals showing disease symptoms and collecting biological samples, reduce the chance of disease spread and contamination of biological samples.

- **Catch Poles** – A catch pole is a pole with a tightening grip cable, a quick-release knob, and a cable loop that tightens around an animal's neck or body and holds the animal away from the captor (Figure 1). Catch poles are used to capture and restrain animals. Animals most often restrained with catch poles are incapacitated animals, such as a deer injured in an automobile accident, or entrapped animals, such as an opossum stuck in a window well at a residence. Catch poles are also used to release animals from traps, such as nontarget animals captured inadvertently or target animals being relocated, handled for collection of biological samples, or other reasons. If an animal is to be euthanized, especially where firearms or other euthanasia methods would cause a safety concern, catch poles are often used to put the animal into a holding cage. The animal is then transported in a cage to a safe location where euthanasia methods can be employed.

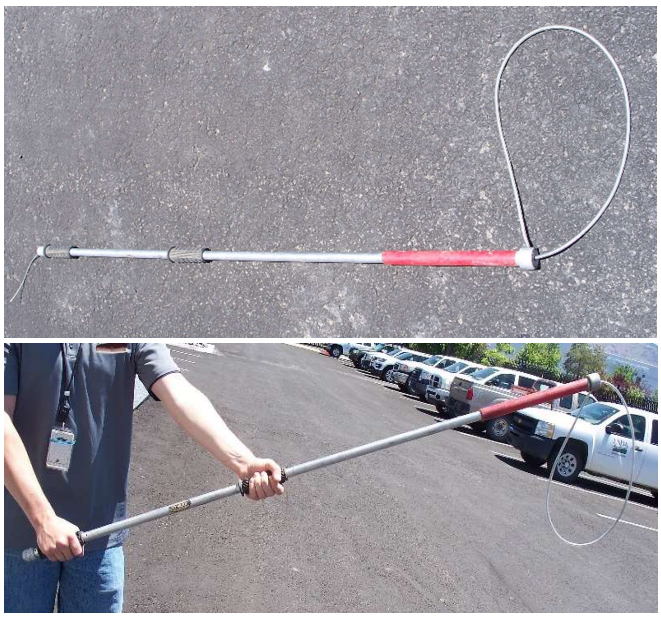

Figure 1. A catch pole with a grip loop and tightening cable, and a catch pole being held to give an indication of length. The grip loop is for capturing the animal and a cable release allows the cable to be loosened.

- **Additional Hand Capture Methods –** WS could use additional hand capture methods to capture animals that function similarly. Those methods live-capture animals by grabbing or restraining animals, such as snake tongs, "Y" poles, and poultry hooks. Snake tongs consist of a pole that allows the user to grab and hold a snake at a distance. "Y" poles consist of a pole with a "V" at one end that allows users to place the "V" over an animal to pin them against the ground or other surface and restrain them at a distance from the user. Poultry hooks generally consist of a pole with a small hook at the end, which allows WS personnel to slide the hook over a bird's foot from a distance to hold it in place for capture.

- **Hand Tools** – Some hand tools that WS could use for various purposes include telescoping extension poles, shovels, and cultivation rakes. WS may use telescoping extension poles to remove nests in out-of-reach locations, shovels to excavate dens, and rakes to remove beaver dams.

- **Ladders and Mobile Elevated Working Platforms** – Ladders, ladder booms (e.g., "cherry pickers – Figure 2), hydraulic lift platforms, and other mobile elevated working platforms may be used to remove nests from high areas. WS removes nests to discourage nesting at a location, especially around airports, bridges, and other areas where they are causing damage. WS personnel that use this type of equipment, especially mobile elevated working platforms, are trained in their use because these machines can present risks in and of themselves.

Figure 2. A cherry picker boom which is used to reach nests in high places. *Picture from http://lvexpo.com/.*

- **Biological Sampling Methods** – WS may use "*sharps*" – anything that can puncture, cut, or scrape skin – to collect biological samples. Examples include syringes for blood sampling and scalpels or knives for tissue and/or tooth sampling. Personnel wear examination gloves to collect samples (e.g., fecal and DNA) to minimize contamination of samples and exposure to zoonotic diseases. PPE is worn, such as gloves, eyeglasses, and masks, especially when working with animals known to have or show disease symptoms, to minimize potential exposure while handling animals. Additionally, WS personnel receive training to reduce the risks of handling sharps.

1.2 Use Pattern

The annual average number of target animals captured with methods and tools for hand capture and hand gathering from FY11 to FY15 is shown in Table 1. A total of 5,067 animals per year were captured using hand gathering and then euthanized using other methods. A total of 1,932 animals per year were relocated or released after capture using hand gathering or hand tools (i.e., catch pole). A total of 41,447 eggs were gathered by hand per year. A total of 382 dens and burrows of predators and rodents were taken per year with an estimated 1,435 animals; of that number, 8% were predators, and 92% were rodents. Catch poles were used to capture an annual average of 109 animals, 61% being predators. Hand tools such as cultivation rakes and telescoping poles were used to remove 8,694 beaver dams and 9,548 bird eggs per year.

WS used hand capture methods and tools to capture or gather an annual average of 8,510 animals, take 382 burrowing mammal dens (den occupants were estimated and added to the lethal take[3]), collect 50,995 bird and reptile eggs, and remove 8,694 beaver dams from FY11 to FY15 (Table 1). There were 268 known species captured using hand gathering methods and tools, reflecting the diversity of species that can be involved. Species caught using hand capture methods and tools can be injured, stuck, rescued, or freed by WS personnel. WS did not take any nontarget species using hand capture methods and tools. Because hand capture is directed at specific target animals, scenarios where a nontarget species would be involved rarely occur.

The annual average number of target mammal species that were taken by all hand capture or hand gathering methods for FY11 to FY15 is shown in Table 2a. Hand captured mammal species may be euthanized on location to minimize pain and stress, including those in distress from an injury, showing disease symptoms, or involved in denning. An annual average of 1,435 mammals were taken in denning operations.

[3] Beaver dens may be beaver lodges that were removed following the draining of a beaver pond. Occupants would have likely left if the water in a pond drained. Beaver dens in dams are sometimes removed when the water in a pond is low and subsequently filled so that the dam does not collapse when the water returns. Though not likely, these could have occupants and thus take was estimated to be conservative.

Table 1. The annual average number of animals captured with hand capture tools and methods by WS in Wildlife Damage Management activities from FY11 to FY15 throughout the United States.[4]

ANNUAL AVERAGE SPECIES TAKEN WITH HAND CAPTURE METHODS AND TOOLS				
SPECIES[1]	TARGET			Burrows[2]/Dams
	Killed[3]	Released	Eggs	Number
HAND CAPTURE – Capture by Hand				
Mammals (54 sp.+ unidentified bats)	177	311	-	-
Birds Associated with Land (83 sp. + 4 sp. empty nest + unid.	1,444	84	4,686	-
Birds Associated with Water (64 sp.)	2,080	1,317	36,243	
Reptiles (54 sp. + unidentified turtles)	1,306	179	518	-
Amphibians (4 sp.)	60	4	0	-
Fish (1 sp.)	0	4	0	-
HAND CAPTURE TOTAL (260 known sp.)	**5,067**	**1,899**	**41,447**	**-**
HAND TOOLS – Denning[1]				
Predators (5 sp.)	129	-	-	34 Dens
Rodents (4 sp.)	1,306	-	-	348 Burrows
DENNING TOTAL (9 sp.)	**1,435**	**0**	**0**	**382**
HAND CAPTURE – Catch Pole				
Predators (12 sp.)	49	17	-	-
Other Mammals (8 sp.)	1	3	-	-
Birds (3 sp.)	23	0.4	-	-
Reptiles (12 sp. + 1 unidentified 0.2)	3	13	-	-
CATCH POLE TOTAL (35 sp. + unid. (1 sp. max))	**76**	**33**	**-**	**-**
HAND TOOLS - Dam Rakes/Cultivation Prongs				
Beaver Dams	0	0	0	8,694 Dams
RAKES (1 sp.)	**0**	**0**	**0**	**8,694**
HAND TOOLS – Nest/Egg Removal				
Birds Associated with Land (20 sp. + 13 sp. empty nests)	-	-	774	-
Birds Associated with Water (12 sp. + 1 sp. empty nest)	-	-	8,774	-
HAND TOOLS – NEST-EGG REMOVAL TOTAL (32 sp.)	**-**	**-**	**9,548**	**-**
AVE. ANNUAL ANIMALS TAKEN WITH HAND CAPTURE	**6,578**	**1,932**	**50,995**	**382/8,694**

[1]Species taken are detailed in Tables 2a, 2b, and 2c.

[2]Den occupants estimated in Table 2a, but given here.

[3]Animals were captured alive and were subsequently euthanized using other methods.

Of these, 85% were California ground squirrels, 7% were coyotes, 5% were woodchucks, and 1% striped skunks. Several raccoons and skunks were captured because they exhibited disease symptoms, such as rabies (*Lyssavirus* spp.) and canine distemper (*Canine morbillivirus*). The remainder were typically injured or entrapped inside structures such as houses and window wells. Bats are often captured from inside residences and airport terminals. Most of the larger animals (e.g., coyote, feral dog) and some smaller ones (e.g., beaver, opossum) were taken with the use of catch poles. Finally, 8,694 beaver dams per year were removed by hand or with tools such as rakes in areas where they had flooded crops, residences, roads, and other resources.

More than 150 free-roaming and feral dogs were taken annually from FY11 to FY15, especially in aircraft movement areas, and are generally turned over to local animal control offices. Free-roaming dogs can be coaxed to come to people easily because they are usually domesticated pets. Two gray wolves, a federally listed threatened and endangered species, and a Louisiana black bear, a federally listed threatened and endangered species in FY11-15, were captured and released. Several animals were freed from materials that entrapped them, such as fences and netting. If animals had injuries that were deemed not survivable, they were euthanized. However, some were taken to wildlife rehabilitators if injuries were minor. Hand capture can be a very effective method and a method that often leads to the least physical trauma. For example, hand capture was also effectively used for a study involving bighorn sheep lambs, whereas other methods may have been more traumatic (Smith et al. 2014).

[4] Minor discrepancies exist between Table1, and Tables 2a, b, and c, due to rounding errors.

Table 2a. The annual average number of target mammal species taken with hand capture methods and tools by WS in Wildlife Damage Management activities for FY11 to FY15 throughout the United States.

SPECIES[1]	TARGET			SPECIES[1]	TARGET		
	Killed	Freed	Den[2]		Killed	Freed	Burrow[2]
MAMMALS							
Virginia Opossum^	51	7	0.6	American Beaver	12	1	6
Feral/Free-roaming Cat*	4	41	-	- Beaver Dams[4]	N/A	N/A	(8,694)
Coyote	112	0	25	Woodchuck	79	1	38
Gray Wolf[T&E]	0	0.4	-	California Ground Squirrel	1,219	0.2	305
- Feral/Free-roaming Dog*	1	152	-	North American Porcupine	0	32	-
Black Bear	0.8	1	-	Rabbit/Other Rodent (18 sp.)[3]	11	6	0.2
- Louisiana Black Bear[T&E]	0	0.2	-	Brazilian Free-tailed Bat	3	8	-
Raccoon	94	16		Big Brown Bat	2	42	-
Striped Skunk	44	2	7	Unidentified Bats[3]	4	4	-
Other Predator (11 sp.)[3]	20	3	2	Other Mammals (9 sp.)[3]	3	7	-
Hoofed Mammals (6 sp.)[3]	5	7	-	**GRAND TOTAL (56 sp.)**	**1,665**	**331**	**384**

* Introduced Species ^ Translocated widely in North America T&E – Threatened and endangered sp. N/A - Not applicable

[1] Species with a lethal and nonlethal take greater than 10 are given, otherwise combined in categories.

[2] An estimate was made for den/burrow occupants for denning if not given since the WS Management Information System (MIS) database requires the number of dens taken to be recorded and not the number of occupants. The estimate was added to the number lethally taken since most are euthanized (some may be given to wildlife rehabilitators, but the outcome is unknown in MIS). Estimates per burrow were 8 for brown rat, 4 for opossum, coyote, red fox, and California ground squirrel, 3 for striped skunk and badger, and 2 for beaver and woodchuck. Thus, for example, of the 112 coyotes taken, at least 100 were den occupants (25 x 4).

[3] Other mammals and possible unidentified bat species are listed in Appendix 1.

[4] Dams taken by hand or with hand tools (e.g., four-pronged cultivators/rakes) were given but not included in the total.

Table 2b. The annual average number of target bird species taken with hand capture methods and tools by APHIS-WS in Wildlife Damage Management activities for FY11 to FY15 throughout the United States.

SPECIES[1]	TARGET			SPECIES[1]	TARGET		
	Killed	Freed	Eggs		Killed	Freed	Eggs
BIRDS							
Birds Associated with Land				**Birds Associated with Water**			
European Starling*	256	0.2	496	Mew Gull	44	4	683
Common Grackle	11	0.6	283	Ring-billed Gull	2	0.6	21,498
Other Blackbirds (5 sp.)[2]	6	0	26	California Gull	56	0.2	20
Rock Dove*	248	3	220	Great Black-backed Gull	9	0	206
Mourning Dove	12	3	88	Glaucous-winged Gull	226	0.2	638
Other Doves (4 sp.)[2]	6	0.2	6	American Herring Gull	375	2	7,812
American Crow	8	0.4	84	Other Larids (5 sp.)[2]	4	0.4	69
Common Raven	26	2	100	Feral Domestic Graylag Goose*	7	3	39
Other Corvids (4 sp.)[2]	1	0.4	17	Canada goose	682	22	8,787
Western Osprey	1	5	48	Mute Swan	25	6	163
Bald Eagle	0	1	0	Gadwall	0	19	0
Red-tailed Hawk	1	11	18	Mallard	44	65	108
Golden Eagle	0	0.2	0	- Feral Domestic Mallard*	11	30	61
American Kestrel	2	10	0.8	Other Waterfowl (18 sp.)[2]	7	14	81
Other Raptors (20 sp.)[2]	3	27	12	Laysan Albatross	0	603	86
Red Junglefowl*	7	0	7	Wedge-tailed Shearwater	0	24	0
- Domestic Chicken*	11	1	4	Newell's Shearwater[T&E]	0	0.6	0
Ring-necked Pheasant (captive)*	500	0	0	Double-crested Cormorant	32	486	2,188
Other Gallinaceous Birds (2 sp.)[2]	0.2	4	2	Other Waterbirds (10 sp.)	0	3	71
Barn Swallow	165	0.4	1,422	Yellow Bittern*	9	0	417
Cliff Swallow	23	1	1,954	Western Cattle Egret^	190	26	1,928
Cave Swallow	84	0	0.8	American Coot	364	0.2	0
Other Aerialists (7 sp.)[2]	2	4	61	Other Wading Birds (6 sp.)[2]	2	1	54
Nonpasserine Forest (3 sp.)[2]	3	0	3	Killdeer	12	2	86
American Robin	22	0.6	147	Other Shorebirds (7 sp.)[2]	1	4	21
House Sparrow*	34	0.6	331	**Total Water Birds (64 sp.)**	**2,102**	**1,316**	**45.016**
Other Passerines (21 sp.)[2]	10	8	57	Unidentified Birds	0	0	75
Total Landbirds (84 sp.)	**1,442**	**84**	**5,388**	**GRAND TOTAL (148 sp.)**	**3,544**	**1,400**	**50,479**

* Introduced Species ^Translocated widely in North America

[1] Species with lethal and nonlethal take, and 1/10 the eggs that are > 10 are given, otherwise combined into categories (T&E species are given).

[2] Other birds are listed in Appendix 1.

The annual number of birds taken with hand capture methods and tools by WS from FY11 to FY15 is shown in Table 2b. The table is separated between birds associated with land and water. Gulls can pose a hazard at airports where they like to feed and loaf. In the United States, gulls were involved in an annual average of 400 of the 9,200 wildlife strikes with aircraft with identified species between FY11 and FY15; 45 involved more than one bird (FAA 2017). Gulls can be extremely dangerous for aircraft and passengers, possibly causing extensive damage (averaging $2.3 million dollars in aircraft damage annually). WS, while protecting aircraft, took 716 gulls, mostly nestlings or injured birds on runways, and 30,926 eggs of larid species annually between FY11 and FY15. Swallows, also nesting at airports, were captured most of all the land birds. In FY14, WS euthanized 2,500 pheasants (annual average of 500) due to an outbreak of avian cholera to prevent the disease from spreading to other domestic and wild birds. The total number of land birds and birds associated with water that was taken using hand capture by WS was minimal and would not harm any of their populations.

The annual number of reptiles, amphibians, and fish that were taken with hand capture methods and tools from FY11 to FY15 by WS personnel is shown in Table 2c. Brown tree snakes, an invasive species on the island of Guam, had the highest take of hand captured reptiles at an average annual take of 1,294 between FY11 to FY15. Night-time spotlight searches of fences with hand capture is a primary brown tree snake capture method (Hall 1996, Engeman and Vice 2001). The green iguana, an invasive species in Florida, was the sole species of reptile with eggs taken from FY11 thru FY15, with an annual average of 518 eggs collected. WS captured and relocated snakes and other reptiles from runways, roadways, and houses. For example, WS relocated two northern Mexican garter snakes, a threatened and endangered species, from roadways where they would have been killed. Less than 100 amphibians and fish are taken by hand capture annually. The majority of these were the marine toad, another invasive species in Guam. Marine toads are highly toxic to dogs, causing toad venom toxicosis. WS monitors kennels for these toads to protect their detector dogs from exposure.

Table 2c. The annual average number of target reptiles, amphibians, and fish taken with hand capture methods by APHIS-WS in Wildlife Damage Management activities for FY11 to FY15 throughout the United States.

SPECIES[1]	TARGET			SPECIES[1]	TARGET		
	Killed	Freed	Eggs		Killed	Freed	Eggs
REPTILES, AMPHIBIANS, AND FISH							
Crocodilians (2 sp.)[2]	0.2	7	0	W. Diamondback Rattlesnake	3	65	0
Pond Slider^	0.6	11	0	Other Snakes (32 sp.)[2]	4	33	0
Common Snapping Turtle^	0	14	0	Unid. Nonvenomous Snakes[3]	0	3	0
Other Turtles (13 sp.)[2]	0	26	0	**Reptile Total (59 sp.)**	**1,310**	**191**	**518**
Unid. Turtles (26 poss. sp.)[2]	0	9	0	Marine Toad*	60	0	0
Green Iguana*	2	0.4	518	Other Toads (3 sp.)[2]	0	4	0
Other Lizards (4 sp.)[2]	0	1	0	**Amphibian Total (4 sp.)**	**60**	**4**	**0**
Brown Tree Snake	1,294	0	0	Flathead Mullet	0	4	0
Gopher snake	6	21	0	**Fish Total (1 sp.)**	**0**	**4**	**0**
Terrestrial Garter Snake	0.2	0.2	0	**TOTAL Table 2c (64 sp.)**	**1,370**	**199**	**518**
- North Mexican Garter Snake[T&E]	0	0.4	0	**TOTAL Tables 2a, 2b, 2c (268 sp.)**	**6,579**	**1,930**	**50997**

* Introduced Species

^Translocated widely in North America

[1] Species with lethal and nonlethal take, and 1/10 the eggs that are > 10 are given, otherwise combined into categories (T&E species are given).

[2] Other categories are listed in Appendix 1.

[3] Unidentified nonvenomous snakes were captured in Florida and Missouri.

The WS National Wildlife Disease Program, National Feral Swine Damage Management Program, and Rabies Management Program, along with all other WS employees, collect biological samples from animals while in hand. Animals can be taken in Wildlife Damage Management (WDM) projects, including hand captured, road-killed, found dead, or hunter-

harvested or captured with other methods such as cage traps. The biological samples WS collected from internal (e.g., blood, tissue, brain stem, and mouth or anal swab), external (e.g., whole carcass, tooth, and external DNA samples, such as hair), and environmental (fecal samples) sources, and samples of parasites (e.g., flukes) and disease vectors (e.g., ticks) are shown in Table 3a. The disease testing conducted using these samples is shown in Table 3b. It should be noted that one animal can supply many different samples. WS has standard methods to collect biological samples to ensure proper sample collection, minimize exposure to WS personnel, and avoid sample contamination and stress to the animal. Biological samples are often collected with "*sharps,*" including syringes, needles, scalpels, microtome blades, razors, knives, Pasteur pipettes, and scissors, which have risks associated with them and will be discussed.

Table 3a. The annual average number of biological samples collected by WS in WDM activities from FY11 to FY15 throughout the United States. Samples were collected from internal (blood, tissues, brain stems, teeth, and mouth or anal swabs), external (complete carcass and DNA samples), and environmental (fecal samples) sources, and from parasites and disease vectors, such as ticks and fleas.

ANNUAL AVERAGE SAMPLES TAKEN							
Class	**Group**	**Sp.**	**Internal**	**External**	**Environ.**	**Invertebr.**	**Total**
Mammal	Predator[1]	32	28,321	255	195	1,067	29,838
	Hoofed	13	14,587	46	337	119	15,089
	Other Mammal[2]	33	1,619	33	-	4	1,656
Bird	Assoc. w/ Water	72	6,676	54	96	126	6,952
	Assoc. w/ Land[3]	71	1,450	126	3	0.2	1,579
Reptile	Turtle	5	122	-	-	-	122
Invertebrate	Vector	na	-	-	-	29	29
TOTAL		**219**	**52,775**	**514**	**631**	**1,345**	**55,265**

1 Samples were taken from wolves and dogs, which are one species.
2 In addition, samples were taken from bats (all) and were not identified, but could have been any number of 40 species.
3 Samples taken from unidentified birds were also included in this category. These were often the remains from bird strikes with aircraft and were sent in for DNA analysis.

Table 3b. The annual average number of biological samples collected by WS in WDM activities from FY11 to FY15 throughout the United States to monitor the presence of different diseases.

ANNUAL AVERAGE SAMPLES OF DISEASES, PARASITES, AND OTHER MALADIES					
Disease	**Samples**	**Disease**	**Samples**	**Disease**	**Samples**
Rabies	18,617	Bovine Tuberculosis	490	Lyme Disease	60
Tularemia	4,996	West Nile Virus	412	Ticks	60
Plague	4,171	Canine Parvovirus	334	African Swine Fever	47
Avian Influenza	3,061	Salmonella	296	Canine Heartworm	41
Exotic Newcastle Disease	2,523	Wellfleet Bay Virus	211	Escherichia Coli	32
Swine Brucellosis	2,105	Equine Encephalitis (Eastern)	193	Echinococcosis	27
Pseudorabies	2,100	Porcine Reprod. & Resp.	193	Porcine Epidemic	25
Classical Swine Fever	2,069	Epizootic Hemorrhagic Disease	169	Ehrlichiosis	25
Chronic Wasting Disease	1,982	Avian Bornavirus	142	Bluetongue	25
Swine Influenza	1,973	Neosporosis	124	Bovine Brucellosis	20
Toxoplasmosis	1,902	Canine Distemper	96	Rocky Mtn. Spotted	16
Raccoon Roundworm	1,450	Lead Poisoning	92	Other Diseases*	1,836
Avian Paramyxovirus	961	Trichinellosis	82	Genetics	436
Leptospirosis	792	Giardiasis	78	Other Parasites	224
Hepatitis E	674	Foot and Mouth Disease	72	Other Tests	31

*Includes mostly diseases not in the MIS system, such as circovirus, protothecosis, and virulent Newcastle disease. However, most were unidentified in the MIS in the remarks and, thus, cannot be parsed out to specific diseases.

WS monitors the prevalence of diseases that can be infectious and transferable to humans (e.g., zoonotic); therefore, WS personnel can be at risk of contracting them should proper protocols not be followed, or an accident happens. Most biological samples collected by WS personnel are blood or tissue that are sent to a lab for processing. WS personnel collected an annual average of 55,265 biological samples from animals taken in WDM projects and animals found dead (e.g., road-kill) or hunter-harvested animals from FY11 through FY15. However, those that died from unknown causes create the most concern because they could have died from an infectious disease. Additionally, animals taken in WDM projects could include sick animals. From FY11 through FY15, WS collected an annual average of 18,617 samples for rabies, 4,996 for tularemia,

and 4,171 for plague. These three infectious diseases accounted for 50% of the biological samples collected for disease testing during this time.

2 HAZARDS

2.1 Human Health and Safety Hazards

Hand capture poses a safety risk to the person conducting the action because the person is often in direct contact with an animal or within arm's reach. Using catch poles, snake tongs, and other hand tools can facilitate capturing or sampling wildlife and minimize some risks. However, even with these tools, large and powerful animals such as small bears or deer are often a serious concern due to their strength. They may require a second person to assist or the use of immobilization drugs prior to handling[5]. Human health and safety hazards associated with hand capture include direct injury from the animal, including bites, scratches, and other direct physical impacts. Wild animals that are "cornered" can be very aggressive, even if it is a typically docile animal. Any wrong move can provide the animal with an opportunity to injure WS personnel.

Collecting biological samples with sharps presents its own risks, especially considering the potential for exposure to infectious diseases. WS personnel may get injuries from using sharps during sample collection, such as cuts, abrasions, or punctures. During collection, it is possible for the employee to accidentally poke or cut themselves while obtaining a biological sample, which could expose them to an infectious zoonotic disease, similar to risks faced by health care professionals. These will be discussed along with incidences of their occurrence. WS personnel are trained to collect the samples to ensure their safety and to obtain them correctly so as not to contaminate them. All WS personnel that use sharps, in collaboration with the APHIS Biosafety Officer, are required to watch "Safe Handling and Disposal of Sharps Training Video" and adhere to Standard Operating Procedure HS/WS 001.00 "Safe Handling and Disposal of Sharps in Laboratory and Field Settings within Wildlife Services".

WS personnel should carry a medical alert card, so medical personnel knows that diseases from animal exposure are a potential source of sickness. Animal bites and scratches must be reported (federal forms CA-1 or -2 and the APHIS Online First Report). Personnel who handle or are exposed to diseased wildlife are trained using disease-specific training manuals. Training manuals include instructions for collecting samples specific to that disease, sample storage, and sample shipping for testing. There are also in-person training courses, including Necropsy Lab and Wildlife Disease Preparedness Training, available for all WS employees through the WS National Training Academy.

2.2 Ecological Hazards

Ecological hazards associated with hand capture methods could include the unintentional injury or death of a target animal while trying to capture it, the capture of a nontarget animal, and ecological contamination from using varying hand capture and biological sampling methods. The injury or death of target species usually occurs when animals try to free themselves from structures or entrapped space and are hurt or killed unintentionally while being captured. WS personnel try to minimize these problems during hand capture activities, primarily by moving slowly, minimizing movements as much as possible, and staying calm. The capture of a nontarget species, though extremely unlikely, would also be an ecological risk. Hand capture methods do not contaminate water or result in the bioaccumulation of chemicals or other hazardous materials, with the exception of collecting biological samples. Collecting biological samples can result in

[5] Animals that have been dosed with immobilization drugs create different concerns, which are addressed in the Immobilization and Euthanasia Risk Assessment.

biohazards, primarily sharps such as needles, scalpel blades, and carcasses or parts thereof. These are disposed of in a manner consistent with WS Policies on disposal and state/local guidelines.

3 RISKS

3.1 Human Health and Safety Risks

WS personnel are at risk of harm from hand capture and biological sampling methods. WS personnel are trained in proper hand capture methods by supervisors. Risks to human health and safety have been minimized for WS employees who are well-trained to use various hand capturing and biological sampling methods properly. The common hazards related to hand capture and biological sampling are the risk of animal bites, sharps injuries, or contracting a disease. Some animals may be restrained, sedated, or euthanized soon after capture to minimize stress to the animal and for the safety of personnel handling the animals. As required by WS Directive 2.635, "Zoonotic Diseases and Personal Protective Equipment," all WS personnel who handle or are exposed to wildlife will be provided with biological sampling, disease exposure safety training, and PPE training. Use of PPE such as examination gloves, cut-resistant gloves, splash-proof aprons, protective eyewear, face masks, and Tyvek® coveralls and shoe covers while handling wildlife can significantly minimize exposure to zoonotic diseases. Injuries to WS personnel from animals captured using methods and tools for hand capture are anticipated to be minimal during any given year. In addition to PPE training, sharps training became mandatory in FY16. In order to ensure that a zoonotic disease is not spread, sharps containers are labeled as biohazardous waste and disposed of according to APHIS policy and state/local guidelines.

Typically, the public is not involved in WS hand capture activities and, for safety, is generally kept away from such activity sites to minimize the risk of injury. Members of the public with good intentions may try to help a sick, injured, or entrapped animal, which could result in injury. WS personnel have responded to requests for assistance prior to the public attempting to free an animal. Capturing injured animals could protect the public from being bitten or injured by an injured animal.

WS field and office employees filed an annual average of 79 Office of Workman's Compensation (OWCP) claims for injuries, including animal bites, lacerations and punctures, burns, strained backs, and other injuries that occurred on the job from FY13 to FY15[6]. WS operational field personnel annually averaged 3.0 bites or injuries from animals. One bite, or 0.3 of the 3.0 annual average, was from a bat captured by another agency that bit a WS employee while collecting a biological sample (testing for rabies and other diseases). Of the remaining bites, 0.7 were dog bites that occurred from hand gathering them at airports where they were a strike risk to aircraft, 0.7 were pet dogs at private residences while WS personnel were contacting people that had requested WS assistance, and 1.3 were animals captured in various traps that were able to bite the WS employee; two of the latter were while the animal was being transferred to another agency. Thus, an average of 2.3 bite incidents were related to capturing animals alive while hand gathering (0.7), transferring custody to another agency after capture (0.7), relocating an animal (0.3), in the process of euthanizing a live-captured animal (0.3), and while handling an animal for biological sampling (0.3). For context, WS operations annually average the lethal take of 43,576 and released 11,432 predators with methods conducive to being bitten from FY13 to FY15. On average, the bite ratio from released animals is one bite per 5,700 releases. For animals to be euthanized, the ratio was much less at one bite for 145,000 animals taken lethally. Overall, the bite ratio was one bite for every 18,000 animals captured with methods where the animal would be captured alive. Thus, bites occur, but the occurrence is low.

[6] WS started collecting claims records nationally in FY13. Thus, data was only available for a three-year period.

In addition to field personnel, from FY13 to FY15, personnel from the WS National Wildlife Research Center had an annual average of 1.0 animal bites or injuries from research animals, with bites from a skunk (0.3) and a rat (0.3), and a bone fracture from feral swine (0.3). Lab animal bites typically come from caged animals during routine maintenance or research. Thus, handling animals as part of operations or research duties has some risks. This is a minimal risk compared to the thousands of animals handled, but a risk nonetheless.

WS employees filed an annual average of 83 Incident Reports for injuries, including animal bites, lacerations and punctures, burns, strained backs, and other injuries that occurred on the job from FY16 to FY20. WS operational field personnel annually averaged 5.0 bites or injuries from animals. An average of 1.6 bites were from dogs and cats that occurred from hand gathering them at airports where they were a strike risk to aircraft or were pets at private residences while WS personnel contacted people requesting WS assistance. The remaining bites (3.4 per year) were animals captured in various traps that could bite the WS employee. The numbers and types of incidents are similar to those reported during FY13-15.

When WS personnel are using methods and tools for hand gathering animals, including those showing disease symptoms or injured, they approach animals cautiously to reduce the chance of panic in the animal, which can have unknown results. The primary goal is to get the animal under control without causing it to flee. After WS captures the animal, the risk of injury post-capture is minimal, but the highest risk is typically from transporting or transferring custody of an animal. Such captured animals have injured five employees or less per year. Risks to employees handling captured animals are reduced by using the appropriate methods to handle animals and using multiple personnel to handle large animals such as deer. A more obvious risk is associated with the release of captured animals. WS employees usually carry a catch pole to move the animal safely. It should be noted that 2 bites in three years, 0.7 annually, occurred as dog attacks; this again is a minimal number as the Centers for Disease Control (CDC 2003, 2015) estimates 4.5 million dog bites from the 68 million owned dogs occur annually throughout the United States with 800,000 requiring medical attention. Thus again, we believe the risk of bites from dogs and other animals to WS personnel is below the norms and, therefore, minimal.

Sharps used to collect samples cause injury to personnel using them or personnel in the vicinity of a project where they are being used. From FY13 to FY15, WS personnel reported an average of 3.7 mishaps annually. While the number of reported sharps mishaps increased in FY16-20 to 6.8 mishaps annually, CDC (2011) estimated that 385,000 sharps-related injuries occur annually in United States hospitals, which gives a clear picture of risk. WS is concerned with the number of incidences and began requiring training for all employees handling sharps to obtain biological samples in FY16. The sharps training emphasizes preparing work areas with all necessary equipment ahead of time, using sharps with safety features, substituting plastic ware for glassware, disposing of needles properly, and working in well-ventilated areas or upwind of contaminated sites.

In addition, field personnel come into contact with disease vectors such as ticks. From FY13 to FY15, WS personnel averaged 3.0 recorded tick bites annually. From FY16-20, WS personnel averaged 21.4 recorded tick bites annually. It should be noted that the reporting of tick bites has increased significantly due to an increased awareness of the need to report tick bites. It is not known if the tick bites transferred tick-borne diseases. Additionally, one person became infected with giardiasis during beaver damage management, but it is unknown if it was from handling a beaver carcass. Giardiasis is caused by a microscopic parasite called *Giardia lamblia.*

WS personnel could be exposed to infectious diseases such as rabies from field and laboratory activities. From FY13 to FY15, WS had an annual average of 4.0 bites, 3.7 sharps punctures/lacerations (it is unknown if a biological sample was taken first), 3.0 bites from disease vectors, specifically ticks, and 0.3 known diseases. None of the animals involved in the incidents were identified as subsequently diseased with the exception of fluids from tissue that came from a known rabid skunk, which splashed into the eye of a researcher. Thus, a potential for 11 incidences per year from FY13 to FY15 caused concern, including the potential for exposure to a virulent disease such as rabies. From FY16 to FY20, WS had an annual average of 5.0 bites, 6.8 sharps punctures/lacerations (it is unknown if a biological sample was taken first), and 21.4 bites from disease vectors, specifically ticks. One of the animals involved in the incidents was identified as subsequently diseased (rabies-positive bat). Thus, a potential for 33.2 incidences per year from FY16 to FY20 caused concern, including the potential for exposure to a virulent disease such as rabies. WS personnel can obtain the pre-exposure rabies prophylactic series with periodic monitoring of titer levels and follow-up boosters to reduce the potential for contracting the disease if exposed through a bite, laceration, or contact with animal fluids (HS/WS 002.00 "Participation in the APHIS Occupational Medial Monitoring Program" and HS039.00 "Rabies vaccinations and titer checks"). During FY16-20, 109 employees had rabies titer checks per year. Employees who suffer a work-related bite, laceration, or contact with animal fluids from a rabies vector species receive post-exposure rabies vaccinations as covered by the Office of Workers' Compensation Program.

Other injuries can occur during hand captures, such as a "*slip and fall*" while pursuing a target animal. Of the injuries, WS employees had an average of 19 injuries from falls, slips, twists, and repetitive activities that resulted in lacerations, sprains, contusions, strains, compression bruises, and fractures that were associated with field activities.

3.2 Ecological Risks

Ecological risks are limited to the unintentional injury or death of target animals that are hand captured or the risk of capturing nontarget animals. The risk of injury or the unintentional death of a target animal can be minimized by proper training in animal handling techniques for employees and maintaining the proper number of personnel on-site to handle captured animals efficiently. A study on the mortality rates of young pronghorns being captured showed that with proper precautions, one might handle young pronghorns without exposing them to additional risk (Byers 1997).

Risks to nontarget animals are negligible to non-existent as hand capturing uses direct contact, only capturing the animals intended. The number of target mammals taken with hand capture methods during FY11 to FY15 annually averaged 8,510, with 6,578 captured and subsequently euthanized. No nontargets were taken, and no animal was injured or killed unintentionally. Thus, data covering FY11 to FY15 showed no risks to target and nontarget animals. However, it could potentially happen, but the risk is believed to be negligible.

It should be noted that just the presence of humans in particular areas could have risk factors for nontarget species. However, WS personnel did not report any occurrence where they were responsible for disrupting any nontarget animals unintentionally. Capturing breeding adults of colonially nesting species can entail risks of nest failure and even colony abandonment, especially in species that react strongly to human disturbance (Courtot et al. 2016). WS has not seen this as a problem, given that operations in the field typically do not cause disturbances in areas over a long period of time.

4 UNCERTAINTIES AND CUMULATIVE IMPACTS

WS understands the potential risks associated with hand capturing methods, the use of hand tools, and associated methods and has developed directives and training to mitigate the risks to workers and animals. Uncertainties relate to the unpredictability of animals and the unique situation of each encounter. An animal's behavior following release, though mostly predictable, can occasionally be different than expected. Uncertainty in this risk assessment is negligible as WS has at least 100 years of using various hand-capturing methods for WDM activities and understands the potential risks of using these methods. The knowledge gained from this experience has helped reduce risks associated with hand capturing methods, especially regarding human health and safety, primarily in developing standard operating procedures and WS directives. Relatively few injuries have occurred due to biologcial sampling, and WS is continuing to modify training manuals to minimize the risks of biological sample collection.

Cumulative impacts could occur to target animals if other factors are occurring to populations simultaneously as WS WDM activities. Additionally, the "Introduction to WS Methods Risk Assessments," Chapter 1, gives all species taken by WS from FY11 to FY15 and shows no significant impacts from a population standpoint. From a human health perspective, using hand capture methods in WDM will not have any known cumulative impacts.

5 SUMMARY

WS uses hand capture techniques, including catch poles, hand tools, and hand gathering, to capture animals as a component of an integrated approach to WDM. WS uses hand capturing and hand tool methods for specific projects as necessary. WS also uses methods and tools to hand capture animals for biological sampling and surveillance. These methods and the animals captured can potentially cause disease or injury to WS personnel. An annual average of 11 incidents were reported to OWCP from FY13 to FY15 by WS personnel from all sources associated with this Risk Assessment, including animal bites (4.0), sharps (3.7), ticks (3.0), and disease (0.3). WS ensures employees are trained and certified in the proper use of methods and tools of hand capture systems and proper biological sample collection methods. Considering the type and severity of injuries, WS believes the number of incidents was minimal. WS will continually strive to reduce this number, but some will likely always occur.

APHIS evaluated the potential human health and environmental risks from WS' proposed use of hand capturing and hand tool methods and determined that the risks to human health and the environment are negligible. Risks to workers are low based on WS personnel being trained in the proper use of methods and wildlife handling. Risks to the general public are negligible or beneficial because WS removes the sick or injured animal, minimizing exposure to the public. Hand capture methods primarily live-capture animals and are not methods that would contaminate water or result in the bioaccumulation of hazardous materials. Ecological hazards associated with hand capture methods are generally limited to the unintentional injury or death of the target species, primarily those entrapped in structures where easy capture or removal may not be possible. Training of WS staff in animal handling techniques reduces the risks of injury or death to animals. Risks are negligible for nontarget animals based on how WS uses the different hand capture methods and tools.

6 LITERATURE CITED

Byers, J.A. 1997. Mortality risk to young pronghorns from handling. J. Mammalogy 78(3):894-899.

Centers for Disease Control (CDC). 2003. Nonfatal dog bite – related injuries treated in hospital emergency department – United States 2001. CDC, Morbidity & Mortality Weekly Report 52(26):605-610.

_____ CDC. 2011. Stop sticks campaign. CDC, Nat'l Instit. Occup. Safety and Health (NIOSH). Last update June 24. @ https://www.cdc.gov/niosh/stopsticks/sharpsinjuries.html. *Accessed 1/11/2018.*

_____ CDC. 2015. Preventing Dog Bites. CDC, National Center for Emerging and Zoonotic Infectious Diseases. May 18. @ https://www.cdc.gov/features/dog-bite-prevention/. *Accessed 8/14/2017.*

Courtot, K.N.; Kerr, L.H.; Lyons, D.E.; Adkins, J.Y.; Roby, D.D. 2016. A low-disturbance capture technique for ground-nesting double-crested cormorants (*Phalacrocorax auritus*). Waterbirds, 39(2):193-198.

Engeman, R. M., and D.S. Vice. 2001. A comparison of three trap designs for capturing brown tree snakes on Guam. Pacific Conservation Biology, Univ. Nebr., Lincoln DigitalCommons@University of Nebraska - Lincoln 7(1), 4-8.

Federal Aviation Administration (FAA). 2017. Search the FAA Wildlife Strike Database. U.S. Dept. Transport., FAA, Wash., D.C. @ https://wildlife.faa.gov/database.aspx. *Accessed 1/11/2018*.

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

National Research Council. 1983. Risk Assessment in the Federal Government: Managing the Process. NRC Comm. Inst. Means for Assessment of Risks to Public Health. National Academies Press, Washington, DC. 190 pp.

Smith, J. B., Walsh, D. P., Goldstein, E. J., Parsons, Z. D., Karsch, R. C., Stiver, J. R., ... & Jenks, J. A. 2014. Wildlife Society Bulletin, 38(1), 165-174.

Tischaefer, R. 2020 Coyotes. Wildlife Damage Management Technical Series. U.S. Department of Agriculture, Animal & Plant Health Inspection Service, Wildlife Services. 10pp

U.S. Environmental Protection Agency (USEPA). 2017. Pesticide science and assessing pesticide risks. USEPA, Office of Pesticide Programs @ https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks. *Accessed 1/11/2018.*

7 PREPARERS

7.1 APHIS WS Methods Risk Assessment Committee

Writers for "The Use of Hand Capturing and Biological Sampling in Wildlife Damage Management"

Writer: Nikeeya Ali
Position: USDA-APHIS-WS, Operational Support Staff, Summer Intern 2017
Education: Pursuing BS degree in Journalism, minor in Broadcasting, South Carolina State University
Experience: Three years as contributor for The Collegian Newspaper and Stated Magazine, One year as Editor-in-Chief of The Collegian Newspaper. Three years' experience in radio and TV Production

Writer: Thomas C. 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. Thirty-two years of service in APHIS Wildlife Services including operations and research in CO 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. These Expert in preparing environmental documents for WS programs to comply with the National Environmental Policy Act and the Endangered Species Act. For cage traps specifically, have used all types of cage traps in WDM and supervised employees that used them in their duties.

Editors for "The Use of Hand Capturing and Biological Sampling in Wildlife Damage Management"

Editor: 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 two 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: Fourteen 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: Nine 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/Contributor: 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. Eighteen 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.

7.2 Internal Reviewers

USDA APHIS Wildlife Services

Reviewer: Shelagh DeLiberto
Position: USDA-APHIS-WS Operational Support Staff, Environmental Management Coordinator, Fort Collins, CO
Education: BA Biology and Environmental Science – Ithaca College; MS Wildlife Biology – Colorado State University
Experience: Nineteen years of service in APHIS conducting wildlife research. Six years of experience in preparing categorical exclusions and environmental analyses in compliance with the National Environmental Policy Act.

Reviewer: Steven Greiner
Position: USDA-APHIS-WS, Safety and Health Manager, Fort Collins, CO
Education: BA in Environmental Biology, University of Colorado; Certified Occupational Health and Safety Technologist
Experience: Thirty years of service in APHIS Wildlife Services, stationed at the National Wildlife Research Center. Responsible for managing the WS Safety and Health Program. Knowledge and responsibilities include: office, field, and laboratory safety (chemical, biological, and radioactive materials), industrial hygiene, chemical management, hazardous waste disposal,

dangerous goods shipping, emergency response, workers' compensation, occupational medical monitoring, environmental management, and safety related training.

Reviewer: Michael Yeary
Position: USDA-APHIS-WS, State Director/Supervisory Wildlife Biologist, Lakewood, CO
Education: BS in Wildlife Ecology, Texas A&M University
Experience: Special expertise in wildlife damage management including supervising an aerial operation program. Thirty-seven years of service in APHIS Wildlife Services in TX, KS, and CO with experience in a wide variety of programs (livestock, aquaculture, dairy, property, natural resources, and human health and safety protection) including predator, bird, beaver, feral swine, and rodent damage management activities.

7.3 Peer Review

The Office of Management and Budget requires agencies to have peer review guidelines for scientific documents. The APHIS guidelines were followed to have "Use of Hand Capture and Biological Sampling in Wildlife Damage Management" peer reviewed. WS worked with the Association of Fish and Wildlife Agencies to have experts review the documents.

7.3.1 Peer Reviewers Selected by the Association of Fish and Wildlife Agencies

Arizona Game & Fish Department

North Carolina Wildlife Resources Commission

Oregon Department of Fish and Wildlife

7.3.2 Comments

1. **Comment:** While it may be outside the scope of the assessment, collection of samples from live animals with "sharps" is described several times without describing any consideration of stress or pain management for the wildlife being sampled. In my mind this represents a risk for injury to wildlife.

   Response: The use of sharps is discussed in this risk assessment because they are often used in conjunction with hand capture for biological sampling (as described in Section 1.1 and Sections 2 and 3. The use of Immobilization and Euthanasia drugs in conjunction with sharps and biological sampling are discussed separately in "Chapter 25, Use of Immobilization and Euthanasia Drugs in Wildlife Damage Management," which will be posted online at a later date.

2. **Comment:** Executive summary- at least with our biologists I would say needle or other "sharps" sticks are also high up there on the potential human health and safety risks of hand capture and sampling.

   Response: Needle or other "sharps" sticks increased among Wildlife Services employees from the FY13-FY15 reporting period to the FY 16-FY20 reporting period. It is a risk that WS takes very seriously in precautionary training and testing for disease following an incident.

3. **Comment:** Table 3b- Should this also reflect the proportion of samples that were positive for these diseases to get an idea of potential risk to wildlife handlers?

Response: The proportion of samples that were positive is unavailable for the FY11-15 data set. We have included, as Appendix 2, samples collected and the percent seropositive for FY17-19. Rates of seropositive samples indicate a small risk of exposure to these zoonotic diseases. WS employees are trained in proper animal handling and sample collection to minimize potential risks.

4. **Comment:** The document mentions training in hand capturing and disease management, but I would like to see more on what kind of training is conducted (one-on-one, hands-on, lecture, etc.) and how changes to the training have affected injury rates. I also would have liked a little more detail and figures on the disease sampling methods and disease testing. I feel they are only briefly mentioned in the document.

   Response: Training in hand capture and disease management is conducted within each program (state or National). Training manuals are available for disease-specific sample methods within each of the National programs (National Wildlife Disease Program, National Feral Swine Management Program, and National Rabies Management program. A general necropsy training program and Wildlife Disease Preparedness Course are available for all WS employees and are provided by our National Training Academy. More information on biological sampling and disease testing are available from our National programs web pages (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/programs). Including further details beyond what is already included is outside the scope of this risk assessment.

5. **Comment:** The statistics in the document use several frequencies and annual averages, but it does not provide any measures for comparison, such as percentages. Percentages would be useful to make comparisons of the work being conducted, or number of wildlife strikes with aircraft, etc. In addition, though averages are useful, they can also be skewed. I recommend listing the range and/or median along with the annual averages to give the reader a better picture of the data

   Response: We have included percentages in the Risk Assessment to aid readers in comparing data in Section 1.2. Annual averages have been used to summarize data in all risk assessments. Using the same summary statistics allows readers to compare risk assessment data easily. While averages can result in skewed values with data that have a non-normal distribution, we feel they represent the best analysis for our data sets.

6. **Comment:** Also, the document mentions terms such as "few," "many," "some," or "high." These terms vary in value from person to person reading the document. I recommend clarifying these statements and using numbers whenever possible. Finally, I would recommend adding more statistical data to the hazards and risks of hand capturing and biological sampling methods.

   Response: We have clarified statements throughout the Risk Assessment that included terms such as "few," "many," "some," or "high" to include numbers whenever possible. We have supplied all the statistical data regarding the hazards and risks of hand capturing and biological sampling methods.

7. **Comment:** In the 1.1 Hand Capture and Biological Sampling Methods, it would be good to include or refer to a list of all hand capturing methods and tools used. The section suggests there are more than what is listed in the document.

Response: Although many tools and hand capturing methods could be included, those mentioned in this Risk Assessment are most commonly used by WS during daily operational activities.

8. **Comment:** 2 Hazards and 3 Risks are very similar, except for the fact that 3 Risks is more detailed. Is there a reason these sections are separated, or could they be combined?

   Response: Hazards are the potential source of harm or danger, and risks are the possibility that something bad or unpleasant (e.g., a hazard) will happen. The format of these sections is standard for a risk assessment and will not be changed.

9. **Comment:** In 1.2 Use Pattern, in paragraph 1, sentence 5, you have 66 in parentheses. Statistically, this should be noted as n=66.

   Response: We have updated this section to include percentages of animal types in each category. Tables 1-3 identify the actual numbers for each animal type.

10. **Comment:** In paragraph 8, zoonotic would be a better term to use to replace "Many of the diseases monitored by the WS programs are infectious and transferable to humans."

    Response: We have included the term zoonotic in this sentence in addition to the description.

11. **Comment:** In 3.1 Human Health and Safety, paragraph 5, I recommend citing the source or provide figures explaining the following statement: "After WS captures the animal, the risk of injury post-capture is minimal, but the highest risk is typically from transporting or transferring custody of an animal."

    Response: We do not have a citation for this statement as it is reflected in injury and handling reports from our employees and staff and discussed in detail later in Section 3.1. It is logical, however, that the highest risk with an animal would be when handling it. Handling the animal occurs when transporting it from a trap to a holding cage or transferring between holding cages (when custody of an animal is transferred).

12. **Comment:** Also, in Section 3.1, paragraph 8, this would be a good place for discussing rabies pre-exposure vaccines, including: is it mandatory for staff to receive; approximately how many people receive pre-exposure vaccines annually, etc.

    Response: Rabies vaccinations are recommended per HS/WS 002.00 "Participation in the APHIS Occupational Medial Monitoring Program" and HS039.00 "Rabies vaccinations and titer checks." There may be job duties that require being rabies vaccinated to perform, and if employees are not vaccinated, they may be restricted from performing those job duties if they are not vaccinated or until they are vaccinated. We have added data to the Risk Assessment describing the number of employees that received titer checks per year, as this is the data that the agency tracks. The number of employees vaccinated is not tracked, as employees could be vaccinated from previous jobs or on personal time.

13. **Comment:** Page 2 – Section 1.2 - The sentence, (starting with "A total of 5,067 animals..."), seems to conflict with the first sentence of the next paragraph, ("WS used

hand capture techniques...") Were 6,999 total animals captured from FY11 to FY15 or was an annual average of 8,509 animals captured?

Response: The first sentence identifies the annual average number of target animals captured lethally with hand capture alone (i.e., not using hand tools like denning or catch poles). This corresponds to the top section of Table 1. The number 8,510 (correction from 8,509) is the total number of animals taken (lethally or released) using any hand capture or hand tool methods. Thus, 5,067 is a subset of the 8,510 animals captured.

14. **Comment:** Page 4 – top of page – "Most of the large animals and some small ones were taken with the use of catch poles." What is considered large or small?

    Response: We have listed examples of the types of animals that we consider large and small.

15. **Comment:** Page 6 – Table 2c – Category in the table listed as "Unid. Nonvenomous Snakes FL/MO" What does FL/MO mean?

    Response: The FL/MO in Table 2c referred to the states in which the unidentified nonvenomous snakes were caught. We have removed this notation and added an additional footnote to make this distinction clearer.

16. **Comment:** Table 3A title – "…….. parasites and insect vectors (disease vectors such as ticks and fleas)." Biting insects such as ticks and fleas are also parasites. Better to say "internal and external parasites," "parasites and disease vectors," or some other designation since "parasites and insect vectors" is a poor categorization.

    Response: We have changed the title of Table 3a to …" parasites and disease vectors, such as ticks and fleas."

17. **Comment:** Page 8 – Section 3.1 – "In addition to PPE training, the sharps training became mandatory recently." When is "recently?" If this document is still active in ten years, will "recently" still be recent?

    Response: The Sharps training became mandatory in FY 16. We have included this timing distinction in Section 3.1.

18. **Comment:** Page 8 – Section 3.1 – "It should be noted that sharps containers, marked "Biohazard," are disposed of properly, especially to ensure that a zoonotic disease is not spread." How is "properly" defined here?

    Response: Proper disposal of sharps containers can vary depending on state and local regulations. Therefore, sharps containers are disposed of in a manner consistent with WS Policies on disposal and state/local guidelines.

19. **Comment:** Page 9 (top) – Section 3.1 – "WS operational field personnel annually averaged 3.0 bites or injuries from animals. One bite, or 0.3 of the 3-annual average, was from a bat that was captured by another agency and bit a WS employee while collecting a biological sample (testing for rabies and other diseases)." If the annual average was 3.0 bites for field personnel, why would one bite incident account for 0.3 of the average? Was only one person bitten across the entire country?

Response: There were a total of nine bites or injuries from animals nationally. The annual average number of bites or injuries from animals was 3.0 bites per year from FY13-15 (three years). One bite in those three years was from a bat, so 1/3=0.3 annual average bites from bats nationally.

20. **Comment:** Page 9 – Section 3.1 – "In addition to field personnel, from FY13 to FY15, personnel from the WS National Wildlife Research Center had an annual average of 1.0 animal bites or injuries from research animals with bites from a skunk (0.3) and a rat (0.3), and a bone fracture from feral swine (0.3)." Again, if the average is 1.0 animal bites annually, why are a third from one skunk bite, a third from one rat, and a third from a specific bone fracture?

    Response: As described in response to Comment 19. There were 3 bites during FY13-15, or an annual average of one bite per year from FY13-15. During those 3 years, 3 bites occurred, one from a skunk, one from a bat, and a bone fracture from a feral swine. One bite or injury from each source (so, 1/3= 0.3 annual average bite or injury from each source).

21. **Comment:** Page 10 – Section 3.1 – "Additionally, one person became infected with giardiasis conducting beaver damage management, but it is not known if it was from handling a beaver carcass." What other ways could that person have contracted giardiasis?

    Response: Giardiasis is transmitted by ingesting the Giardia parasite. The parasite can be spread by several methods, including swallowing unsafe food or water contaminated with Giardia germs, transferring Giardia parasites picked up from contaminated surfaces into your mouth, or having contact with infected animals or animal environments contaminated with feces (CDC 2021; https://www.cdc.gov/parasites/giardia/infection-sources.html#:~:text=You%20can%20get%20giardiasis%20if,mouth%20could%20make%20you%20sick).

22. **Comment:** The biggest concern about the document relates to capture by trap. In my mind there's perhaps some unintended ambiguity regarding how the use of traps relates to this report. Traps are NOT listed as capture method, so do any of the tables include data where the animal was initially caught in a trap? If a catch pole is used to remove an animal from a box trap or leghold trap is that counted as a hand capture? If birds are caught in a mist net and sampled for West Nile virus is that included in this report. If geese are rounded-up in a panel trap and subsequently euthanized is that a hand capture? The report needs to be very clear regarding "trapped" animals.

    Response: As the Risk Assessment describes, animals are sometimes trapped and need to be relocated to another location, to another agency, or to a place where euthanasia can be performed. Traps can be used to transport animals in these situations, and an animal may need to be handled prior to transport. The hand capture described in this risk assessment is largely with bird species (58% of all hand captures were bird species). The birds hand captured were not captured in a mist net or panel trap first. For reference, 704 Canada geese were captured using hand capture methods during FY11-15, and 25,029 Canada geese were captured using all methods (see Chapter 1 Introduction to Risk Assessments for Methods Used in Wildlife Damage Management).

23. **Comment:** Page i – Executive Summary - The use of hand capture by WS includes the use of direct hand capture, catch poles, hand gathering scat samples, denning, and the

hand removal of beaver dams. Denning refers to what an animal does not a method of hand capture.

Response: Denning is a technique used to manage damage to livestock or other resources and/or reduce threats to human health and safety caused by predators or burrowing rodents (Tischaefer 2020). Denning is conducted in accordance with WS Directive 2.425 ("Denning") and is only done for burrowing predators and rodents.

.

24. **Comment:** Table 2b – Feral Domestic Mallard category – What criteria are used to distinguish between "mallard" and "feral domestic mallard"?

    Response: Feral domestic mallards are larger than wild mallards and can be up to twice the size of a wild mallard. WS employees are trained in wildlife identification and can distinguish feral domestic mallards based on plumage coloration.

25. **Comment:** Page 6 – "Animals can be taken in WDM projects which may include some hand captured, road-killed, found dead, or sportsmen harvested, or captured with other methods such as cage traps." If it's captured in a cage and then removed by hand, is it hand captured?

    Response: No, animals captured with other methods such as cage traps are not considered hand captured. The section that this question is from is describing the biological sampling methods. Samples taken by WS National Wildlife Disease Program, National Feral Swine Damage Management Program, and Rabies Management Program, and other WS personnel can be from any animal that is captured by Wildlife Services, including those captured by means other than hand capture. The biological sampling conducted by Wildlife Services is included in this Risk Assessment because these are times when WS employees are in close contact with animals. The risks associated with biological sampling can be similar to those when animals are hand captured. Please also see the response to Comment 22.

26. **Comment:** Page 7 – Section 2.1 – "Hand capture has risks because a person is often in direct contact with an animal or within arm's reach." Does this include capture in an enclosed type trap?

    Response: No, this Risk Assessment addresses hand capture of animals, not animals that have been caught in traps. See Chapters 2 Cage-traps, Chapter 3 Cable devices, Chapter 4 Foothold traps, Chapter 14 Quick-kill traps for a discussion of risks associated with traps used by WS. See the responses to Comments 22 and 25.

27. **Comment:** Page 7 – "During collection, it is possible for the employee to accidentally poke or cut themselves while obtaining a biological sample, which could expose them to an infectious zoonotic disease, similar to risks faced by health care professionals." May want to consider mentioning accidental injection of euthanasia or immobilizing drugs.

    Response: The use of Immobilization and Euthanasia drugs in conjunction with sharps and biological sampling are discussed separately in "Chapter 25 Use of Immobilization and Euthanasia Drugs in Wildlife Damage Management" which will be posted online at a later date.

28. **Comment:** Page 9 – "Of the remaining bites, 0.7 were dog bites that occurred from hand gathering them on airports where they were a strike risk to aircraft, 0.7 were pet dogs at private residences while WS personnel were contacting people that had requested WS

assistance, and 1.3 were animals captured in various traps that were able to bite the WS employee; two of the latter were while the animal was being transferred to another agency." Traps mentioned here, but are they included in the totals captured and should they be mentioned in this report?

Response: The data available for Human Health and Safety is not specific enough to identify if the incident was specifically related to a hand capture method or another trapping method. As the Risk Assessment describes, animals are sometimes trapped and then need to be relocated to another location, to another agency, or to a place where euthanasia can be performed. Traps can transport animals in these situations, and an animal may need to be handled before transport. Please see the responses to Comments 22, 25, and 26 for additional information.

29. **Comment:** Page 9 – "For context, WS operations annually average the lethal take of 43,576 and released 11,432 predators with methods conducive to being bitten from FY13 to FY15." So, this obviously includes predators not in the "hand capture" category, so why include here?

    Response: As stated in the Risk Assessment these data are provided for context to show that the numbers of bites that occur during all operations are low and that bites that occur during hand capture methods are a small portion of the overall incidents.

30. **Comment:** Page 9 - Section 3.1 lists total numbers of lethal take and released predators. This would appear to include "trapped" animals as the numbers in this section are much higher than those reported on page 4. If the point of this section (3.1) is talk about Human Health and Safety, then shouldn't the comparison be to accidents related solely to hand capture rather than the all captures (including traps)? They also say in this section that on average 1.3 bites annually were caused by animals caught in various traps. So…….. are trapped animals included or not?

    Response: Please see the response to Comment 28.

Comments received not requiring a response.

1. **Comment:** The risk assessment is fair and balanced. It correctly identifies training and adhering to established protocols for animal handling and capture and the use of PPE as effective means for mitigating risk to personnel and wildlife. The injury rates for personnel and wildlife appear to support the risk assessment.

APPENDIX 1. "Other Species" Included in Tables

Table 2a

MAMMALS

Other predator = feral cat*, small Asian mongoose*, red fox^, arctic fox^, gray fox, river otter, European ferret*, badger, coati, hooded skunk, and western spotted skunk

Hoofed mammals = feral swine*, collared peccary, moose, mule deer (incl. black-tailed deer), white-tailed deer, and pronghorn

Rabbit and other rodent = muskrat, nutria*, black-tailed prairie dog, Wyoming ground squirrel, eastern chipmunk, least chipmunk, Botta's pocket gopher, prairie vole, tundra vole, western gray squirrel, eastern gray squirrel^, eastern fox squirrel^, brown (Norway) rat*, black rat*, eastern cottontail^, desert cottontail, European rabbit*, and black-tailed jackrabbit

Unidentified bat possibilities = Peter's ghost-faced, big free-tailed, Brazilian free-tailed, big-eared, Rafinesque's big-eared, Virginia big-eared[T&E], Townsend's big-eared, spotted, pallid, big brown, hoary, eastern red, western red, evening, and silver-haired bats, eastern pipistrelle, western pipistrelle (canyon bat), and little brown, gray[T&E], Indiana[T&E], northern[T&E], Arizona, California, fringed, long-legged, long-eared, dark-nosed small-footed, western small-footed, eastern small-footed, southwestern and Yuma myotises

Other mammals = nine-banded armadillo, eastern red bat, eastern pipistrelle, pallid bat, little brown myotis, cave myotis, long-legged myotis, dark-nosed small-footed myotis, and Yuma myotis

Table 2b

BIRDS

Birds Associated with Land

Other blackbirds = red-winged blackbird, Brewer's blackbird, brown-headed cowbird, boat-tailed grackle, and great-tailed grackle

Other dove = island collared-dove*, Eurasian collared-dove*, spotted dove*, and zebra dove*

Other corvid = California scrub-jay, black-billed magpie, northwestern crow, and fish crow

Other raptor = turkey vulture, black vulture, Cooper's Hawk, northern harrier, Mississippi kite, Harris's hawk, red-shouldered hawk, broad-winged hawk, Swainson's hawk, common barn owl, snowy owl, great horned owl, barred owl, northern hawk owl, northern pygmy-owl, burrowing owl, short-eared owl, merlin, prairie falcon, and peregrine falcon

Other gallinaceous bird = wild turkey and greater sage-grouse

Other aerialist = common nighthawk, common poor will, chimney swift, Rivoli's hummingbird, bank swallow, violet-green swallow, and northern rough-winged swallow

Nonpasserine forest birds = hairy woodpecker, northern flicker, and monk parakeet

Other passerine birds = eastern phoebe, Say's phoebe, vermillion flycatcher, western kingbird, scissor-tailed flycatcher, eastern kingbird, Abert's towhee, savannah sparrow, song sparrow, eastern meadowlark, western meadowlark, house wren, gray catbird, northern mockingbird, American dipper, house finch^, common yellowthroat, northern cardinal, black drongo*, common myna*, and Eurasian tree sparrow*

Birds Associated with Water

Other larids = laughing gull, western gull, Caspian tern, least tern, and arctic tern

Other waterfowl = brant, cackling goose, tundra swan, feral domestic muscovy duck*, wood duck, American wigeon, blue-winged teal, northern shoveler, northern pintail, green-winged teal, greater scaup, lesser scaup, common eider, harlequin duck, common goldeneye, Barrow's goldeneye, common merganser, and red-breasted merganser

Other waterbirds = red-throated loon, Pacific loon, common loon, pied-billed grebe, red-necked grebe, horned grebe, eared grebe, western grebe, brown pelican, and pelagic cormorant,

Other wading birds = black-crowned night-heron, green heron, great blue heron, great egret, little blue heron, and sandhill crane

Other shorebirds = American oystercatcher, American avocet, Pacific golden-plover, semipalmated sandpiper, upland sandpiper, ruddy turnstone, and red-necked phalarope

Table 2c

REPTILES, AMPHIBIANS, AND FISH

Crocodilians = American alligator and spectacled caiman*

Other Turtles = gopher tortoise, spotted turtle, eastern box turtle, Florida box turtle, ornate box turtle, northern painted turtle, chicken turtle, Florida red-bellied cooter, eastern mud turtle, striped mud turtle, common musk turtle, Florida softshell, and spiny softshell

Unidentified turtle possibilities = gopher tortoise, spotted turtle, eastern box turtle, Florida box turtle, ornate box turtle, pond slider, northern painted turtle, southern painted turtle^, chicken turtle, Escambia map turtle (*Graptemys ernsti*), Barbour's map turtle (*G. barbouri*), false map turtle, Florida red-bellied cooter, river cooter, peninsula cooter (*Pseudemys peninsularis*), common snapping turtle, alligator snapping turtle, eastern mud turtle, striped mud turtle, common musk turtle, loggerhead musk turtle (*Sternotherus minor*), smooth softshell, Florida softshell, and spiny softshell

Other lizards = Mountain spiny lizard, eastern glass lizard, Gila monster, and Argentine black-and-white tegu*

Other snakes = red-tailed boa*, Sonoran whipsnake, North American racer, coachwhip, eastern ratsnake, red cornsnake, western ratsnake, gray ratsnake, eastern foxsnake, yellow-bellied kingsnake, eastern kingsnake, speckled kingsnake, plain-bellied watersnake, eastern watersnake, diamond-backed watersnake, northern watersnake, Dekay's brownsnake, black-necked gartersnake, two-striped gartersnake, eastern ribbonsnake, common gartersnake, eastern hog-nosed snake, copperhead, cottonmouth, eastern diamondback rattlesnake, black-tailed rattlesnake, western rattlesnake, red diamond rattlesnake, Mojave rattlesnake, prairie rattlesnake, Indian python*, and ball python*

Unidentified Snakes – Most non-venomous snakes in FL and MO (captured on airport runways/taxiways and released elsewhere) – 48 species possible

Other Toads = American toad, Great Plains toad, and southern toad

* Introduced species ^ Introduced populations

EMPTY BIRD NESTS

Nests removed from under bridges or at airports that were outside nesting season –Steller's jay, bald eagle (2 nests), downy woodpecker, spotted towhee, Bullock's oriole, American bushtit, black-capped chickadee, yellow warbler, and unidentifiable bird

* Introduced species ^ Introduced populations

Table 3a

MAMMALS

Predator = Virginia opossum, feral cat*, lynx, bobcat, mountain lion, small Asian mongoose*, coyote^, Alaskan gray wolf, northwestern gray wolf, Great Plains wolf, feral domestic dog*, red fox^, swift fox, kit fox, arctic fox^, gray fox, black bear, grizzly bear, river otter, wolverine, fisher, American marten, least weasel, long-tailed weasel, short-tailed weasel, mink, badger, ringtail, coati, hog-nosed skunk, hooded skunk, striped skunk, eastern spotted skunk, and western spotted skunk

Hoofed mammals = feral swine*, collared peccary, moose, elk, red deer*, mule deer (incl. black-tailed deer), wild and captive white-tailed deer, caribou, feral cattle*, feral goat*, feral sheep*, and feral horse*

Other mammals = beaver^, muskrat, nutria*, black-tailed prairie dog, Gunnison's prairie dog, woodchuck, California ground squirrel, rock squirrel, Wyoming ground squirrel, thirteen-lined ground squirrel, round-tailed ground squirrel, eastern gray squirrel^, eastern fox squirrel^, red squirrel, southern flying squirrel, brown (Norway) rat*, black rat*, porcupine, Appalachian cottontail, eastern cottontail^, desert cottontail, snowshoe hare, black-tailed jackrabbit^, nine-banded armadillo, patas monkey*, rhesus monkey*, eastern mole, Brazilian free-tailed bat, big brown bat, eastern red bat, little brown myotis, and unidentified bats (up to 40 spp.),

BIRDS

Birds associated with land = European starling*, red-winged blackbird, brown-headed cowbird, common grackle, great-tailed grackle, rock pigeon*, Eurasian collared-dove*, spotted dove*, zebra dove*, mourning dove, blue jay, American crow, fish crow, common raven, turkey vulture, black vulture, osprey, sharp-shinned hawk, Cooper's hawk, northern harrier, Mississippi kite, Harris's hawk, red-shouldered hawk, broad-winged hawk, Swainson's hawk, red-tailed, hawk, rough-legged hawk, ferruginous hawk, common barn owl, eastern screech-owl, western screech-owl, great horned owl, barred owl, burrowing owl, long-eared owl, short-eared owl, northern saw-whet owl, American kestrel, merlin, prairie falcon, peregrine falcon, wild turkey, sharp-tailed grouse, gray partridge*, feral chicken*,

ring-necked pheasant*, common peafowl*, common nighthawk, black-billed cuckoo, tree swallow, barn swallow, cliff swallow, red-headed woodpecker, northern flicker, western kingbird, horned lark, California towhee, lark bunting, eastern meadowlark, western meadowlark, brown thrasher, American robin, house finch, pine siskin, northern cardinal^, red-vented bulbul*, common myna*, house sparrow*, and unidentifiable bird

Birds associated with water = Bonaparte's gull, laughing gull, Franklin's gull, mew gull, ring-billed gull, California gull, great black-backed gull, glaucous-winged gull, herring gull, black-bellied whistling duck, greater white-fronted goose, feral domestic goose*, snow goose, cackling goose, Canada goose, mute swan*, trumpeter swan, feral domestic muscovy duck*, wood duck, gadwall, American wigeon, American black duck, mallard including feral domestic mallards*, mottled duck, blue-winged teal, cinnamon teal, northern shoveler, northern pintail, green-winged teal, canvasback, redhead, ring-necked duck, greater scaup, lesser scaup, common eider, surf scoter, white-winged scoter, black scoter, long-tailed duck, bufflehead, common goldeneye, Barrow's goldeneye, harlequin duck, common goldeneye, Barrow's goldeneye, hooded merganser, common merganser, red-breasted merganser, ruddy duck, common loon, pied-billed grebe, American white pelican, double-crested cormorant, common murre, wood stork, American white ibis, black-crowned night-heron, green heron, western cattle egret, great blue heron, great egret, little blue heron, snowy egret, Hawaiian common gallinule, Hawaiian coot, American coot, sandhill crane, black-necked stilt, American golden-plover, Pacific golden-plover, gray plover, killdeer, Wilson's snipe, and upland sandpiper

REPTILES

Turtles = pond slider^, northern painted turtle^, northern map turtle, common snapping turtle^, and common musk turtle

* Introduced species ^ Introduced populations

Table 3b

Other Diseases = adenovirus hemorrhagic disease, anthrax, avian cholera, avian tuberculosis, boravirus, botulism, bovine brucellosis, canine adenovirus, deer hair loss syndrome, pigeon zoonosis, Q-fever, reovirus, Rift Valley fever, sheep pox, swine vesicular disease, typhus fever, and non-specific disease, general disease, and other disease categories

Other parasites = flukes, heartworms, keds, lice, mites, roundworms, and general parasites category

APPENDIX 2. Biological Samples collected

Table 1. The average annual biological samples submitted for disease tests by WS operational personnel from FY17-FY19, as reported in the MIS and seropositive rate (have had the virus but may not be shedding) from any source. Rabies surveillance collections included an average of 8,466 brainstems collected in the eastern U.S. (for raccoon rabies variant), with 221 positives for the rabies virus. Some collections were from years other than FY17-FY19 where data were not available yet from testing, but the year is noted below. One highly pathogenic avian influenza was found in FY17 in a mallard. This table is also in Chapter 23, "Use of Carcass Disposal in Wildlife Damage Management."

DISEASE	Predator	Hoofed Mammal	Rodent & Rabbit	Bats	Bird	Turtle	TOTAL	% Seropositive
VIRUS								
Rabies	18,840	12	143	174	-	-	**19,169**	**2%**
Avian Flu	2	-	19	-	10,652	-	**10,673**	**~13%**
Pseudorabies	5	1,861	-	-	-	-	**1,866**	**20%***
Hog Cholera	1	1,829	-	-	-	-	**1,830**	**0%**
West Nile Virus	2	311	-	-	84	592	**989**	**na**
Epizootic Hemorrhagic		227	-	-	-	-	**227**	**^**
Avian Paramyxovirus	-	-	-	-	162	-	**162**	**16%+**
Exotic Newcastle	-	-	-	-	152	-	**152**	**na**
Other Viral[1]	1	42	-	-	78	-	**121**	**na**
BACTERIA								
Plague	2,004	97	127	-	-	-	**2,228**	**27%**
Swine Brucellosis	1	2,132	-	-	-	-	**2,133**	**6.3%***
Tularemia	1,499	117	204	-	-	-	**1,820**	**0.7%**
Leptospirosis	622	118	-	-	-	-	**740**	**3.6%****
Salmonella	-	-	-	-	206	-	**206**	**8%#**
Tuberculosis[3]	2	95	-	-	40	-	**137**	**na**
Other Bacterial[4]	1	10	-	-	40	-	**51**	**na**
OTHER								
Unspecified Disease	223	1,452	19	-	302	-	**1,996**	**na**
Prion	-	564	-	-	-	-	**564**	**na**
Roundworms	302	-	64	-	25	-	**391**	**na**
Toxoplasmosis	5	53	-	-	79	-	**137**	**13%**
Other Parasite/Insect Vector[5]	78	72	4	-	-	-	**154**	**na**
Environmental (Lead)	-	-	-	-	51	-	**51**	**na**
TOTAL	**23,588**	**8,992**	**580**	**174**	**11,871**	**592**	**45,797**	**na**

[1] Other virus = Adenovirus, African swine fever (0%), avian bornavirus, canine parvovirus, equine encephalitis, hepatitis E, porcine epidemic diarrhea, swine influenza (7%), swine vesicular disease, viral encephalitis, and Wellfleet Bay virus;

[2] Swine and bovine brucellosis;

[3] Avian and bovine tuberculosis;

[4] Other bacteria = Anthrax, avian cholera, bluetongue, botulism, bovine brucellosis, chlamydiosis, ehrlichiosis, *Escherichia coli*, and typhus;

[5] Other Parasite/Invertebrate = Canine heartworm, echinococcosis, giardiasis, mites, neosporosis, Rocky Mountain spotted fever, trichinellosis (14% FY14-FY16), tapeworms, and ticks; ^ vector borne and not presented on carcass; + FY13 - 3,826 samples NWRC surveillance ann. avg. FY17-FY19 - * 3,190 feral swine, ** 308 feral swine between, # – 388 gamebird intestinal samples, tularemia 168/23,426 in FY12